SEVENTH FRAMEWORK PROGRAMME

THEME [ENV.2011.1.1.2-1] [The impact of atmospheric pollution on European land ecosystems and soil in a changing climate]

Grant agreement for: Collaborative project*

Annex I - "Description of Work"

Project acronym: ECLAIRE

Project full title: " Effects of Climate Change on Air Pollution Impacts and Response Strategies for European Ecosystems "

Grant agreement no: 282910

Version date: 2011-10-14

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Part A

Workplan Tables

A1:
Project summary

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per project

General information			
Project title [3]	Effects of Climate Change on Air Pollution Impacts and Response Strategies for European Ecosystems		
Starting date [4]	01/01/1970		
Duration in months [5]	48		
Call (part) identifier [6]	FP7-ENV-2011		
Activity code(s) most relevant to your topic [7]	ENV.2011.1.1.2-1: The impact of atmospheric pollution on European land ecosystems and soil in a changing climate		

Abstract [9]

ÉCLAIRE investigates the ways in which climate change alters the threat of air pollution on European land ecosystems including soils. Based on field observations, experimental data and models, it establishes new flux, concentration and dose-response relationships, as a basis to inform future European policies.
Starting with biosphere-atmosphere exchange measurements, ÉCLAIRE quantifies how global warming and altered precipitation will affect emissions of key European primary pollutants (NOx, NH3, VOCs), including interactions with increasing aerosol and hemispheric O3 background concentrations, modifying atmospheric transport and deposition. An ensemble of chemistry transport models will be applied to assess uncertainty in response to harmonized scenarios for climate, emissions and land-use, while high resolution studies will investigate how climate change alters local patterns of pollutant exposure and threshold exceedance.
A network of European experiments for contrasting ecosystems and climates, combined with meta-analysis of unpublished datasets, will quantify how climate change alters ecosystem vulnerability to tropospheric O3 and N deposition, including interaction with increased CO2. Combined with special topics on interactions with N form (wet/dry, NHx/NOy), aerosol-exacerbated drought stress and BVOC self-protection of O3 effects, novel threshold and dose-response approaches will be developed. These will be combined with regional atmospheric and biogeochemical models to estimate interactions and feedbacks on plant/soil carbon stocks, greenhouse gas balance and plant species change.
The new risk assessment chain to be developed will be applied at the European scale, quantifying how projected climate change will alter damage estimates. Combined with economic valuation of ecosystem services, improved integrated assessment modelling will allow a cost-benefit analysis to inform future mitigation and adaptation strategies on air pollution and climate change.

A2:
List of Beneficiaries

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

List of Beneficiaries

No	Name	Short name	Country	Project entry month[10]	Project exit month
1	NATURAL ENVIRONMENT RESEARCH COUNCIL	NERC	United Kingdom	1	48
2	LUNDS UNIVERSITET	ULUND	Sweden	1	48
3	DANMARKS TEKNISKE UNIVERSITET	DTU	Denmark	1	48
4	STICHTING DIENST LANDBOUWKUNDIG ONDERZOEK	ALTERRA	Netherlands	1	48
5	INTERNATIONALES INSTITUT FUER ANGEWANDTE SYSTEMANALYSE	IIASA	Austria	1	48
6	METEOROLOGISK INSTITUTT	met.no	Norway	1	48
7	FORSCHUNGSZENTRUM JUELICH GMBH	Juelich	Germany	1	48
8	STICHTING ENERGIEONDERZOEK CENTRUM NEDERLAND	ECN	Netherlands	1	48
9	CONSIGLIO NAZIONALE DELLE RICERCHE	CNR	Italy	1	48
10	Karlsruher Institut fuer Technologie	KIT	Germany	1	48
11	JRC -JOINT RESEARCH CENTRE- EUROPEAN COMMISSION	JRC	Belgium	1	48
12	UNIVERSITY OF YORK	SEI-Y, UoY	United Kingdom	1	48
13	INSTITUT NATIONAL DE LA RECHERCHE AGRONOMIQUE	INRA	France	1	48
14	RIJKSINSTITUUT VOOR VOLKSGEZONDHEIDEN MILIEU*NATIONAL INSTITUTEFOR PUBLIC HEALTH AND THE ENVIRONMENTEN	RIVM	Netherlands	1	48
15	EIDGENOESSISCHES VOLKSWIRTSCHAFTSDEPARTEMENT	FDEA-ART	Switzerland	1	48
16	GOETEBORGS UNIVERSITET	UGOT	Sweden	1	48
17	ERDESZETI TUDOMANYOS INTEZET	ERTI - FRI	Hungary	1	48
18	ILMATIETEEN LAITOS	FMI	Finland	1	48
19	HELSINGIN YLIOPISTO	UHEL	Finland	1	48
20	UNIVERSITA CATTOLICA DEL SACRO CUORE	UNICATT	Italy	1	48
21	ODESSA NATIONAL I.I. MECHNIKOV UNIVERSITY	ONU	Ukraine	1	48
22	UNIVERSITAET FUER BODENKULTUR WIEN	BOKU	Austria	1	48

No	Name	Short name	Country	Project entry month[10]	Project exit month
23	UNIVERSIDAD POLITECNICA DE MADRID	UPM	Spain	1	48
24	CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT	CIEMAT	Spain	1	48
25	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE	CNRS	France	1	48
26	SVERIGES METEOROLOGISKA OCH HYDROLOGISKA INSTITUT	SMHI	Sweden	1	48
27	DRZAVNI HIDROMETEOROLOSKI ZAVOD	DHMZ	Croatia	1	48
28	THE UNIVERSITY OF EDINBURGH	UEDIN	United Kingdom	1	48
29	RHEINISCHE FRIEDRICH-WILHELMS-UNIVERSITAET BONN	UBO	Germany	1	48
30	EIDGENOESSISCHE FORSCHUNGSANSTALT WSL	WSL	Switzerland	1	48
31	IVL SVENSKA MILJOEINSTITUTET AB	IVL	Sweden	1	48
32	MAX PLANCK GESELLSCHAFT ZUR FOERDERUNG DER WISSENSCHAFTEN E.V.	MPG	Germany	1	48
33	INSTITUTE OF PHYSICOCHEMICAL AND BIOLOGICAL PROBLEMS IN SOIL SCIENCE OF RUSSIAN ACADEMY OF SCIENCES	IPBPSS	Russian Federation	1	48
34	HOLLAND MICHAEL	EMRC	United Kingdom	1	48
35	AARHUS UNIVERSITET	AU	Denmark	1	48
36	WAGENINGEN UNIVERSITEIT	WU	Netherlands	1	48
37	UNIVERSITE LIBRE DE BRUXELLES	ULB	Belgium	1	48
38	INSTITUTE OF PLANT PHYSIOLOGY AND GENETICS OF BULGARIAN ACADEMY OF SCIENCES	BAS - IFRG	Bulgaria	1	48
39	NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK - TNO	TNO	Netherlands	1	48

A3:
Budget Breakdown

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One Form per Project

Participant number in this project [11]	Participant short name	Fund. %[12]	Ind. costs[13]	Estimated eligible costs (whole duration of the project)					Total receipts	Requested EU contribution
				RTD / Innovation (A)	Demonstration (B)	Management (C)	Other (D)	Total A+B+C+D		
1	NERC	75.0	A	2,090,000.00	0.00	257,000.00	122,000.00	2,469,000.00	0.00	1,424,000.00
2	ULUND	75.0	T	406,667.20	0.00	0.00	5,000.00	411,667.20	0.00	310,000.00
3	DTU	75.0	S	406,667.30	0.00	0.00	5,000.00	411,667.30	0.00	310,000.00
4	ALTERRA	75.0	A	540,000.00	0.00	2,000.00	5,000.00	547,000.00	0.00	412,000.00
5	IIASA	75.0	A	366,668.00	0.00	0.00	5,000.00	371,668.00	0.00	280,001.00
6	met.no	75.0	A	420,000.00	0.00	0.00	0.00	420,000.00	0.00	210,000.00
7	Juelich	75.0	A	200,000.00	0.00	0.00	0.00	200,000.00	0.00	150,000.00
8	ECN	75.0	A	326,667.00	0.00	0.00	0.00	326,667.00	0.00	245,000.00
9	CNR	75.0	S	340,000.00	0.00	0.00	0.00	340,000.00	0.00	170,000.00
10	KIT	75.0	T	260,000.00	0.00	0.00	0.00	260,000.00	0.00	130,000.00
11	JRC	75.0	T	373,334.40	0.00	0.00	0.00	373,334.40	0.00	280,000.00
12	SEI-Y, UoY	75.0	T	300,000.00	0.00	0.00	2,000.00	302,000.00	0.00	227,000.00
13	INRA	75.0	T	569,600.00	0.00	0.00	0.00	569,600.00	0.00	285,000.00
14	RIVM	75.0	A	333,334.00	0.00	0.00	0.00	333,334.00	0.00	250,000.00
15	FDEA-ART	75.0	T	253,334.40	0.00	0.00	0.00	253,334.40	0.00	190,000.00
16	UGOT	75.0	T	185,600.00	0.00	0.00	0.00	185,600.00	0.00	105,000.00
17	ERTI - FRI	75.0	F	106,800.00	0.00	0.00	0.00	106,800.00	0.00	80,000.00
18	FMI	75.0	A	120,000.00	0.00	0.00	0.00	120,000.00	0.00	90,000.00
19	UHEL	75.0	T	120,000.00	0.00	0.00	0.00	120,000.00	0.00	90,000.00
20	UNICATT	75.0	T	266,667.20	0.00	0.00	0.00	266,667.20	0.00	200,000.00
21	ONU	75.0	T	73,334.40	0.00	0.00	0.00	73,334.40	0.00	55,000.00

A3: Budget Breakdown

Participant number in this project [11]	Participant short name	Fund. % [12]	Ind. costs [13]	Estimated eligible costs (whole duration of the project)					Total receipts	Requested EU contribution
				RTD / Innovation (A)	Demonstration (B)	Management (C)	Other (D)	Total A+B+C+D		
22	BOKU	75.0	T	260,000.00	0.00	0.00	3,600.00	263,600.00	0.00	132,000.00
23	UPM	75.0	A	175,000.00	0.00	0.00	10,000.00	185,000.00	0.00	115,000.00
24	CIEMAT	75.0	A	240,000.00	0.00	0.00	0.00	240,000.00	0.00	120,000.00
25	CNRS	75.0	T	220,000.00	0.00	0.00	0.00	220,000.00	0.00	110,000.00
26	SMHI	75.0	A	81,000.00	0.00	0.00	0.00	81,000.00	0.00	60,000.00
27	DHMZ	75.0	T	100,000.00	0.00	0.00	0.00	100,000.00	0.00	50,000.00
28	UEDIN	75.0	S	106,667.00	0.00	243,000.00	4,000.00	353,667.00	0.00	327,000.00
29	UBO	75.0	T	93,334.40	0.00	0.00	0.00	93,334.40	0.00	70,000.00
30	WSL	75.0	T	60,000.00	0.00	0.00	0.00	60,000.00	0.00	45,000.00
31	IVL	75.0	A	73,334.00	0.00	0.00	0.00	73,334.00	0.00	55,000.00
32	MPG	75.0	S	66,667.00	0.00	0.00	0.00	66,667.00	0.00	50,000.00
33	IPBPSS	75.0	F	53,334.00	0.00	0.00	0.00	53,334.00	0.00	40,000.00
34	EMRC	75.0	F	107,001.60	0.00	0.00	0.00	107,001.60	0.00	80,000.00
35	AU	75.0	T	120,000.00	0.00	0.00	0.00	120,000.00	0.00	60,000.00
36	WU	75.0	A	93,334.00	0.00	0.00	0.00	93,334.00	0.00	70,000.00
37	ULB	75.0	T	53,334.40	0.00	0.00	0.00	53,334.40	0.00	40,000.00
38	BAS - IFRG	75.0	A	53,350.00	0.00	0.00	0.00	53,350.00	0.00	40,000.00
39	TNO	75.0	A	53,334.00	0.00	0.00	0.00	53,334.00	0.00	40,000.00
Total				10,068,364.30	0.00	502,000.00	161,600.00	10,731,964.30	0.00	6,997,001.00

Note that the budget mentioned in this table is the total budget requested by the Beneficiary and associated Third Parties.

*** The following funding schemes are distinguished**

Collaborative Project (if a distinction is made in the call please state which type of Collaborative project is referred to: (i) Small of medium-scale focused research project, (ii) Large-scale integrating project, (iii) Project targeted to special groups such as SMEs and other smaller actors), Network of Excellence, Coordination Action, Support Action.

1. Project number

The project number has been assigned by the Commission as the unique identifier for your project, and it cannot be changed. The project number **should appear on each page of the grant agreement preparation documents** to prevent errors during its handling.

2. Project acronym

Use the project acronym as indicated in the submitted proposal. It cannot be changed, unless agreed during the negotiations. The same acronym **should appear on each page of the grant agreement preparation documents** to prevent errors during its handling.

3. Project title

Use the title (preferably no longer than 200 characters) as indicated in the submitted proposal. Minor corrections are possible if agreed during the preparation of the grant agreement.

4. Starting date

Unless a specific (fixed) starting date is duly justified and agreed upon during the preparation of the Grant Agreement, the project will start on the first day of the month following the entry info force of the Grant Agreement (NB : entry into force = signature by the Commission). Please note that if a fixed starting date is used, you will be required to provide a detailed justification on a separate note.

5. Duration

Insert the duration of the project in full months.

6. Call (part) identifier

The Call (part) identifier is the reference number given in the call or part of the call you were addressing, as indicated in the publication of the call in the Official Journal of the European Union. You have to use the identifier given by the Commission in the letter inviting to prepare the grant agreement.

7. Activity code

Select the activity code from the drop-down menu.

8. Free keywords

Use the free keywords from your original proposal; changes and additions are possible.

9. Abstract

10. The month at which the participant joined the consortium, month 1 marking the start date of the project, and all other start dates being relative to this start date.

11. The number allocated by the Consortium to the participant for this project.

12. Include the funding % for RTD/Innovation – either 50% or 75%

13. Indirect cost model

- **A: Actual Costs**
- **S: Actual Costs Simplified Method**
- **T: Transitional Flat rate**
- **F :Flat Rate**

Workplan Tables

Project number

282910

Project title

ECLAIRE—Effects of Climate Change on Air Pollution Impacts and Response Strategies for European Ecosystems

Call (part) identifier

FP7-ENV-2011

Funding scheme

Collaborative project

WT1
List of work packages

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

LIST OF WORK PACKAGES (WP)

WP Number [53]	WP Title	Type of activity [54]	Lead beneficiary number [55]	Person-months [56]	Start month [57]	End month [58]
WP 1	Field studies on exchange processes	RTD	1	230.20	1	30
WP 2	Controlled studies on exchange processes	RTD	7	68.00	1	45
WP 3	Modelling emission processes	RTD	10	29.00	1	30
WP 4	Surface exchange modelling	RTD	13	70.00	1	42
WP 5	Past and future changes of atmospheric pollutants transported into Europe	RTD	11	28.00	1	36
WP 6	Emissions on regional, European, to global scale	RTD	2	25.50	1	30
WP 7	Modelling European air pollution and deposition	RTD	6	52.00	1	48
WP 8	Assessing local and regional variation	RTD	8	46.50	1	30
WP 9	Synthesis and meta-analysis of measurements of plant and soil responses	RTD	1	23.70	1	24
WP 10	Field-scale ecosystem manipulation and controlled studies on ecological responses	RTD	3	100.00	1	24
WP 11	Investigtion of novel ecosystem – air pollution –climate interations.	RTD	9	74.00	4	34
WP 12	Development and assessment of novel Thresholds	RTD	12	26.85	1	40
WP 13	Modelling of carbon stocks, greenhouse gas and vegetation change	RTD	1	39.85	1	36
WP 14	Air pollution-climate impacts on European carbon stocks and green house gas emissions	RTD	11	121.00	1	44
WP 15	Air pollution-climate impacts on biodiversity and soil quality	RTD	4	17.00	1	42
WP 16	European maps of novel thresholds and exceedances	RTD	14	40.00	6	40
WP 17	Local variation in threshold exceedance	RTD	23	17.00	1	44
WP 18	Deriving economic impacts and valuation of ecosystem services	RTD	34	21.80	1	48
WP 19	Integrating effects of air pollution under climate change	RTD	14	16.80	1	44
WP 20	Implications for mitigation and adaptation strategies	RTD	5	25.75	7	48
WP 21	Standards and Data Management	RTD	28	34.30	1	48
WP 22	Coordination & Management	MGT	1	76.00	1	48

WP Number [53]	WP Title	Type of activity [54]	Lead beneficiary number [55]	Person-months [56]	Start month [57]	End month [58]
WP 23	Training	OTHER	23	4.70	1	48
WP 24	Networking & Dissemination	OTHER	1	7.33	1	48
			Total	1,195.28		

WT2:
List of Deliverables

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

List of Deliverables - to be submitted for review to EC

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D1.1	First 6 months of continuous flux data of CO2, H2O, O3 and meteorological variables at 9 sites	1	1	50.00	O	PP	18
D1.2	Final 9 months of continuous flux data of CO2, H2O, O3 and meteorological variables at 9 sites	1	1	60.00	O	PP	24
D1.3	2 x 6 weeks of campaign-based fluxes of VOCs, NH3 and NOx at selected sites	1	1	50.00	O	PP	24
D1.4	NH3 fluxes over Mediterranean agricultural and semi-natural surfaces	1	1	5.00	O	PP	15
D1.5	Integrated dataset of canopy scale flux and in-canopy gradient measurements at a forest site	1	1	20.00	O	PP	16
D1.6	4 publications on integrated campaign	1	1	9.00	R	PU	30
D2.1	Initial database of controlled emission measurements on soil and litter	2	7	12.00	O	PU	24
D2.2	Data on microbial N turnover and NO (N2O) and CO2 emissions	2	7	1.00	O	PU	24

Deliverable Number [61]	Deliverable Title	WP number [53]	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D2.3	Assessment of primary and secondary BVOC exchange rates	2	7	20.00	R	PU	22
D2.4	Definition and improved parameterization of fluxes of BVOC	2	7	8.00	R	PU	42
D2.5	Manuscript on constitutive emission considered for ozone balance	2	7	3.00	R	PU	13
D2.6	Manuscript on stress induced emissions considered in ozone balance	2	7	3.00	R	PU	45
D3.1	NH3 emission model for agricultural management	3	10	10.00	O	PP	30
D3.2	NH3 exchange with soil/vegetation module	3	10	4.00	O	PP	30
D3.3	Soil NO emission model	3	10	7.00	O	PP	30
D3.4	BVOC modelling framework	3	10	4.00	O	PP	30
D4.1	Improved pollution- and climate-sensitive exchange parameterisations	4	13	15.00	O	PP	36
D4.2	Ozone dry deposition parameterisations	4	13	5.00	D	PP	36
D4.3	A coupled pollutant deposition and carbon based growth model	4	13	6.00	O	PP	36
D4.4	Chemical processing model of NO-	4	13	7.00	O	PP	36

Deliverable Number [61]	Deliverable Title	WP number [53]	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
	NO2-O3-VOCs and NH3-HNO						
D4.5	Current and future estimates of Nr and O3 deposition	4	13	16.00	O	PP	42
D5.1	Assessment of current GCMs and CTMS	5	11	7.00	R	PU	18
D5.2	Report describing the range of future evolutions of global, hemispheric and European ozone	5	11	7.00	R	PU	36
D5.3	Report describing the contributions of regions and processes on key environmental variables	5	11	7.00	R	PU	36
D5.4	Boundary conditions for regional conditions	5	11	7.00	R	PU	24
D6.1	Initial dynamic biogenic emissions, based on synthesis of existing work and mainly for testing	6	2	9.00	O	PP	8
D6.2	Improved terrestrial (semi)natural and agricultural emissions	6	2	9.00	O	PP	30
D6.3	Sectoral emission profiles for selected source sectors and countries	6	2	7.50	O	PU	30
D7.1	Maps of current air pollution	7	6	10.00	R	PU	18

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
	metrics (APMs) across Europe, from the EMEP model and five other CTMs						
D7.2	Improved EMEP model with climate-change and canopy-chemistry capabilities, able to predict the impac	7	6	10.00	O	PP	40
D7.3	Report on effects of in-canopy BVOC and NO emissions on in-canopy O3 and POD estimates	7	6	10.00	R	PU	44
D7.4	Report on effects of changes in global climate, chemistry, emissions and landcover changes on APMs	7	6	10.00	R	PU	48
D7.5	Source-receptor matrices of APMs for current and future conditions	7	6	12.00	O	PP	36
D8.1	Synthesis report on the different local scale models dealing with atmosphere-biosphere exchange	8	8	11.00	R	PU	12
D8.2	Report on local scale interactions between air quality and climate change	8	8	11.00	R	PU	30

Deliverable Number [61]	Deliverable Title	WP number [53]	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D8.3	Concentration and deposition maps	8	8	11.00	R	PU	16
D8.4	Sub-Grid module for inclusion in the EMEP model	8	8	13.00	O	PP	30
D9.1	Progress report on availability of data for use in WPs 12 and 13	9	1	8.00	R	PU	6
D9.2	First phase database for use in initial modelling and identification of data gaps	9	1	8.00	O	PP	12
D9.3	Completed database and results of meta-analysis handed to WP12 and WP13	9	1	7.70	O	PP	24
D10.1	Ecosystem and plant characteristic data for model application	10	3	26.00	O	PP	12
D10.2	One year ecosystem response data on plant responses to experimental changes	10	3	30.00	O	PP	18
D10.3	Response data on ecosystem carbon balance responses to experimental changes	10	3	30.00	O	PP	24
D11.1	Parameterization of the impact of reduced and oxidised wet and dry N deposition on GHG & NOx fluxes	11	9	14.00	O	PP	18

Deliverable Number [61]	Deliverable Title	WP number [53]	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D11.2	Predictive modelling of GHG fluxes	11	9	12.00	R	PU	24
D11.3	Quantification and parameterization of foliar O3 deposition	11	9	12.00	O	PP	24
D11.4	Measurement and parameterization of the fraction of O3 that is taken by leaves due to detoxification	11	9	12.00	O	PP	34
D11.5	Quantification of minimum epidermal conductance under different loads of particles	11	9	12.00	O	PP	20
D11.6	Parameterization of water use efficiency for model use	11	9	12.00	O	PP	30
D12.1	Summary report describing key response parameters derived from empirical studies	12	12	6.00	R	PU	12
D12.2	Documentation of the DO3SE_C model	12	12	7.00	O	PP	24
D12.3	Delivery of novel thresholds for key dose-response relationships	12	12	7.00	O	PP	30
D12.4	Final Report describing new dose-response relationships and novel thresholds	12	12	6.00	R	PU	40
D13.1	Finalised list of models for use in C3, and	13	1	10.00	R	PU	6

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
	list of data requirements for each model						
D13.2	New version of DO3SE model	13	1	10.00	O	PP	18
D13.3	Report on performance of site-based and regional-scale models	13	1	9.00	R	PU	24
D13.4	Assessment of the effects of combined air pollution and climate change scenarios on ecosys	13	1	10.00	R	PU	36
D14.1	Synthesis of applicable data on impacts of ozone on photosynthesis	14	11	15.00	O	PP	6
D14.2	Updated versions of DGVMs and DSVMs	14	11	15.00	O	PP	18
D14.3	Validated and evaluated version of models (DGVMs and DSVMs) using databases on plant productivity	14	11	15.00	O	PP	24
D14.4	Model runs (DGVMs and DSVMS) using the ÉCLAIRE scenarios of future emissions and climate change	14	11	15.00	O	PP	30
D14.5	Dataset of model runs to assess the impact of combined air pollution, climate change scenarios	14	11	15.00	O	PP	36

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D14.6	Report on the comparison of regional-scale models	14	11	15.00	R	PU	40
D14.7	Report on ensemble application of DGVMs and DSVMs	14	11	15.00	R	PU	42
D14.8	Report on the impacts of historic and future changes (period 1900-2100) in climate, air quality	14	11	15.00	R	PU	44
D15.1	The model EU MOVE	15	4	3.00	O	PP	24
D15.2	Collated dataset of European soil 14C data	15	4	4.00	O	PP	24
D15.3	The VSD+-EUMOVE and MADOC-EUMOVE models linked to European databases	15	4	4.00	O	PP	30
D15.4	Assessments of the effects of combined air pollution and climate change scenarios on plant species	15	4	2.00	O	PP	42
D16.1	Indicators for geo-chemical and biological endpoints	16	14	8.00	O	PP	12
D16.2	Map of critical ozone uptake thresholds at European scale	16	14	8.00	R	PU	24
D16.3	Map of critical N loads based on an inverse	16	14	8.00	R	PU	34

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
	VSD+-EUMOVE approach at European scale						
D16.4	Map of critical N load and critical ozone uptake exceedances based on a comparison with EMEP model	16	14	8.00	R	PU	40
D16.5	Feedback from the GAINS model on the applicability of the newly acquired critical thresholds	16	14	8.00	R	PU	36
D17.1	Database of soil and vegetation data for the regional and landscape domains	17	23	5.00	O	PP	12
D17.2	Database of ammonia concentration and nitrogen deposition data for the regional and landscape domain	17	23	5.00	O	PP	18
D17.3	Assessments of uncertainty of critical thresholds for N and their exceedances at the European scale	17	23	6.00	R	PU	44
D18.1	Report on existing applications of the ESA in Europe	18	34	5.00	R	PU	12
D18.2	Description of data for quantifying ecosystem	18	34	6.00	O	PP	24

Deliverable Number [61]	Deliverable Title	WP number [53]	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
	effects and for valuation						
D18.3	Elaboration of the modelling approach, to include illustrative applications	18	34	6.00	R	PU	30
D18.4	Scenario analysis to include policy recommendations and advice to other interest groups	18	34	4.00	O	PP	38
D19.1	Progress report on the implementation of effect indicators and critical thresholds in GAINS system	19	14	4.00	R	PU	12
D19.2	Report on the modelling system for the impacts assessment under ÉCLAIRE	19	14	4.00	R	PU	24
D19.3	Report on magnitude, location and robustness of assessments of adverse effects of GAINS scenarios	19	14	5.00	R	PU	36
D19.4	Final report on the development, implementation and scenario application of methods	19	14	3.00	R	PU	44
D20.1	Report from stakeholder workshop	20	5	1.00	R	PU	9
D20.2	Detailed description of model	20	5	4.00	R	PU	14

Deliverable Number [61]	Deliverable Title	WP number [53]	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
	integration to establish 2050 scenarios						
D20.3	Detailed description of modelling system beyond 2050	20	5	4.00	R	PU	19
D20.4	Description of the consequences of management change	20	4	4.00	R	PU	22
D20.5	Preliminary report on cost optimization for 2050 scenarios	20	4	4.00	R	PU	28
D20.6	Assessment of sensitivities and uncertainties of the scenarios	20	4	4.00	R	PU	34
D20.7	Final cost optimization scenarios for 2050 and beyond	20	5	3.00	R	PU	44
D20.8	Policy recommendations and advice to other interest groups	20	5	1.00	R	PU	48
D21.1	Initial scenario guide as an updatable, internal web page	21	5	2.00	D	PP	6
D21.2	ÉCLAIRE scenario reference	21	5	6.00	O	PP	42
D21.3	Agreement on common measurement protocols for components C1 and C3	21	15	9.00	D	PP	8
D21.4	Agreement on common modelling and	21	15	0.25	O	PP	9

Deliverable Number [61]	Deliverable Title	WP number [53]	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
	uncertainty assessment protocols across components C1-5						
D21.5	First report on uncertainty in model output due to structural elements	21	28	0.25	O	PP	36
D21.6	Final report on uncertainty in model output due to structural elements	21	28	0.25	O	PP	48
D21.7	ÉCLAIRE Data Management Plan & Data Policy Documents	21	1	1.00	O	PP	6
D21.8	ÉCLAIRE Data Portal	21	1	1.00	O	PP	6
D21.9	Database training sessions for users – online tutorials	21	1	1.00	O	PP	8
D21.10	Database documentation and guides for users	21	1	1.00	R	PU	8
D21.11	First database report on intermediate content, including QA/QC report	21	1	3.00	R	PU	12
D21.12	Second database report on intermediate content, including QA/QC report	21	1	3.00	R	PU	24
D21.13	Third database report on intermediate content, including QA/QC report	21	1	3.00	R	PU	36

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D21.14	Final database report on intermediate content, including QA/QC report	21	1	3.00	R	PU	48
D22.1	Annual progress report year 1	22	1	1.00	R	PU	13
D22.2	Annual progress report year 2	22	1	1.00	R	PU	25
D22.3	Annual progress report year 3	22	1	1.00	R	PU	37
D22.4	Annual progress report year 4	22	1	1.00	R	PU	48
D22.5	First periodic Gender Action Report	22	1	0.25	R	PU	19
D22.6	Second periodic Gender Action Report	22	1	0.25	R	PU	37
D22.7	Final periodic Gender Action Report	22	1	0.25	R	PU	48
D23.1	ÉCLAIRE Training plan	23	23	0.50	O	PP	6
D23.2	First periodic report on training activities	23	23	0.50	R	PU	19
D23.3	Second periodic report on training	23	23	1.00	R	PU	37
D23.4	Final periodic report on training	23	23	1.00	R	PU	48
D23.5	Concept for an ÉCLAIRE Summer School in year 2	23	23	1.00	O	PP	12
D23.6	Report on ÉCLAIRE Summer School	23	23	0.50	R	PU	22
D24.1	A project web portal for internal and external project communication	24	1	1.00	O	PP	1

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D24.2	First dissemination & communication plan	24	1	1.00	O	PP	18
D24.3	Second dissemination & communication plan	24	1	0.20	O	PP	36
D24.4	Final dissemination & communication plan	24	1	1.00	O	PP	48
D24.5	First report to the General Assembly on networking activities	24	1	1.00	R	PU	18
D24.6	Second report to the General Assembly on networking activities	24	1	1.00	R	PU	36
D24.7	Final report to the General Assembly on networking activities	24	1	1.00	R	PU	48
			Total	1,015.40			

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP1	Type of activity [54]	RTD
Work package title	Field studies on exchange processes		
Start month	1		
End month	30		
Lead beneficiary number [55]	1		

Objectives

The aim of the WP is to make field flux measurements across the ÉCLAIRE flux network and during campaigns, to provide targeted high-quality data to derive mechanistic parameterisations of biosphere/atmosphere exchange in response to environmental drivers, utilising the natural climate variability at and between sites. The specific objectives are:
1. To obtain 15 months of high temporal resolution flux data of key trace compounds (O3, NO, CO2, H2O) across a 9-site European flux network for the study of fluxes in relation to climatic drivers, using changing meteorological conditions at the sites as a proxy for climate.
2. To study the exchange of additional compounds (NH3, NOx, VOCs) through synchronised intensive measurement periods across the 9-site flux network, in relation to meteorological drivers, and to provide a test database for the evaluation of European chemical transport models.
3. To quantify the effect of aerosols on gross primary productivity through modulating in-canopy light levels for three forest ecosystems.
4. To quantify the importance of in-canopy chemical transformations on the deposition mechanism and effective emission of biogenic compounds into the atmosphere, through an integrated intensive measurement campaign above/within a polluted forest.
5. To make targeted measurements of NH3 exchange with Mediterranean semi-natural vegetation during distinct growth phases (active vs. dormant).

Description of work and role of partners

Task 1.1: Long-term flux measurements across a 9-site European flux network (NERC(EDI) (Nemitz), FDEA-ART, FRI, ECN, UHEL, FMI, ECN, INRA(G), JRC, UNICATT, ONU, CNR). Long-term, high quality flux measurements will be made for 15 months (Aug 2012 - Oct 2013) over a European network spanning 9 sites. This will include eddy-covariance flux measurements of CO2, H2O, sensible heat and O3, as well as ground fluxes of NO by continuous chamber techniques or equivalent approaches. This will be augmented by extensive measurements of meteorological parameters including temperature, humidity, pressure, solar radiation, PAR (direct vs. diffuse), leaf wetness, soil temperature, moisture and soil heat flux, and water table height where relevant. Measurements will be made of canopy height, LAI, organic matter (above/below ground) and soil concentrations of NH4+ and NO3-. CO2 fluxes will be measured according to the NitroEurope and CarboEurope protocols.
Task 1.2: Intensive measurement periods across the flux network (NERC(EDI) (Nemitz), FDEA-ART, ERTI-FRI, ECN, UHEL, FMI, ECN, INRA(G), JRC, UNICATT, ONU, CNR). During two contrasting measurement periods, which will be harmonised across the network (envisaged are Feb/Mar and Jun/Jul 2013, but this may be refined according to the management at the arable sites), targeted flux measurements will be made of additional compounds, including above-canopy NO and NO2 by gradient and/or eddy-covariance, NH3 and volatile organic compounds (VOCs).
Task 1.3: Assessment of the effect of aerosol on gross primary productivity (JRC (Cescatti), UHEL, ECN, NERC(EDI)). Aerosols play an important and not fully understood indirect effect on plant productivity by affecting the radio between direct and diffuse radiation. It has been shown that diffuse radiation stimulates photosynthesis by enhancing the canopy light use efficiency. The apparent increase in light use efficiency can be ascribed to a change in the distribution of light on the leaf area and/or to variation in the fraction of absorbed PAR (FaPAR).
In order to address this important issue in WP 1 we will perform consistent measurement of FaPAR at all

forest sites and analyze the variation in light use efficiency induced by changes in aerosol load and fraction of diffuse light. This analysis will also draw on existing sun photometer measurements and ground-based aerosol characterisation at Hyytiala and the Ispra Forest.

Table 1.4: Summary of flux measurements performed across the ÉCLAIRE flux network (table also reproduced in part B, section B7)

Site| Partner| 15 month fluxes (Task 1.1)| 2 x 6-weeks (Task 1.2)|
CO_2 /H_2O| O_3| NOflux | Other fluxes| NH_3| VOC | Above-canopy NO| NO_2 |
Forests|
1. Hyytiala, FI| UHEL/FMI| IRGA| FAST-CL| Auto chamber| Total aerosol number| N/Aa)| PTR-MS| N/Aa)| N/Aa)|
2. Speulder Bos, NL| ECN| IRGA| FAST-CL| Auto chamber| -| GRAHAM| -| -| -|
3. Ispra Forest, IT| JRC| IRGA| FAST-CL| Auto chamber| CH_4| QCL| PTR-MS| -| -|
Grasslands|
4. Auchencorth, UK| NERC| IRGA| ROFI| Auto chamber| SO_2| AMANDA| PTR-MS| EC| -|
5. Oensingen, CH| FDEA-ART| IRGA| LOZ-3| Auto chamber| -| eTR-MS| PTR-MS| Total Nr by TRANC|
6. Bugac, HU| ERTI-FRI| IRGA| FAST-CL| Auto chamber| -| AMANDA| -| Gradient| Gradient|
Arable|
7. Grignon, FR| INRA| IRGA| Sextant Tech Ltd.| Eddy-covar.| SO_2| ROSAA REA| Ponctual Cuvette| EC|
Luminox|
8. Brescia, IT| UNICATT| IRGA| FAST-CL| gradient -| -| -| -| gradient|
9. Petrodolinskoye, UA ONU| IRGA| ROFI Auto chamber| -| AMANDA| -| -| -|
a) Concentrations/fluxes below the detection limit of available instrumentation. b) Supported by national funding.

Task 1.4: Intensive measurement campaign (NERC(EDI) (Nemitz), UNICATT, ECN, INRA(G), KIT, ULB, CNR, UHEL, Juelich, ERTI-FRI). A 6-week (including set-up) intensive measurement campaign above a mixed oak forest at Bosco Fontana in the Po Valley, Italy in June/July 2012, will study the importance of in-canopy chemical processes on net biosphere / atmosphere exchange fluxes, with emphasis of chemistry of the NH_3-HNO_3-NH_4NO_3 and NO-NO_2-O_3-VOC systems. This site was chosen as it provides the possibility to study the interaction of a semi-natural ecosystem with its emissions of BVOCs in the context of a landscape with considerable emissions from agricultural and industrial emissions. The Po Valley is one of the most polluted regions in W Europe and also offers the possibility to study the effect of increased temperatures and drought and the interactions, relevant for future climate of large parts of Europe. Measurements will include:
• above-canopy gradients of NH_3, HNO_3, HCl, SO_2, NH_4^+, NO_3^-, SO_4^{2-}, Cl^- with a wet-chemistry gradient system (ECN/NERC(EDI)),
• above-canopy fluxes of aerosol numbers and aerosol chemical components by Aerosol Mass Spectrometer (NERC(EDI)),
• above-canopy eddy-covariance fluxes of NO (INRA(G)),
• soil fluxes of NO, N_2O and CH_4 by automated chamber (KIT),
• measurements multi-height ozone fluxes by eddy-covariance (INRA(G) / NERC(EDI)),
• gradients of turbulence, temperature, relative humidity and radiation (NERC(EDI)),
• above-canopy fluxes of VOCs by PTR-ToF-MS (UHEL / Juelich / NERC(EDI))
• aerosol physics (UHEL),
• in-situ measurements of leaf-level VOC emissions responses with speciation (CNR),
• in-canopy concentration gradients of NO, NO_2, VOCs and aerosol (NERC(EDI)),
• fluxes of CO_2, H_2O and standard meteorological parameters (UNICATT).
In addition, ULB will provide Earth Observation (EO) based concentration fields of NH_3, O_3, HNO_3, CO, CH_3OH and HCOOH derived from IASI/MetOp satellite data, and NERC(EDI) will make weekly passive sampler measurements of NH_3, HNO_3, O_3 and NO_2 in the wider landscape, validated at the main site, to compare column and ground level measurements. The campaign will be aligned with the PEGASOS Po Valley campaign, which will additionally provide concentration measurements at several sites of the southern Po Valley (San Pietro Capofiume, Bologna, Monte Cimone) and from a Zeppelin platform, to allow the results to be interpreted in the context of regional air quality and to maximise synergies between the two projects.
Task 1.5: Targeted measurements of NH_3 exchange with Mediterranean vegetation. (UPM (Theobald), NERC(EDI)). There is a complete lack of understanding of NH_3 exchange for Southern European vegetation and climate and therefore for those climatic conditions that will become more prevalent across Europe, with periods of high temperatures and associated drought. Targeted measurements of NH_3 exchange will therefore be made above semi-natural vegetation (e.g., semi-natural grassland or ‘matorral’) in Spain, during two 4-week

campaigns, contrasting the active and dormant vegetation period (spring and late summer). Measurements will be accompanied by measurements of CO_2/H_2O fluxes and meteorological parameters to study the fluxes in relation to plant functioning, stomatal controls and meteorological variables. The work will collaborate with Spanish partners external to ÉCLAIRE (e.g., CSIC - Spanish National Research Council).

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	NERC	24.00
7	Juelich	1.00
8	ECN	10.00
9	CNR	2.00
10	KIT	1.00
11	JRC	12.00
13	INRA	49.00
15	FDEA-ART	36.00
17	ERTI - FRI	30.00
18	FMI	5.00
19	UHEL	13.00
20	UNICATT	22.00
21	ONU	18.00
23	UPM	6.00
37	ULB	1.20
	Total	230.20

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D1.1	First 6 months of continuous flux data of CO2, H2O, O3 and meteorological variables at 9 sites	1	50.00	O	PP	18
D1.2	Final 9 months of continuous flux data of CO2, H2O, O3 and meteorological variables at 9 sites	1	60.00	O	PP	24
D1.3	2 x 6 weeks of campaign-based fluxes of VOCs, NH3 and NOx at selected sites	1	50.00	O	PP	24
D1.4	NH3 fluxes over Mediterranean agricultural and semi-natural surfaces	1	5.00	O	PP	15

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D1.5	Integrated dataset of canopy scale flux and in-canopy gradient measurements at a forest site	1	20.00	O	PP	16
D1.6	4 publications on integrated campaign	1	9.00	R	PU	30
		Total	194.00			

Description of deliverables

D1.1) First 6 months of continuous flux data of CO2, H2O, O3 and meteorological variables at 9 sites: [month 18]

D1.2) Final 9 months of continuous flux data of CO2, H2O, O3 and meteorological variables at 9 sites: [month 24]

D1.3) 2 x 6 weeks of campaign-based fluxes of VOCs, NH3 and NOx at selected sites: [month 24]

D1.4) NH3 fluxes over Mediterranean agricultural and semi-natural surfaces: [month 15]

D1.5) Integrated dataset of canopy scale flux and in-canopy gradient measurements at a forest site: [month 16]

D1.6) 4 publications on integrated campaign: [month 30]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS1	First 6 months data from flux network in database	1	18	
MS2	Final 9 months data from flux network in database	1	24	
MS3	Data from 1st synchronised campaign in database	1	20	
MS4	Data from 2nd synchronised campaign in database	1	24	
MS5	Data from integrated forest campaign in database	1	16	

WT3:
Work package description

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP2	Type of activity [54]	RTD
Work package title	Controlled studies on exchange processes		
Start month	1		
End month	45		
Lead beneficiary number [55]	7		

Objectives

The aim of this work package is the study and quantification of key emission mechanisms to provide targeted data that can be used to derive parameterisations of the emission processes in WP1.3.

1. To obtain response curves of soil and litter emissions to meteorological drivers (temperature, moisture) for CO2, CH4, O3, N2O, NO, NO2 and NH3 across a wide range of soils.
2. To provide data on NO emissions after rewetting events as a basis to improve the mechanistic understanding and predictive capability, through novel laboratory experiments.
3. To quantify VOC emission responses under combined environmental change scenarios and develop a process understanding of the controls.
4. To investigate the effect of stresses (drought, heat) on BVOC emissions and the impact on O3 deposition and formation.
5. To quantify deposition rates of VOCs and their controls.

Description of work and role of partners

Task 2.1: Controlled emission measurements of CO2, CH4, N2O, NO and NH3 using monoliths and litter from the ÉCLAIRE flux network (BFW (Zechmeister-Boltenstern), NERC(EDI)). The task aims at determination of precise relationships between soil trace gas fluxes and climate conditions in order to improve our understanding of the couplings between climate change (warming and precipitation change), pollution and surface-atmosphere fluxes.

Laboratory incubations will be conducted in addition to field experiments. Intact soil monoliths and litter samples from selected ÉCLAIRE flux network sites (Task 1.1) will be incubated in the laboratory in a two-factorial design of different soil moistures (from 20-80% water filled pore space) and soil temperatures (from 5-20°C) and analysed for trace gas fluxes. With this technique, fluxes will be estimated of N2O, NO, NO2, NH3, O3, CO2 as well as CH4, using a fully automatic laboratory incubation system (Schaufler et al., 2010). Carbon dioxide and NO will be analysed by the open flow system using an infrared gas analyser (CO2) and a chemiluminescence analyser (NO and NO2). Methane and N2O will be measured with the closed chamber technique and analysis by GC. These measurements will be performed by BFW with NERC supporting the measurement of NH3, using a membrane / conductivity NH3 analyser provided by NERC(EDI).

Task 2.2: Quantifying the effect of re-wetting on NO emissions (KIT (Butterbach-Bahl)). Drying re-wetting cycles have been shown to result in peak emissions of NO from soils, with emissions during these periods estimated to contribute about 20% of the global soils emission and dominating annual budgets in some ecosystems.

The frequency of rain events is forecast to change significantly in future climates and emissions are likely to respond. In Task 2 controlled laboratory experiments with intact soil cores will be performed from a number of ÉCLAIRE sites and other sites, specifically from the Mediterranean climate zone, to improve our understanding of microbial and soil-physical processes contributing to NO peak emissions. Measurements of NO (N2O) production, consumption and emission will be supplemented with measurements of microbial N turnover processes (gross mineralisation/ nitrification, denitrification), soil gas permeability and soil respiration to get a mechanistic understanding of the underlying processes.

Task 2.3: Quantifying BVOCs exchanges in field experiments and in response to combined environmental change and pollution scenarios (CNR (Loreto), BAS-IFRG). BVOC emission responses will be studied in controlled phytotron experiments under various combinations of treatments. These include increased temperature, increased CO2, drought, and episodic O3 exposure, per se or in combination. The impact of climate change and anthropogenic pollution on “constitutive” BVOC will be asssessed, improving current

knowledge on VOC exchange rates in strong BVOC emitters, but also investigating deposition rates and mechanisms in non-emitting plants, and physiological and ecological controls on BVOC deposition. Focus will also be on the assessment of “induced” BVOC (e.g. methanol, acetaldehyde, C6-OVOC) and of BVOC oxidation products, such as MVK, MACR and formaldehyde in the case of isoprene oxidation. Determination of important traits such as the compensation point will be attempted in strong BVOC emitting species (poplars, oaks), to arrive at a novel formulation of exchange rates of BVOC oxidation products. Additionally, this task will provide information on the atmospheric reactivity of BVOC with other reactive nitrogen and oxygen species (NO, ROS) within canopies and within leafs. The experiments will include simulation of plant emissions considering enhanced constitutive emission of volatile isoprenoids under expected conditions of climate warming. This work will provide an improved mechanistic understanding of BVOC exchanges and will complement experimentation to determine O3 losses/uptake (Task 2.4) and O3 detoxification (WP3.3), as well as the determination of induced BVOC in other plant species (Task 2.4).
Task 2.4: Coupling between climate change induced stresses on vegetation, BVOC emissions, O3 and NOx uptake, and O3 forming potential. (JUELICH (Mentel)). BVOC emissions have positive and negative effects on O3 exposure and uptake: while they have the potential to destroy O3 locally (and therefore decrease exposure) they result in O3 formation at the scale of 10s of km (thereby increasing exposure downwind). In addition, they can detoxify O3 within the plant, thereby enhancing the efficiency by which O3 can be taken up, the process of which is further investigated in Task 3 .2.
In Task 2.4 we will balance - for eco-systems under changing climate conditions - the sink strength for O3 and, uniquely, the source strength of O3 by photochemistry of (stress induced) BVOC. The experiments will be performed in the coupled plant chamber-reaction chamber system (JPAC) in order to separate stress induced emissions, O3 & NOX deposition within the eco-system, and photo-chemical ozone formation.
1. Determination of the dry deposition of O3 and NO2 by uptake through the plants’ stomata (separately).
2. Determination of O3 losses by reactions with BVOC in the reaction chamber, taking the air from the plant chamber including the (stress induced) BVOC and the O3 left after uptake by the plants.
3. Determination of the photochemical O3 production in the reaction chamber by (stress induced) BVOC, O3 and NOX both left after uptake by the plants as transferred from the plant chamber
Work will proceed in two steps:
A. The ozone balance (uptake by plants + loss by gas phase reactions + photochemical production) will be established for Boreal and Mediterranean forest species under present day conditions, in order to consider different emission mechanisms for BVOC.
B. The plants will be subjected to drought and/or heat stress expected by global warming. The stress effects will induce emissions of BVOC produced within the octadecanoid pathway (alcohols, aldehydes) and phenylpropanoid pathway (oxygenated aromatic BVOC) and change the emissions of terpenoids. The applied stress will also change the stomatal opening. The pathways of O3 destruction and production and its stomatal exchange as altered by stress effects will be determined applying the steps 1 to 3.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	NERC	1.00
7	Juelich	11.00
9	CNR	18.00
10	KIT	1.00
22	BOKU	24.00
38	BAS - IFRG	13.00
	Total	68.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D2.1	Initial database of controlled emission measurements on soil and litter	7	12.00	O	PU	24
D2.2	Data on microbial N turnover and NO (N2O) and CO2 emissions	7	1.00	O	PU	24
D2.3	Assessment of primary and secondary BVOC exchange rates	7	20.00	R	PU	22
D2.4	Definition and improved parameterization of fluxes of BVOC	7	8.00	R	PU	42
D2.5	Manuscript on constitutive emission considered for ozone balance	7	3.00	R	PU	13
D2.6	Manuscript on stress induced emissions considered in ozone balance	7	3.00	R	PU	45
		Total	47.00			

Description of deliverables

D2.1) Initial database of controlled emission measurements on soil and litter: [month 24]

D2.2) Data on microbial N turnover and NO (N2O) and CO2 emissions: Data on microbial N turnover and NO (N2O) and CO2 emissions from soils following re-wetting of dried soils for improving parameterization of models [month 24]

D2.3) Assessment of primary and secondary BVOC exchange rates: Assessment of primary and secondary BVOC exchange rates in controlled conditions under simulated climate change and pollution scenarios [month 22]

D2.4) Definition and improved parameterization of fluxes of BVOC: Definition and improved parameterization of fluxes of BVOC under new environmental constraints and in relation to pollutants and endogenous induced emissions of NO and reactive oxygen species [month 42]

D2.5) Manuscript on constitutive emission considered for ozone balance: [month 13]

D2.6) Manuscript on stress induced emissions considered in ozone balance: [month 45]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS6	Data on soil and litter emissions under changing climate conditions in database	22	44	
MS7	Description of drying-re-wetting effects on soil NO emissions	10	24	Improved description of drying-re-wetting effects on soil NO emissions for different soil types, management and climate

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
				zones handed available for inclusion in models
MS8	BVOC exchange rates under simulated combined climate change and pollution available to modellers	9	24	
MS9	O3 balance data for Mediterranean and Boreal forest species for input in models	7	29	
MS10	O3 balance for Mediterranean and Boreal forest species	7	45	O3 balance for Mediterranean and Boreal forest species considering heat and drought stress for input in models

WT3:
Work package description

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP3	Type of activity [54]	RTD
Work package title	Modelling emission processes		
Start month	1		
End month	30		
Lead beneficiary number [55]	10		

Objectives

The aim of this work package is to provide improved parameterisations of biogenic and agricultural emissions to the modellers which include a robust response to climatic conditions that are predicted to change in the future.
The individual objectives are:
1. To improve the climate response characteristics of NH3 emission models for agricultural sources and vegetation,
2. To improve the climate response characteristics of soil NO emission models,
3. To improve European BVOC emission models and their response to meteorological drivers and stresses

Description of work and role of partners

Task 3.1: Improve agricultural NH3 emission modules in relation to meteorological drivers (UPM (Theobald), INRA, NERC(EDI)). Existing process models for describing ammonia volatilisation following manure/ slurry/ fertiliser applications will be improved with emphasis on the response on those conditions that are expected to change in the future (temperature, moisture, management). Models will be tested with the NH3 flux data from the agricultural flux sites of the ÉCLAIRE network and earlier projects (NitroEurope IP, GRAMINAE).
Task 3.2: Improve bi-directional exchange parameterisations of NH3 with vegetation (INRA (Loubet), NERC(EDI)). Using new flux measurement data from the ÉCLAIRE network, earlier European projects (NitroEurope IP, GRAMINAE) and national activities, the bi-directional exchange models needed for describing NH3 exchange during periods of background conditions (outside management periods) will be improved. Particular emphasis will be given to improve responses of NH3 exchange to changes in meteorological conditions under a changing climate, such as temperatures, leaf surface wetness and co-deposition of chemically interacting compounds. The work will also integrate the results from the controlled soil and litter emission measurements of NH3 (WP2, Task 1) into the modelling framework.
Task 3.3: Improvement of mechanistic parameterisations of NO soil emissions (KIT (Butterbach-Bahl)). Integrating information from the controlled studies (WP2, Tasks 1 & 2), new data from the ÉCLAIRE flux network and existing data from EU and national project, parameterisations of NO will be improved, in particular in their response to meteorological parameters (soil temperature, wetness, precipitation frequency etc.). A specific focus will be given to a better mechanistic description of drying-re-wetting cycles on soil NO emissions, which have been found to be of major importance for an improved understanding of the magnitude and seasonality of soil NO emissions.
Task 3.4: Improvement of the European BVOC modelling framework (ULund, (Arneth)). The data from the controlled VOC measurements (WP2, Tasks 3 & 4) and data from existing EU and national measurement activities will be integrated to improve the European BVOC emissions modelling framework, with focus of responses to changes in meteorological parameters (temperature, PAR, drought) and atmospheric composition (CO2, O3).

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	NERC	2.00
2	ULUND	3.00

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
10	KIT	9.00
13	INRA	11.00
23	UPM	4.00
	Total	29.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D3.1	NH3 emission model for agricultural management	10	10.00	O	PP	30
D3.2	NH3 exchange with soil/vegetation module	10	4.00	O	PP	30
D3.3	Soil NO emission model	10	7.00	O	PP	30
D3.4	BVOC modelling framework	10	4.00	O	PP	30
		Total	25.00			

Description of deliverables

D3.1) NH3 emission model for agricultural management: NH3 emission model for agricultural management (improved with regard to its sensitivity to predicted changes in environmental conditions and management) [month 30]

D3.2) NH3 exchange with soil/vegetation module: Background bi-directional NH3 exchange with soil/vegetation module (updated parameterization and inclusion of co-deposition effects) [month 30]

D3.3) Soil NO emission model: Soil NO emission model (improved parameterization with regard to responses to changes in environmental conditions) [month 30]

D3.4) BVOC modelling framework: BVOC modelling framework allowing to integrate effects of climate and atmospheric composition change [month 30]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS11	Workshop for summarizing state of the art of the different models	10	6	Workshop for summarizing state of the art of the different models/ modules and to outline in detail the upcoming developing work and strategies for model uncertainty

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
				assessment (joined with WP4)
MS12	Summary report	13	24	Summary report on site applications of improved NH3/NO and VOC models, including uncertainty assessment and comparison with original approaches
MS13	Provision of site based estimates of NH3/NO and VOC	10	44	Provision of site based estimates of NH3/NO and VOC exchange for ÉCLAIRE core sites for present and future environmental conditions

WT3:
Work package description

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP4	Type of activity [54]	RTD
Work package title	Surface exchange modelling		
Start month	1		
End month	42		
Lead beneficiary number [55]	13		

Objectives

The general aim of this work package is to improve the description of surface/ atmosphere exchange processes for atmospheric pollutants under variable climatic conditions. These parameterisations will be developed for incorporation into European-scale chemistry and transport models (CTM) in Component 2 and used in the derivation of dose-response relationships in Component 3. This information will also be used to estimate atmospheric N inputs and O3 deposition for the ecosystems being investigated at the effect study sites in Component 3. The effect of chemical- and gas-aerosol transformations that occur near and within plant canopies will also be investigated in relation to emission, deposition and bi-directional exchange for each of the pollutants considered. The interplay between substrate scale emissions and deposition and chemical- and gas-aerosol transformations result in the occurrence of bi-directional exchange at the canopy scale. Specific objectives include:

1. To improve surface exchange routines for the main reactive inorganic nitrogen (Nr) compounds (NH3, HNO3, NO2, NH4+, NO3-) and their response to changes in climate and surface chemistry.
2. To improve the parameterisation of O3 dry deposition in relation to environmental drivers, and its partitioning btween stomatal and non-stomatal pathways. The effects of CO2 and O3 on stomatal functioning and therefore on the uptake of both gases will also be considered.
3. To estimate the dry deposition of O3 and the total atmospheric Nr inputs at the effects study sites of Component 3 using multi-layer inferential modelling and monitored air concentrations/wet deposition at the sites.
4. To improve a multi-layer bi-directional exchange and chemistry model, which accounts for in-canopy interactions between emissions, deposition, chemistry and turbulent transport and is suitable for incorporation into CTMs (Component 2), by coupling gas phase to aerosol phase chemical processes within the canopy.

Description of work and role of partners

Task 4.1: Surface exchange routines for inorganic nitrogen compounds (INRA (Flechard), NERC(EDI), WU, met.no). Dry deposition/emission routines for NH3 (in collaboration with WP2, Task 2), HNO3, NO2, NO3- and NH4+ will be improved, with emphasis on the response of the parameterisations to environmental change (meteorology & atmospheric composition). This work will provide an integrating analysis of the NH3 fluxes from the ÉCLAIRE flux network providing parameterisations suitable for translation into the European atmospheric transport models, including the EMEP model (Component 2, WP3.2). The effect of NH4NO3 volatilisation near warm surfaces will be included, jointly with Task 3.

Task 4.2: Ozone deposition parameterisations (FMI (Tuovinen), SEI-Y,UoY, UGOT, met.no). Using existing data from European and national project, as well as new data collected at from the ÉCLAIRE flux network, the formulation and parameterisation of an existing O3 deposition model (DO3SE) will be improved. This will focus on providing more accurate descriptions of the mechanisms controlling stomatal and non-stomatal deposition of O3 as a function of environmental drivers, in particular meteorology, canopy wetness, phenology, atmospheric CO2 concentrations, and BVOC emissions. The work will develop mechanisms by which the feedback effect of O3 on stomatal function can be incorporated through inclusion of a photosynthesis-driven carbon based growth model within DO3SE. Where appropriate for application at the regional scale, the improved model descriptions will be formulated so that they can be incorporated into the EMEP model (C2) and also be used to estimate novel thresholds within WP 3.4. As such, this work will be co-ordinated with Components 2 and 3.

Task 4.3: In-canopy chemical processing (WU (Ganzeveld), NERC(EDI), met.no). To account explicitly for chemical conversions of pollutants near and within plant canopies, which modify the net exchange rate with vegetation, a computationally efficient coupled multi-layer exchange and chemistry model for site- to global-scale simulations of in-canopy interactions and net exchange fluxes will be further improved and evaluated. An existing scheme that treats the interactions within the NO-NO2-O3-VOCs system and their dependence on in-canopy turbulence will be extended to treat the phase partitioning of the NH3-HNO3-NH4NO3 system and made adapted for inclusion into the EMEP model (C2). The model framework will be assessed and fine-tuned against data from the ÉCLAIRE intensive campaigns (WP1) and other suitable datasets and compared against the single-layer approaches. The multi-layer model will also be used to investigate the vertical distribution of O3 concentration and sinks within the canopy resulting from gradients in irradiance, stomatal conductance and surface wetness.

Task 4.4: Estimating deposition at the ÉCLAIRE effect study sites by combining measured concentrations with a bi-directional exchange model (INRA(Flechard), SHI, NERC(EDI)). Monthly measurements will be made of concentrations of the inorganic reactive nitrogen compounds NH3, HNO3, NO2, NH4+ and NO3- at those effect sites, where atmospheric deposition dominates the total N input. Dry deposition fluxes of Nr will be estimated from these concentration measurements using the improved bi-directional exchange routines from Task 4.1 (inferential modelling). Bulk deposition measurements will be added to estimate wet deposition Nr inputs where no other near-by measurements are available. The air concentration and wetdeposition monitoring procedures will follow those already developed by these partners for implementation at 50 level 1 sites of NitroEurope (i.e., monthly active denuder monitoring for gas and aerosols, robust high sensivity passive sampling for NO2 and bulk sampling for wet deposition. The dry deposition of O3 at the effect study sites will be modelled using the improved routines from Task 4.2. These estimates of deposition will be used in Component 3 to develop dose-response relationships and novel thresholds.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	NERC	4.00
6	met.no	1.00
12	SEI-Y, UoY	6.00
13	INRA	27.00
16	UGOT	3.00
18	FMI	7.00
27	DHMZ	16.00
36	WU	6.00
	Total	70.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D4.1	Improved pollution- and climate-sensitive exchange parameterisations	13	15.00	O	PP	36
D4.2	Ozone dry deposition parameterisations	13	5.00	D	PP	36

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D4.3	A coupled pollutant deposition and carbon based growth model	13	6.00	O	PP	36
D4.4	Chemical processing model of NO-NO2-O3-VOCs and NH3-HNO	13	7.00	O	PP	36
D4.5	Current and future estimates of Nr and O3 deposition	13	16.00	O	PP	42
		Total	49.00			

Description of deliverables

D4.1) Improved pollution- and climate-sensitive exchange parameterisations: Improved pollution- and climate-sensitive exchange parameterisations for the main inorganic Nr compounds, suitable for inclusion in CTMs [month 36]

D4.2) Ozone dry deposition parameterisations: Ozone dry deposition parameterisations, improved with respect to changes in climate and environmental conditions, suitable for inclusion in CTMs [month 36]

D4.3) A coupled pollutant deposition and carbon based growth model: A coupled pollutant deposition and carbon based growth model (DOSE_C), based on the existing DO3SE model for O3 deposition [month 36]

D4.4) Chemical processing model of NO-NO2-O3-VOCs and NH3-HNO: A vertically-resolved, multi-layer in-canopy chemical processing model of NO-NO2-O3-VOCs and NH3-HNO3-NH4NO3 exchange [month 36]

D4.5) Current and future estimates of Nr and O3 deposition: Inferential model current and future estimates of Nr and O3 deposition at effects study sites of Component 2 [month 42]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS14	Measurement network established for monthly Nr concentrations at the ÉCLAIRE effect study sites.	13	12	Measurement network established for monthly Nr concentrations at the ÉCLAIRE effect study sites. Start of monitoring for years 2 and 3
MS15	Literature review	18	12	Literature review completed on the effects of O3 and Nr deposition on stomatal functioning and on the influence of surface wetness on total O3 deposition
MS16	New ÉCLAIRE experimental datasets	12	18	New ÉCLAIRE experimental datasets used to develop dose-response functions

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
				in collaboration with WPs3 & 12
MS17	Improved representation of the influence of environmental drivers	12	24	Improved representation of the influence of environmental drivers on stomatal conductance and the partitioning between stomatal and non-stomatal deposition of O3 and their incorporation in EMEP model
MS18	Incorporation of results from flux monitoring data generated within ÉCLAIRE into modelling framework	13	24	Incorporation of results from flux monitoring data generated within ÉCLAIRE into process modelling framework
MS19	Calibration of model parameterisation completed	13	30	Preliminary estimates of Nr and O3 fluxes at the effects study sites inferred from monitored concentrations
MS20	Estimates of Nr and O3 fluxes at the effects study sites inferred from monitored concent	13	30	
MS21	Comparison of inferential model estimates with EMEP model results	13	33	
MS22	Provision of site based estimates of NH3/NO and VOC exchange for ÉCLAIRE core sites	13	44	Provision of site based estimates of NH3/NO and VOC exchange for ÉCLAIRE core sites for present and future environmental conditions

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP5	Type of activity [54]	RTD
Work package title	Past and future changes of atmospheric pollutants transported into Europe		
Start month	1		
End month	36		
Lead beneficiary number [55]	11		

Objectives

1. To assess our current understanding of ozone and other air pollution trends, based on knowledge acquired within the UNECE TF HTAP, work for IPCC-AR5 and other projects, with a focus on the inflow regions of Europe.
2. To evaluate the transport of atmospheric pollutants (ozone and precursors, aerosols) into Europe, evaluate the relative contributions of long-range-transported and European pollution on atmospheric composition and deposition to the ecosystems in Europe and in other regions, and provide a range of chemical boundary conditions to regional models within ÉCLAIRE (WP7), taking into account changes in global anthropogenic and natural emissions under current and future climate change conditions.
3. To examine the relative contributions and impacts on air pollution of future biogenic and soil and fire emissions produced in WP15 of ozone and aerosol precursors on European pollutants levels and their export to the hemispheric and large scale atmosphere.

Description of work and role of partners

Task 5.1: Understanding pollutant trends and model predictions (JRC (Dentener), CNRS). A selected set of IPCC-AR5 historical (1960-2010) simulations, FP7 PEGASOS simulations, and dedicated sensitivity simulations will be analysed for their ability to reproduce recent ozone trends, satellite derived NO2 columns and nitrogen and sulphur deposition, focussing on the role of anthropogenic (TM5) and natural emissions (LMDZ), to provide a best estimate and uncertainty of ozone and other air pollutant inflows at the boundary of Europe.
Task 5.2: Predicting future pollutant trends (JRC (Dentener), CNRS, met.no). Selected scenarios of future emissions provided by IPCC AR5 RCPs, and possibly other scenarios, will be used to evaluate the possible global, hemispheric and European evolution of ozone and other air pollutants for 2030, 2050 and 2100. LMDz-INCA-ORCHIDEE will be used to simulate the future impact of biogenic and soil emissions of ozone and aerosol precursors on future levels of pollutants, especially O3 and reactive N-compounds. The uncertainty of these emissions will be estimated using emission datasets developed in WP6, accounting for future climate and changes in land use a well as anthropogenic and biogenic emissions. Sensitivity simulations will be carried out in order to discriminate the relative contributions of the various changes on the level of pollutants in Europe and interactions with pollution on global scale (TM5, LMDz and, up to 2050, EMEP).
Task 5.3: Quantifying the importance of long-range transport for ecosystem impacts (ULUND (Arneth), CNRS). This task will analyse the evolution of key environmental variables impacting ecosystems (ozone levels, PM levels, N and S deposition) under the various emission and climate scenarios and isolate the role played by long range transport of pollution, climate change and changing variability, biogenic/emissions, lightning emissions, and anthropogenic emissions in Europe and other regions.
Task 5.4: Provision of future European pollutant boundary conditions (CNRS (Lathière), JRC, ULUND, met.no). This task will provide a best estimate and uncertainty range of present and future O3, O3 precursors and aerosol as boundary conditions to regional models, for further impact assessment on ecosystems.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
2	ULUND	4.00

WT3:
Work package description

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
6	met.no	1.00
11	JRC	7.00
25	CNRS	16.00
	Total	28.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D5.1	Assessment of current GCMs and CTMS	11	7.00	R	PU	18
D5.2	Report describing the range of future evolutions of global, hemispheric and European ozone	11	7.00	R	PU	36
D5.3	Report describing the contributions of regions and processes on key environmental variables	11	7.00	R	PU	36
D5.4	Boundary conditions for regional conditions	11	7.00	R	PU	24
		Total	28.00			

Description of deliverables

D5.1) Assessment of current GCMs and CTMS: Assessment of current GCMs and CTMS to reproduced recent trends models by comparison with selected observations [month 18]

D5.2) Report describing the range of future evolutions of global, hemispheric and European ozone: Report describing the range of future evolutions of global, hemispheric and European ozone, ozone precursors, and aerosol using a range of anthropogenic and natural emissions [month 36]

D5.3) Report describing the contributions of regions and processes on key environmental variables: Report describing the contributions of regions and processes on key environmental variables under future conditions [month 36]

D5.4) Boundary conditions for regional conditions: [month 24]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS23	Evaluation of AR5 and other simulations with climate and chemistry global models	11	18	
MS24	Future simulations with improved biogenic and soil emissions	11	24	

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP6	Type of activity [54]	RTD
Work package title	Emissions on regional, European, to global scale		
Start month	1		
End month	30		
Lead beneficiary number [55]	2		

Objectives

The aim of WP6 is to provide emission patterns for model experiments on European and global scale (see WPs 7,13,14), with a focus on terrestrial biogenic and pyrogenic emissions, and to provide improved temporal resolution of non-agricultural anthropogenic emissions. A select number of new modelling analyses are specifically assigned to incorporate ÉCLAIRE new process understanding emerging from Component 1.
Specifically, the objectives are:
1. To quantify how trace gas emissions from natural, semi-natural, and agricultural ecosystems vary in response to interactions of weather and climate, atmospheric CO_2 burden and N deposition, vegetation and soil carbon and nitrogen dynamics, and land use/land cover change
2. To provide improved temporal dis-aggregation of non-ecosystem, anthropogenic European (pollutant emission patterns for selected source sectors.

Description of work and role of partners

Understanding the seasonal and geographic short-term variability and long-term trends of trace gas emissions from natural and agricultural ecosystems, including fire, is one of the chief challenges for understanding air quality-climate change interactions. Ecosystems not only respond to the impacts of pollution and climate change, they also all affect atmospheric composition and hence air pollution and climate in turn, by exchanges of greenhouse gases, reactive trace gases and particles (Forester et al., 2007; Arneth et al., 2009). This WP will be organised into four tasks:
Task 6.1: Synthesis of existing terrestrial biogenic and pyrogenic emission estimates from the consortium partners (scale: regional, European, global) (ULUND (Arneth), all WP partners). This initial synthesis will bring together relevant previous and ongoing simulation results (e.g., for BVOC, NO_x, NH_3, fire) that are available from the ÉCLAIRE partners. The chief aim is to early-on establish and test for suitable input format and resolution, and file exchange strategies with atmospheric chemistry and carbon cycle models.
Task 6.2: Improved emissions from (semi-) natural ecosystems (ULUND (Arneth), KIT, CNRS). ÉCLAIRE emission models will be driven by past, present-day and future climate, CO_2 and N deposition scenarios (same as applied in WP7) for a consistent, process-based analysis of vegetation emissions that takes into account the tight coupling between biogeochemical cycles of carbon, water and nitrogen, atmospheric chemistry and climate. Process descriptions and parameterisations will be updated with the most recent information from Component 1.
Task 6.3: Emissions from agricultural sources (AU (Geels), KIT, ALTERRA, AU, NERC(EDI)). In a similar approach to Task 6.2, the emissions from agricultural systems will be modelled in response to their key drivers. This will integrate the improvements in process understanding from WP3.
Task 6.4: Emission profiles from anthropogenic sources (NERC (Reis), UEDIN). Temporal European emission profiles will be developed for key source sectors (road transport, other mobile sources, power generation, industrial production and agriculture), based on experience on highly detailed national scale work. The aim is to derive robust profiles by sector and sub-sector representing the timing of emissions (hourly, daily, monthly or seasonal; building on accessible national and European statistics) which enable modellers in ÉCLAIRE to implement these profiles and run models for a wide range of years/scenarios.

The table below is also reproduced with formatting, in section B7 of Part B.

Model (Partner) ¦ Spatial unit ¦Time units ¦ Inputs ¦ Outputs
A. Dynamic vegetation and trace gas emissions model (DGVMs)

A1. CLM 4.0, Community Land Model (JRC)* ¦ 0.25° at continental or 1° at global scale. ¦ Sub-daily ¦ R, P, T, u, rh, CO2, Ndep, Luc¦ FE, ☐, BVOC, C-cycle, N-cycle
A2. LPJ-GUESS (ULUND) ¦ 10' (Europe) or 0.5° (globe) ¦daily ¦P, R, T, CO2, Ndep, O3, Luc, ¦ Forest, crop: C-cycle, N-cycle, BVOC, fire, (theta) ¦
A3. JULES (NERC) 0.5°to 3.75° x 2.5° ¦Sub-daily ¦R, P, T, u, rh, O3, CO2, Luc ¦
FE, (theta), C-cycle (incl. CH4), BVOC emissions
A4. ORCHIDEE (CNRS)¦ typically 1-2° (global) ¦ Sub-daily ¦ R, P, T, u, rh, CO2, Ndep, Luc ¦Forest, crop : C-cycle, N-cycle, BVOC
B. Soil process and trace gas emission models (DSVMs)
B1. DNDC-metamodel
(JRC)* ¦ EU at fine grid (HSMU) ¦As in DNDC-EUROPE model (daily) ¦R, P, T, Ndep, Luc¦ N-cycle (agricultural soils)
B.2 DNDC-MOBILE¦Variable ¦Sub-daily to daily ¦R, P, T, Ndep, Luc, soil & vegetation properties ¦C-cycle, N-cycle, leaching, acidification
B3. FORSPACE (ALTERRA)* ¦Variable ¦Daily to monthly ¦R, P, T, rh, CO2, Ndep, soil & vegetation properties¦C-cycle, N-cycle, disturbance impact, functional diversity (effect-response)
B4. SUMO (ALTERRA)* ¦Point ¦Annual ¦R, P, T, rh, CO2, soil & vegetation properties (incl nutrient content) ¦Biomass, element content of harvest and litter
B5. VSD-N14C (RIVM, NERC) ¦Point ¦Annual ¦Deposition of S, N, Ca, Mg, K, Na & Cl; soil properties (physical, chemical) ¦Soil and biomass C & N pools; soil solution chemistry.

*) Model takes part in the spatial ensemble modelling activity of effects (WP14), but not in the emissions activity (WP6)

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	NERC	1.50
2	ULUND	7.00
4	ALTERRA	2.00
10	KIT	3.00
25	CNRS	5.00
28	UEDIN	3.00
35	AU	4.00
	Total	25.50

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D6.1	Initial dynamic biogenic emissions, based on synthesis of existing work and mainly for testing	2	9.00	O	PP	8
D6.2	Improved terrestrial (semi)natural and agricultural emissions	2	9.00	O	PP	30
D6.3	Sectoral emission profiles for selected source sectors and countries	2	7.50	O	PU	30

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
		Total	25.50			

Description of deliverables

D6.1) Initial dynamic biogenic emissions, based on synthesis of existing work and mainly for testing: Initial dynamic biogenic emissions, based on synthesis of existing work and mainly for test and set-up of Éclaire atmospheric model experiments WP2.3 and in 4.1. Test for compatibility of file format & establish appropriate resolution for use in atmospheric models [month 8]

D6.2) Improved terrestrial (semi)natural and agricultural emissions: Improved terrestrial (semi)natural and agricultural emissions in response to integrated effects of climate change, change in atmospheric CO2 and N burden and land use/land management change [month 30]

D6.3) Sectoral emission profiles for selected source sectors and countries: Sectoral emission profiles for selected source sectors and countries for application in local-to-regional scale models [month 30]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS25	WP meeting and decision on emission-model experimental protocol	2	8	WP meeting and decision on emission-model experimental protocol, including spatial and temporal profiles (in coordination with the other C2 WPs)
MS26	First improved emission estimates, based on model development	2	24	
MS27	Improved emission estimates, evaluated against ÉCLAIRE results	2	30	Improved emission estimates, documented to other groups in ÉCLAIRE, evaluation against ÉCLAIRE results

WT3:
Work package description

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP7	Type of activity [54]	RTD
Work package title	Modelling European air pollution and deposition		
Start month	1		
End month	48		
Lead beneficiary number [55]	6		

Objectives

The aim of this WP is to provide maps of O3-damage metrics and N-deposition over Europe, for current and future scenarios, as inputs to the ecological response and effects packages (C3 and C4) and to integrated assessment modelling (C5). Activities ranging from global to local scale, and linking meteorological, chemical and ecological models will interact with each other and be merged to fulfil these objectives. In particular, new process understanding of biosphere-atmosphere exchange and changes associated with increased CO2 levels and future climate will be incorporated into CTMs. A small ensemble of CTMs and regional climate-model results (Table 1.1) will be used to illustrate the robustness and uncertainty of the AQ metrics, in current and future scenarios. Model developments and provision of results will be continuous, in order to make best use of C1 updates at any given time, but also to provide provisional data to C3-C5 as early as possible.
1. To map current air pollution metrics (APMs, mainly ozone damage indicators, POD & AOTx, and N-deposition) using a small ensemble of CTMs, in order to provide a best-estimate and uncertainty range on vegetation effects metrics.
2. To implement on the European scale new modules for stomatal uptake, in-canopy-chemistry, and emissions and sub-grid effects into the EMEP chemical transport model, able to take account of changes in CO2, N deposition, BVOC emissions and climate over coming decades.
3. To estimate changes in APMs to specific ecosystems up to year 2030 and 2050, accounting for climate-changed induced changes in meteorology, vegetation, and biosphere-atmosphere exchange processes.

Description of work and role of partners

Task 7.1: Implementation of advanced exchange models into European CTMs (met.no (Simpson), ULUND).
C1 will provide the EMEP model with a photo-synthesis based DO3SE model, and a multi-layer canopy model, tested at the site scale. In this Task we will implement these improvements at the European scale, and accounting for effects of future climate change. Implementation work will commence in the first year, and modules updated as C1 progresses with measurements and testing. The main focus of these developments will be on the EMEP model, but modules will be made available to all participants for use in other CTMs.
Task 7.2: Scenario calculation of climate effects for assessment of air pollution transport and deposition (SMHI (Engardt), ULUND, AU, met.no, CNRS). Future scenarios for 2030, 2050, will be developed using the following inputs:
• meteorology from a regional climate model (SMHI's RCA3), driven by 3 different global climate models (ECHAM3,HADCM3,CNRM). RCA will downscale the GCM data to 50 x 50 km2 resolution (SMHI);
• changes in land cover and vegetation characteristics (e.g. leaf area) as estimated by the LPJ-GUESS model (or for other models where readily available) (ULUND);
• changes in hemispheric air quality (O3, CO, CH4, etc) from the global models in WP5 will act as boundary conditions for the European-scale modelling. (JRC, CNRS);
• changes in natural and anthropogenic emissions from WP6, including changed BVOC and NH3 emissions as a result of climate change (ULUND, AU, met.no);
This activity will be harmonized with other scenario developments in ÉCLAIRE under WP6.1.
Task 7.3: Assessing the importance of biogenic emissions and in-canopy chemistry on pollutant deposition at the European scale (met.no (Simpson), WU, JUELICH). This task will implement the coupled multi-layer in-canopy emission / exchange / chemistry model of WP1.4 into the EMEP model and investigation of the importance of biogenic emissions and in-canopy chemistry on O3 and O3 uptake (POD) as well as on N-exchange at the European scale.

Task 7.4: Calculation of European fields and source-receptor matrices for deposition and pollution metrics / thresholds under future climate change (met.no (Simpson)). The EMEP model will be used to assess the importance of changing BVOC emissions, CO2 and climate changes (including changing precipitation fields) on O3 and N deposition metrics, at 20 km resolution over Europe (and with sub-grid ecosystem estimates). Source-receptor matrices at 50 km resolution will be calculated for use in C5. (Timing issues will necessitate the calculation of initial matrices using a best-available model version during year 3, to provide data to C5 in due time.)
Task 7.5: Ensemble calculation of maps of deposition and pollution metrics and analysis of uncertainty (ULUND (Arneth), all WP partners). Ensemble simulations of 6 CTMs (cf Table 1.1) will be conducted for the current-year case, and for EMEP, MATCH (and where readily achievable, possibly through other projects), for future scenarios. The results of the ensembles will be inter-compared in order to generate an ensemble mean, and associated uncertainty. The importance of the different factors (meteorology, air quality, emissions, vegetation) will be assessed.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
2	ULUND	9.00
6	met.no	17.00
7	Juelich	3.00
11	JRC	4.00
25	CNRS	8.00
26	SMHI	5.00
36	WU	2.00
39	TNO	4.00
	Total	52.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D7.1	Maps of current air pollution metrics (APMs) across Europe, from the EMEP model and five other CTMs	6	10.00	R	PU	18
D7.2	Improved EMEP model with climate-change and canopy-chemistry capabilities, able to predict the impac	6	10.00	O	PP	40
D7.3	Report on effects of in-canopy BVOC and NO emissions on in-canopy O3 and POD estimates	6	10.00	R	PU	44
D7.4	Report on effects of changes in global climate, chemistry, emissions and landcover changes on APMs	6	10.00	R	PU	48
D7.5	Source-receptor matrices of APMs for current and future conditions	6	12.00	O	PP	36

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
		Total	52.00			

Description of deliverables

D7.1) Maps of current air pollution metrics (APMs) across Europe, from the EMEP model and five other CTMs: Implementation and initial testing of coupled model system: EMEP with C1 (preliminary) DO3SE and canopy-chemistry models, combined with WP2.1 boundary conditions and WP2.2 emissions and landcover changes at European level. [month 18]

D7.2) Improved EMEP model with climate-change and canopy-chemistry capabilities, able to predict the impac: [month 40]

D7.3) Report on effects of in-canopy BVOC and NO emissions on in-canopy O3 and POD estimates: [month 44]

D7.4) Report on effects of changes in global climate, chemistry, emissions and landcover changes on APMs: [month 48]

D7.5) Source-receptor matrices of APMs for current and future conditions: Source-receptor matrices of APMs for current and future conidtions for use in effects and intergrated assessment components. [month 36]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS28	Implementation and initial testing of coupled model system	6	24	Implementation and initial testing of coupled model system: EMEP with C1 (preliminary) DO3SE and canopy-chemistry models, combined with WP2.1 boundary conditions and WP2.2 emissions and landcover chan
MS29	Initial ensemble runs for current conditions	6	18	
MS30	Incorporation of sub-grid methodology from WP2.4 into EMEP model	6	30	
MS31	Future scenario data-sets ready	6	30	
MS32	“Final” model-system ready. Commencement of source-receptor calculations	6	36	

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP8	Type of activity [54]	RTD
Work package title	Assessing local and regional variation		
Start month	1		
End month	30		
Lead beneficiary number [55]	8		

Objectives

The aim of WP8 is to develop a better scientific understanding of the air pollution and climate change relationships at regional/local/landscape-scale and sub-grid approaches for inclusion in large-scale models that enable a good representation of the multitude of processes that play a role on smaller scales (e.g., landscape-scale). By doing this, large-scale concentration and deposition patterns will better represent the local-scale interactions and provide more relevant input, e.g., for European scenario studies that involve one or more of the affected parameters. The objectives are:
1. To synthesize the available knowledge on local interactions in relation to climate and air quality, as well as the way this knowledge is included in local-scale atmosphere-biosphere modelling systems;
2. To analyse the sensitivity of the landscape scale effects on changing pollutant fluxes, especially as affected by climate change;
3. To include local/landscape-scale effects of climate change and air pollution interactions into large scale/European scale models by means of sub-grid representation of the most important processes.

Description of work and role of partners

While landscape interactions occur at a resolution of tens of meters (or even less), European and/or global models use grid sizes ranging from 20 – 100 km (or even more). The local variability of landscape-scale effects of climate change and air pollution on emissions from ecosystems (e.g., difference in the response in drought affected vs. well-watered systems, effects of extreme events vs. trends) and deposition patterns (and their potential impacts) can easily be masked by these large grid sizes. Furthermore, landscape interactions create different dynamics in the atmosphere-biosphere system which cannot be resolved with the static grid modelling and need sub-grid approaches. Substantial heterogeneity occurs at this scale, including lateral dispersion effects, revealed in local gradients in NH3, NOx, O3 and HNO3 concentrations and deposition. Issues of altered temperature and precipitation are also highly relevant at the landscape scale, as local effects (such as irrigation and drainage patterns) affect the water balance and O3 uptake. Landscape patterns as well as farm management in rural landscapes are also a strong source of small-scale heterogeneity, the consequences of which are difficult to assess at larger scales. Understanding these local-scale variations is thus of major importance for the quantification of climate - air pollution interactions. In order to achieve the objectives, this WP will be organised into three main tasks:
Task 8.1: Synthesis of existing local-scale transport models suitable for dealing with atmosphere-biosphere exchange taking into account climate change and air quality interactions (ECN (Bleeker) + all WP partners). This synthesis will provide a broad overview of the different activities related to local-scale modelling work for the relevant compounds, and attempt to draw statistical relationships between land cover, emissions and concentrations. The main aim of this task is to be able to build on existing experience with respect to the local-scale modelling work.
Task 8.2: Improved scientific understanding of the air quality and climate change relations at the landscape scale (ECN (Bleeker), UPM, KIT, NERC(EDI), UEDIN, INRA, AU). A model (NitroScape) to simulate the different flows and transformations of reactive nitrogen in a landscape in relation to agricultural management was developed as part of the NitroEurope IP. While NitroScape at the moment mainly focuses on agricultural systems and nitrogen, the work in ÉCLAIRE will extend this modelling framework to the needs of ÉCLAIRE to analyze sensitivity to climate change, especially in relation to atmospheric deposition to sensitive ecosystems (e.g. as affected by nitrogen deposition, to be addressed based on outputs of WP8 in WP17).

Together with dedicated atmospheric models (e.g., EMEP4UK), the local scale relations will be investigated for selected landscapes in Europe (Scotland and Netherlands) at different resolutions (i.e., 5 x 5 km2, 1 x 1 km2, and down to 50 m x 50 m). Overall, Task 1 will form the basis for this work on improving our understanding of these local interactions between air pollutant fluxes and climate change. Alongside NitroScape, the most relevant models evaluated as part of Task 1 will be used as a starting point for further development with respect to these interactions The developments will also build on activities from WP6 and Component 1.
The modelling of the two contrasting case-study areas will be achieved cost-effectively by focusing on a) high resolution national datasets, available down to 1 km resolution (e.g., including new 1 km resolution ammonia emissions data, Hallsworth et al. (2010), which will for the first time be applied into the EMEP4UK model (covering both UK and NL) with parallel high resolution data from the Netherlands; b) use of two intensively landscapes (Burnsmuir, Scotland; NFW, Netherlands) which have already been intensively inventoried at a field, farm and forest scale etc allowing the NitroScape model to be run over domains of c. 5 x 5 km2 at a grid resolution of 50 m. As the inventory data are already available, the work will focus on updates and extension to analyse the consequences of climate change interactions for atmospheric concencentrations and deposition estimates.

Task 8.3. Development of sub-grid parameterisations / corrections for European scale CTMs (ECN (Bleeker), met.no, UEDIN, NERC(EDI)). The results from Task 8.2 will be used to improve transport and deposition model(s), so that they better represent the sub-grid variability that they are currently lacking (e.g. EMEP). Special focus will be on incorporating the sub-grid variability in the EMEP model, through a statistical approach linked to land cover and emissions variability, and will then be used for evaluating the whole range of local-scale to large-scale variation in terms of the climate change / air pollution interactions. The procedure to be developed will combine the low-resolution European estimates of the EMEP model (20 km or 50 km grid) to be combined with a) high resolution landcover datasets - especially important where receptor type dominates the subgrid variability (e.g., O3, HNO3 and aerosol deposition), and b) high resolution emissions datasets, where source distribution dominates the subgrid variability (e.g., NOx, NH3). For this purpose high resolution emission and landcover datasets emerging from NitroEurope IP and other projects will be fully exploited.

The outputs of this WP will feed especially into WP7, in regard of the sub-grid procedure (D8.4), and into WP15, in regard of the concentration and deposition estimates for the two case study areas (D8.3).

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	NERC	7.00
6	met.no	1.00
8	ECN	7.00
10	KIT	2.00
13	INRA	21.00
23	UPM	3.00
35	AU	1.50
37	ULB	4.00
	Total	46.50

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D8.1	Synthesis report on the different local scale models dealing with atmosphere-biosphere exchange	8	11.00	R	PU	12
D8.2	Report on local scale interactions between air quality and climate change	8	11.00	R	PU	30
D8.3	Concentration and deposition maps	8	11.00	R	PU	16
D8.4	Sub-Grid module for inclusion in the EMEP model	8	13.00	O	PP	30
		Total	46.00			

Description of deliverables

D8.1) Synthesis report on the different local scale models dealing with atmosphere-biosphere exchange: Synthesis report on the different local scale models dealing with atmosphere-biosphere exchange and their relevance for describing the climate change / air pollution interaction [month 12]

D8.2) Report on local scale interactions between air quality and climate change: Report on local scale interactions (and their variability) between air quality and climate change, based on modelling studies for selected regions in Europe [month 30]

D8.3) Concentration and deposition maps: Concentration and deposition maps, for the regions mentioned above, at 5 x 5 km2, 1 x 1 km2, down to 50 x 50 m2 resolution for different components (e.g. NH3, NOx, O3) [month 16]

D8.4) Sub-Grid module for inclusion in the EMEP model: Sub-Grid module for inclusion in the EMEP model, enabling the description of sub-grid variability, based on activities from Tasks 2.4.1 and 2.4.2 [month 30]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS33	Inventory of relevant local scale models	8	10	
MS34	Report on local scale models inventory	8	12	
MS35	Update of NitroScape to reflect ÉCLAIRE needs	8	16	
MS36	Concentration/Deposition maps	8	16	Concentration/Deposition maps (e.g. NH3 on 5 km x 5 km, 1 km x 1 km, up to 50 m x 50 m resolution) available for further use in ÉCLAIRE (e.g. WP4.4)

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS37	Description of local scale interactions between air quality and climate change	8	30	Description of local scale interactions between air quality and climate change, based on e.g. NitroScape / EMEP4UK
MS38	Sub-grid module available for implementation in EMEP model	8	40	

WT3:
Work package description

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP9	Type of activity [54]	RTD
Work package title	Synthesis and meta-analysis of measurements of plant and soil responses		
Start month	1		
End month	24		
Lead beneficiary number [55]	1		

Objectives

1. To conduct a pan-European data mining exercise compiling data from previous survey, field-scale manipulation and controlled exposure experiments on air pollution impacts on ecosystem function and services, including interactions with other drivers such as climate change
2. To conduct a meta-analysis on the compiled data to provide a priority analysis for the modelers of the most important effects and associated processes
3. To analyse the data to develop a database of response-relationships for key ecosystem processes, functions and services to air pollutants (singly, and where available, in combination) including the influence of climate change, for use in activities WP12 and WP13.
4. To identify key knowledge gaps that can be filled by experimentation in WP10 and WP11.

Description of work and role of partners

Over the last 20 years, scientists across Europe have been studying the effects of air pollutants on natural ecosystems. Experiments and surveys have usually been targetted at the responses of single processes or ecosystem components to individual pollutants. Separate research communities have developed within Europe for each pollutant which have often been further subdivided into groups studying specific ecosystem type – pollutant combinations (e.g. N impacts on forest ecosystems, O3 impacts on crop yield). Some of this research has been coordinated as part of European initiatives (e.g., CLIMOOR, NitroEurope IP) or activities of the CLRTAP (ICP Vegetation, ICP Forests), with the remainder being conducted on an ad-hoc basis to meet national requirements. Together, these experiments provide an invaluable, but as yet untapped resource for the European Union. In this activity, for the first time, pan-European data from survey (e.g., Mills et al., 2010; Ferretti et al., 2007; Karlsson et al, 2006), field-scale ecosystem manipulation (e.g. Beier et al., 2009; Bassin et al., 2009) and controlled exposure experiments (e.g., Hayes et al., 2010; Gonzalez-Fernadez et al., 2008) conducted under near-ambient climatic conditions will be compiled according to a common protocol.
Data analyses will derive quantitative relationships between N, S and O3 exposure, and effects on terrestrial ecosystem functioning and carbon balance, accounting for climatic variations. These will include information on drivers (e.g. climatic conditions and pollutant concentration) and the plant responses such as measurements of stomatal conductance and impacts on biomass and/or yield. Only data from experiments conducted under field conditions of a naturally fluctuating climate will be included. This data mining exercise will be driven by the need to improve modelling and will thus contribute to the development of novel thresholds (WP12) and modelling effects on ecosystem function and services including species change, C stocks and greenhouse gas interactions (WP13). Identified gaps in knowledge will be used to inform experimental design in activities WP10 and WP11.
The work will be conducted within tasks, which are split by ecosystem type, with a common aim of collating data on: species composition, management practices, pollutant treatment regime, soil type and properties, atmospheric O3, CO2 concentration and N load, meteorological data, plant measurements (including leaf area index, photosynthesis and respiration, and above and below ground biomass) and soil measurements (including C and N pools, soil solution chemistry and CH4 and N2O fluxes).
Task 9.1: Forest ecosystems (ALTERRA (De Vries), WSL, IVL). Benefitting from full access to ICP Forests level II data (a highly detailed monitoring dataset for over 700 forest sites across Europe with a long time series, see www.icp-forests.org and van Dobben and De Vries, 2010 for further details), empirical stand-scale relationships relating forest growth to environmental conditions will be derived from a 15 year time series by incorporating measured drivers of change (including O3, N, S). Further forest effects data will be compiled from published and unpublished data from pollutant exposure experiments conducted under (near-) field conditions, including,

for example, an expansion of that recently compiled by the ICP Vegetation for the derivation of O3 flux-effect relationships.

Task 9.2: Grassland ecosystems (NERC(BAN) (Mills), SEI-Y, UoY). Grassland ecosystems are by far the most diverse of the ecosystem types being covered, with all pollutants being considered under ÉCLAIR having an impact. Grasslands representative of northern (upland conservation grassland, e.g., Hayes et al., 2006), central (lowland conservation meadow, e.g., Volk et al., 2006; alpine meadow, e.g., Bassin et al., 2009) and southern Europe (Mediterranean grassland, e.g. Gimeno et al., 2004) will be selected for the most detailed analysis, with examples of other grasslands being included where suitable data is available. Data mining will focus on experiments quantifying effects on species growing within a competitive environment and will include effects on component species (including changes in species number, shifts in functional groups, loss of iconic and rare species), ecosystem processes and interactions with climate change.
Task 9.3: Agricultural ecosystems (UGOT (Pleijel), NERC(BAN)). For agricultural ecosystems, data compilation will concentrate on impacts of ozone within a changing climate since N pollutants tend to have a fertilizing effect that is (often inadvertently) included within fertilizer regimes. Existing databases held by the ICP Vegetation on effects on yield quantity (e.g., Pleijel et al., 2007) will be expanded to including effects on yield quality, photosynthesis and respiration, carbon allocation, leaf N efficiency and effects on carbon nitrogen balance of agro-ecosystems.
Task 9.4: Wetland and dry heathland ecosystems (DTU (Beier), NERC(EDI)). Valued for their biodiversity and balance of lower plants and slow-growing shrubs, the focus of the data mining for these ecosystems will be on the interacting effects of pollutants (N, S, O3) and climate on species composition and ecosystem processes and services. Data synthesis will benefit from previous/ongoing EU-funded projects, with the main sources of data being the EU-INCREASE experimental sites (Shrublands: Mols, DK; Brandbjerg, DK; Clocaenog, UK; Oldebroek, NL; Kiskun Sag, HU; Capo Caccia, IT; Garraf, SP) and the EU-NitroEurope sites (Whim, UK; Fäjemyren, SE; Storgama, SE). No coordinated studies have been conducted on O3 effects on these ecosystems and thus data will be compiled from nationally-funded experiments such as those conducted in Finland (e.g., Rinnan et al., 2008) and the UK (e.g., Toet et al, 2010).

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	NERC	7.00
3	DTU	2.00
4	ALTERRA	1.90
12	SEI-Y, UoY	3.00
16	UGOT	3.00
30	WSL	5.00
31	IVL	1.80
	Total	23.70

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D9.1	Progress report on availability of data for use in WPs 12 and 13	1	8.00	R	PU	6
D9.2	First phase database for use in initial modelling and identification of data gaps	1	8.00	O	PP	12

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D9.3	Completed database and results of meta-analysis handed to WP12 and WP13	1	7.70	O	PP	24
		Total	23.70			

Description of deliverables

D9.1) Progress report on availability of data for use in WPs 12 and 13: [month 6]

D9.2) First phase database for use in initial modelling and identification of data gaps: [month 12]

D9.3) Completed database and results of meta-analysis handed to WP12 and WP13: First phase database for use in initial modelling and identification of data gaps for experiments being conducted in WP10 and WP11 [month 24]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS39	Compilation of data from published papers and list of knowledge gaps	1	12	
MS40	Completion of data compilation	1	18	
MS41	Completion of meta-analysis and handing over of data for use in WP12 and 13	1	24	

WT3:
Work package description

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP10	Type of activity [54]	RTD
Work package title	Field-scale ecosystem manipulation and controlled studies on ecological responses		
Start month	1		
End month	24		
Lead beneficiary number [55]	3		

Objectives

1. To conduct relevant field-scale and controlled-exposure experiments on impacts of air pollution components on plant and ecosystem processes including interactions with climate change.
2. To use these experiments to quantify impacts of air pollution, in particular ozone and nitrogen components on key ecosystem processes, greenhouse gas exchange and ecosystem carbon balances
3. To provide inputs for developments and parameterization for modeling (WP13).

Description of work and role of partners

In addition to literature review and data mining of past monitoring and experiments on air pollution impacts on terrestrial ecosystems (WP9), there is a need to conduct new experiments representative for different ecosystems and climates across Europe, and to test and document impacts, interactions and relationships that reaches beyond the focus of previous studies. This will be particularly true with respect to climate change, since previous experiments and data did not take this aspect into account and were not measuring under relevant conditions. Therefore experimental studies will be carried out in key ecosystem types and at a range of climates to specifically address the question of air pollution impacts under future conditions. The ecosystem experiments will be based on ongoing experiments in order to reduce the overall costs and in order to maximise the value for the money, since all the experimental sites will have a basic setup and existing site relevant data and model applications. Plant and ecosystem responses in terms of plant performance, carbon uptake and ecosystem carbon dynamics will be measured and the data and results from the experiments will feed into the development of novel thresholds (WP12) and the ecosystem models (WP13). The experiments will be conducted in 4 different ecosystem types:
Task 10.1: Forest site experiments (NERC(BAN) (Mills), UNICATT). Forest trees representing N European conditions (Silver birch and alder) will be exposed in solar domes to elevated O3, wet N deposition and drought to establish dose/response relationships and N-O3-water interactions (NERC(BAN)). In addition, trees representing S European conditions (Beech, Ash, Oak, Poplar) will be exposed at field scale exposures with elevated O3, drought, wet N to highlight air pollution-climate interactions (UNICATT).
Task 10.2: Agricultural experiments (DTU (Beier), CIEMAT). Agricultural crops (barley and oil seed rape) from N Europe will be exposed in a phytothrone experiments to elevated CO2, temperature, precipitation and O3 to investigate effects and interactions of climate and O3 on plant stress, carbon uptake and disease vulnerability (DTU) and legume crops from Mediterranean conditions will be exposed at the field scale to combined O3 and wet N to establish dose/response relationships on effects and carbon storage (CIEMAT).
Task 10.3: Shrubland site experiments (DTU (Beier), UNICATT). Interactions between climate and air pollution will be investigated in a field scale exposure of a N. European shrubland to combined CO2 and climate change combined with campaign/mesocosm studies of elevated O3 (DTU). Also a Mediterranean macchia will be exposed to elevated O3, drought, wet N (UNICATT).
Task 10.4: Grassland site experiments. (CIEMAT (Bermejo), FDEA-ART). Data will be delivered from two grassland ecosystem experiments particularly devoted to investigate the effects of increased ozone concentrations and especially the interactions with N deposition. The two experiments represent two different climatic conditions relevant for Europe: (a) A Mediterranean grassland that will be exposed to elevated O3, N deposition, and drought (CIEMAT); (b) a high subalpine grassland that has been exposed for 7 years in the field to elevated O3 and N; the analysis of vegetation data and soil material from this experiment will be carried out during ÉCLAIRE (FDEA-ART).

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	NERC	14.00
3	DTU	26.00
15	FDEA-ART	2.00
20	UNICATT	36.00
24	CIEMAT	22.00
	Total	100.00

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D10.1	Ecosystem and plant characteristic data for model application	3	26.00	O	PP	12
D10.2	One year ecosystem response data on plant responses to experimental changes	3	30.00	O	PP	18
D10.3	Response data on ecosystem carbon balance responses to experimental changes	3	30.00	O	PP	24
		Total	86.00			

Description of deliverables

D10.1) Ecosystem and plant characteristic data for model application: [month 12]

D10.2) One year ecosystem response data on plant responses to experimental changes: [month 18]

D10.3) Response data on ecosystem carbon balance responses to experimental changes: One year response data on ecosystem carbon balance responses to experimental changes and interactions with air pollution factors [month 24]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS42	Component-kick off meeting – discussion of experimental approaches and responses	3	2	
MS43	Protocol for experimental approaches and interactions	3	3	
MS44	Protocol for response measurements	3	6	
MS45	Data- model interaction and initial model application workshop	3	20	

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS46	Data-model interaction and final model application	3	30	

WT3:
Work package description

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP11	Type of activity [54]	RTD
Work package title	Investigtion of novel ecosystem – air pollution –climate interations.		
Start month	4		
End month	34		
Lead beneficiary number [55]	9		

Objectives

The aim of this WP is to conduct studies on three novel concepts in order to establish new empirical relationships for vegetation-air pollution interactions needed to establish novel thresholds (WP12) and ecological modelling (WP13). The specific objectives are:
1. To quantify how climate change, including increasing background ozone concentration will enhance greenhouse gas and NO release and exacerbate the threat to vegetation caused by dry or wet N deposition, including the distinction between oxidized (NOy) and reduced (NHx) nitrogen forms.
2. To assess if BVOC emissions from vegetation will increase the potential for O3 and NOx uptake by plants, and detoxification of reactive oxygen species, leading to improved antioxidant properties and reduced emission of other stress-induced, reactive BVOC (e.g., LOX compounds).
3. To demonstrate if hygroscopic particles accumulating on leaves from aerosol and trace gas deposition may attract water and lead to enhanced transpiration and reduced drought tolerance.

Description of work and role of partners

Task 11.1: Peat bog experiment on N-climate-O3 interactions (NERC(EDI) (Sheppard), BFW, NERC(BAN)).
Measurements will be made at the ongoing N 'field release' experiment on the Whim ombrotrophic bog established by NERC(EDI). The effects of dry N depositin (NH3) and oxidised- and reduced -wet N deposition (NO3-, NH4+), will be assessed on cores extracted from Whim bog and exposed to either moisture and temperature regimes (BFW), or to increasing ozone regimes (NERC(BAN)). The main tasks of this activity are:
• To quantify how the changes in species composition driven by N and ozone affect the C and N cycle, in particular fluxes of CO2, VOC, CH4 and N2O, NOx and soil pore water nitrate.
• To assess induced changes on soil/litter gas fluxes (including NO, NH3,CO2, and N2O).
• To investigate changes in species physiology and soil chemistry
• To quantify the relative importance of wet and dry nitrogen deposition on peatland plant communities under climate change.
Based on 10 years treatment of the Whim Bog with different N forms, major changes in species composition have been observed (Sheppard et al., 2008), which can be expected to relate to substantial changes in peat carbon stocks, as well as to altered ozone vulnarability, especially under future climate change. Available measurements made under NitroEurope have demonstrated that greenhouse gas fluxes in response to manipulation of this site are important for each of CO2, CH4 and to a lesser extent N2O. However, these flux responses to N deposition may be expected to change substantially under climate change, as may the vulnerability to O3 damage. Intensive measurements at the manipulation site as part of ÉCLAIRE will therefore focus on soil carbon stocks and net ecosystem exchange, especially in response to altered partitioning between different forms of N deposition, which is expected to alter under future climatic conditions. In parallel, based on the long-term treatments so far conducted, the collected cores will be exposed under controlled conditions to assess the alteration of temperature and moisture senstivity of trace gas fluxes (BFW) and the alteration of ozone vulnerability (expressed in terms of dry matter production and other indicators (NERC(BAN)). The results will feed directly into the development of novel thresholds considering interactions between climate, O3 and N deposition, especially the role that altered partioning of N form may play. For BFW the soil gas exchange same system will be applied as in WP2.

Task 11.2: Physiological controls of climate change and pollutant exposure on exchange of BVOCs, NO and O3 (CNR, Loreto). As described in relation to Task 2.4, BVOC emissions have positive and negative effects

on O3 exposure and uptake. To complement work in that task, here the physiological processes that lead to O3 detoxification will be investigated, and its potential effect on increased stomatal uptake will be investigated. Exchange of BVOC, NO and O3 will be simultaneously measured in constitutively high (oaks, poplars) and low (wheat) emitters of volatile isoprenoids under changing environmental conditions (temperature, water and CO2 availability) and under episodes of air pollution (O3 +/- aerosol). Analysis of impacts of pollutants on primary and secondary metabolism (photosynthesis, water use efficiency, synthesis of defensive compounds) and measurements of actual growth and yield will be delivered:
• To investigate deposition of O3 with environmental (especially drought and temperature stress occurrence) and biological (seasonality, leaf development) changes.
• To measure and parameterize detoxification of O3 by constitutive BVOC during leaf development and with associated environmental constraints.
• To assess BVOC-modulated release of volatiles that signal hypersensitive responses (NO) and structural foliar damage (LOX) under O3, aerosol episodes.
• To deliver information on thresholds of O3 damage and O3 detoxification capacities, complementing the analysis of O3 damage vs. O3 stomatal uptake to be carried out in WP12.

Task 11.3: Effects of aerosol deposition on stomatal function (UBO, Burkhardt). A recent analysis of available evidence (Burkhardt, 2010) has highlighted how deposition of atmospheric aerosol may alter plant vulnerability to drought conditions, as a result of a ‘wicking effect’ whereby hygroscopic particles draw water out of otherwise closed stomata. Although this mechanism has not been widely understood, the effect is known to plant breeders, who use hygroscopic salts to induce drought stress as a bioassay for cultivar testing. However, the role of these processes in the natural environment remains hardly studied, and it needs to be tested whether ambient aerosol deposition may contribute significantly to altering plant drought stress. Based on demonstration of such relationships and a sound mechanistic understanding it will become possible to investigate the basis for novel thresholds of this effect.
To address these issues, unstressed potted plants (Scots pine, beech, sunflower) will be repeatedly sprayed with solutions of hygroscopic salts (NaCl, NaNO3, (NH4)2SO4), with and without tensides (substances affecting surface tension). Accumulated salt concentrations on the leaves will be determined under two different temperature/humidity regimes. Water relations will be measured using sap flow, gas exchange, total and osmotic water potential, and carbon isotope composition of leaves. Minimum epidermal conductance will be used as measure for the ‘hydraulic activation of stomata’ (HAS), which describes the degree of wicking. Leaf surfaces will be characterised using ESEM (Environmental scanning electron microscopy). Hydraulic conditions of the plants will be characterised using HPFM (High pressure flow meter). These measurements will:
• Quantify minimum epidermal conductance under different loads of particles.
• Provide estimates of transpiration increase by specified amounts of aerosols.
• Parameterise water use efficiency for model use under conditions of particle pollution.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	NERC	19.00
9	CNR	24.00
22	BOKU	7.00
29	UBO	24.00
	Total	74.00

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D11.1	Parameterization of the impact of reduced and oxidised wet and dry N deposition on GHG & NOx fluxes	9	14.00	O	PP	18
D11.2	Predictive modelling of GHG fluxes	9	12.00	R	PU	24
D11.3	Quantification and parameterization of foliar O3 deposition	9	12.00	O	PP	24
D11.4	Measurement and parameterization of the fraction of O3 that is taken by leaves due to detoxification	9	12.00	O	PP	34
D11.5	Quantification of minimum epidermal conductance under different loads of particles	9	12.00	O	PP	20
D11.6	Parameterization of water use efficiency for model use	9	12.00	O	PP	30
		Total	74.00			

Description of deliverables

D11.1) Parameterization of the impact of reduced and oxidised wet and dry N deposition on GHG & NOx fluxes: Parameterization of the impact of reduced and oxidised wet and dry N deposition on GHG and NOx fluxes, N immobilisation, natural vegetation types, species physiology, soil chemistry, and losses and allocation of C & N [month 18]

D11.2) Predictive modelling of GHG fluxes: Predictive modelling of GHG fluxes, especially CO2 under different N deposition regimes [month 24]

D11.3) Quantification and parameterization of foliar O3 deposition: Quantification and parameterization of foliar O3 deposition under progressing drought and temperature stress (Month 16) and during leaf development and seasonal metabolic changes [month 24]

D11.4) Measurement and parameterization of the fraction of O3 that is taken by leaves due to detoxification: Measurement and parameterization of the fraction of O3 that is taken up by leaves due to detoxification by constitutive BVOC, under associated environmental constraints and during leaf development [month 34]

D11.5) Quantification of minimum epidermal conductance under different loads of particles: Quantification of minimum epidermal conductance under different loads of particles (Month12) and estimation of transpiration increase by specified amounts of aerosols [month 20]

D11.6) Parameterization of water use efficiency for model use: Parameterization of water use efficiency for model use (WP13) under conditions of particle pollution [month 30]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS47	Completion of experimental set-up	9	6	

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS48	Completion of data collection on NEE, GHG, soil pore water C and N	9	12	Completion of data collection on NEE, GHG, soil pore water C and N and M3.3.3 species change
MS49	Completion of measurements of ozone uptake, water exchange, chemical analysis	9	18	Completion of measurements of ozone uptake, water exchange, chemical analysis and gas exchange
MS50	Submission of data to database for modelling purposes	9	24	
MS51	Completion of analysis of water use efficiency, water deficit, analysis of gas fluxes	9	24	Completion of analysis of water use efficiency, water deficit, analysis of gas fluxes and soil pore water chemistry and assessment of release of induced volatiles that signal hypersensitive responses
MS52	Assignment of thresholds of O3 damage and BVOC-mediated O3 detoxification capacity	9	33	Assignment of thresholds of O3 damage and BVOC-mediated O3 detoxification capacity, to be delivered for modelling refinement (WP13)

WT3:
Work package description

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP12	Type of activity [54]	RTD
Work package title	Development and assessment of novel Thresholds		
Start month	1		
End month	40		
Lead beneficiary number [55]	12		

Objectives

The aim of this WP is to use the improved DO3SE_C model (WP3) and other empirical relationships and models (including new conceptual models) to synthesise data collated from the data mining activities (WP9) and the ÉCLAIRE experimental effects studies (WP10). This data synthesis will provide an improved understanding of vegetation based processes that relate pollutant deposition and uptake to plant responses that will be used to derive new dose-response relationships from which novel thresholds can be defined and incorporated into ecosystem based modelling approaches (WP12) to aid in the assessment of regional scale impacts of air pollution (Component 5). The specific objectives are:

1. To define pollutant-response relationships relevant for ecosystem service evaluation
2. To define intermediate plant processes that relate pollutant deposition and uptake to plant responses
3. To apply the DO3SE_C model to simulate deposition and uptake for key ÉCLAIRE experimental effects studies
4. To develop and apply other necessary conceptual and quantitative modelling frameworks as a basis for investigating dose response relationships (especially relevant for the novel interactions addressed under WP11)
5. To analyse these data to develop new dose-response relationships and novel thresholds

Description of work and role of partners

Task 12.1: Definition of pollutant-response parameters relevant for ecosystem service valuation (NERC(BAN) (Evans), DTU, SEI-Y, UoY, RIVM, UGOT, IVL). Working closely with WPs9, 10 and 11, this task will specifically identify the 'ecosystem service' relevant responses to develop novel dose-response relationships and thresholds that can be specifically used for integrated risk assessment and policy analysis in Component 5. This will also involve collaboration with WP5.1 to identify data which will be suitable for informing the valuation exercises of the project. It is anticipated that further knowledge gaps may be identified that would be filled by modification of the ongoing experimental components of ÉCLAIRE conducted in WP10 and WP11.
Task 12.2: Definition of intermediate plant processes determining response to pollutant deposition and uptake (SEI-Y, UoY (Emberson), NERC(BAN), UGOT). Using data collated in WP9 and experimental data from WPs 10 and 11, this task will identify the key plant processes that mediate between pollutant deposition and uptake and the eventual 'ecosystem-relevant' responses. For example, O3 uptake may cause reductions in photosynthesis which may alter C allocation ultimately leading to the 'ecosystem relevant' response such as yield losses in agricultural crops. Understanding the 'intermediate' plant processes that determine the ultimate response will allow extrapolation of empirical data on pollutant effects (collected in WPs 9, 10 and 11) to a wider range of environmental conditions and plant traits (e.g. physiological and morphological characteristics that may modify plant sensitivity to pollution). The integration of these processes will be achieved using the improved DO3SE model (WP3) to simulate pollutant effects on important ecosystem relevant response as a function of the intermediate determining plant processes (e.g. photosynthesis, C allocation, soil-plant water balance). Other conceptual and quantitative modelling frameworks may also be necessary where the observed relationships (such as derived from the novel experiments in WP11) go beyond the bounds of the DO3SE modelling framework. For example, novel approaches may need to be developed to handle the wicking effect of particle deposition on plant water relations and the differential effects of nitrogen form (wet/dry, oxidized/reduced deposition), including the potential and consequences of foliar injury. The modelling of these process will be conducted in cooperation with consideration of the ecosystem modelling methods in WP12, with implications considered for the subsequent regioanl upscaling of relationships (WPs14, 15, 16). Wherever possible standard

methods will be used to model integral plant processes so that there is consistency between the derivation and application of dose-response relationships and the resulting novel thresholds.
Task 12.3: Apply the DO3SE_C model (and where necessary other models) to analyse ÉCLAIRE experimental effect study results (SEI-Y, UoY (Emberson), NERC(EDI), NERC(BAN), DTU, UGOT). This activity will collate and transform detailed data from the ÉCLAIRE experimental study sites together with that available from past experiments (e.g., as already collated on O3 effects by the ICP Vegetation) into the format required for DO3SE_C modelling. This will involve both collation of the input data describing environmental conditions (e.g. irradiance, temperature, VPD and soil moisture), atmospheric pollution concentration data (e.g. O3, CO2, Nr) as well as the physiological measurements (e.g. data on photosynthesis, respiration, C allocation) and the end of exposure period responses (e.g. yield loss, changes in community composition). These data will be processed using the DO3SE_C model such that pollutant deposition and uptake estimates are made (defining the pollutant 'dose') and can be related to 'interim' and 'ultimate' effects (response). The same principles will be applied should it become necessary to include other dose-response modelling frameworks.
Task 12.4: Development of new dose-response relationships and novel thresholds (SEI-Y, UoY (Emberson), NERC(BAN), UGOT, IVL, RIVM, NERC(EDI)). The dose-response data will be used to define dose-response relationships for each of the key responses investigated in these experimental studies and data mining exercises with the type of dose-response relationship being defined in terms of the application required in Component 4. Ultimately, this will lead to different 'types' of dose response relationship:
i. Interim dose-response functions that can be used in conjunction with the DOSE_C model to understand the plant based mechanistic responses to pollutants that result in the 'ultimate' ecosystem-relevant responses.
ii. Simple yet robust dose-response relationships that can be used to relate pollutant data to 'ultimate' response data relevant to inform impacts on key ecosystem services for use in regional scale mapping and modelling for emission reduction policy formulation.
It is these simple yet robust dose-response relationship that will be used to derive novel thresholds relating pollutant deposition and uptake to ecosystem effects. The thresholds will be novel for a variety of reasons: they will integrate environmental conditions that modify the sensitivity of species/communities to pollutants; they will consider the effect of pollutant combinations; they will may include new mechanisms and relationships ; and they will have been developed using methods that are consistent with the means by which they will be applied at the regional scale. The same time the thresholds will be policy relevant, since they will be targeted specifically for ecosystem-service evaluation

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	NERC	6.00
3	DTU	2.00
12	SEI-Y, UoY	11.00
14	RIVM	0.85
16	UGOT	6.00
31	IVL	1.00
	Total	26.85

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D12.1	Summary report describing key response parameters derived from empirical studies	12	6.00	R	PU	12

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D12.2	Documentation of the DO3SE_C model	12	7.00	O	PP	24
D12.3	Delivery of novel thresholds for key dose-response relationships	12	7.00	O	PP	30
D12.4	Final Report describing new dose-response relationships and novel thresholds	12	6.00	R	PU	40
		Total	26.00			

Description of deliverables

D12.1) Summary report describing key response parameters derived from empirical studies: Summary report describing key response parameters derived from empirical studies and suitable for use in the first phase of the ecosystem valuation work [month 12]

D12.2) Documentation of the DO3SE_C model: [month 24]

D12.3) Delivery of novel thresholds for key dose-response relationships: Delivery of novel thresholds for key dose-response relationships for use in regional scale modelling and mapping relevant for ecosystem service assessment [month 30]

D12.4) Final Report describing new dose-response relationships and novel thresholds: [month 40]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS53	Identification of empirical data	12	6	Identification of empirical data required for model application to derive dose-response relationships and novel thresholds
MS54	Identification of key response variables for ozone and N pollution	12	12	
MS55	Application of DOSE_C to develop dose-response relationships	12	24	

WT3:
Work package description

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP13	Type of activity [54]	RTD
Work package title	Modelling of carbon stocks, greenhouse gas and vegetation change		
Start month	1		
End month	36		
Lead beneficiary number [55]	1		

Objectives

1. To develop a model describing the combined effects of O3, other atmospheric pollutants and climate on plant CO2 uptake, net ecosystem exchange (NEE) and C sequestration in soil and vegetation, suitable for linking to existing plant-soil biogeochemistry models.
2. To develop existing dynamic vegetation models to better simulate the impacts of different air pollutants on plant growth and competition, and feedbacks on ecosystem carbon cycling.
3. To incorporate CH4 and N2O, as well as dissolved C and N losses, into biogeochemistry models for relevant ecosystems.
4. To integrate models in order to simulate the combined response of soils and vegetation to N, S and O3 exposure, diffuse radiation and climate change, suitable for application at a range of scales and for addressing a range of ecosystem impacts such as changes in C sequestration, vegetation diversity.
5. To undertake parallel testing of models with different process descriptions and levels of complexity against detailed data from experiments
6. To use the final tested models for prediction of future ecosystem responses to air pollution and climate change at a site level, and to deliver models for regional scale application in C4.

Description of work and role of partners

Task 13.1: Model development and linking (SEI-Y, UoY (Emberson); ULUND; NERC(BAN), ALTERRA, RIVM, KIT)
• The DO3SE model will be developed to predict the impact of O3 exposure, N and S deposition, diffuse radiation and climate on CO2 assimilation by different vegetation types. This task will also support the development of novel thresholds in WP12 (SEI-Y, UoY).
• The LPJ-GUESS model will be developed to simulate the interactive effects of climate, CO2, O3 and N on plant C assimilation, C sequestration, growth, mortality and BVOC emissions (ULUND)
• New and existing site-based models of air pollutant impacts on photosynthesis (DOSE), plant growth/competition (SUMO), soil biogeochemistry (VSD+, VSD-N14C) and species occurrence (MOVE, GBMOVE) will be dynamically linked, to provide integrated models of vegetation composition and diversity, soil quality, and ecosystem C balance as a function of air pollution and climate drivers. Data from WP9 will be used to help derive ecosystem-level parameter estimates for use in the models (NERC(BAN), ALTERRA, RIVM, SEI-Y, UoY)
• Process parameterisation of the DNDC-MOBILE model with regard to ecosystem GHG exchange, C sequestration, leaching losses and eutrophication will be further improved and uncertainty of key parameters will be assessed using, e.g., Bayesian calibration methods.
Task 13.2: Model testing (NERC(BAN) (Evans), ALTERRA, KIT, ULUND)
• The detailed process models developed in Task 13.1 will be parameterised and tested using consistent datasets obtained from the field manipulation experiments in WPs 10 and 11. Different model configurations and process descriptions will be tested to determine the optimal approaches and levels of complexity required to reproduce observed ecosystem responses (NERC(BAN), ALTERRA, KIT).
• A parallel set of model tests will be undertaken, based on the same data, using models developed for larger-scale application (JULES, LPJ-GUESS). This task will be used to examine trade-offs between model performance, data requirements and spatial coverage, and will inform the optimal choice of models for large-scale application in C4 (NERC(BAN), ULUND).
Task 13.3: Model application (NERC(BAN) (Evans), ALTERRA, KIT, ULUND)

• The tested site-based models will be used to forecast future changes in a range of ecosystem functions and properties (C sequestration, GHG fluxes, soil quality, species diversity) under different air pollution and climate scenarios. Models will be applied initially to the experimental sites, then to other well-characterised sites such as ICP Forests (NERC(BAN), ALTERRA, KIT, ULUND)

• Regional-scale models will be applied to the same set of sites for the same scenarios as the site-based models, using best available datasets. These predictions will be compared to the outputs of large-scale model runs for the same regions and ecosystem types in C4 (NERC(BAN), ULUND).

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	NERC	12.00
2	ULUND	5.00
4	ALTERRA	6.00
10	KIT	7.00
12	SEI-Y, UoY	9.00
14	RIVM	0.85
	Total	39.85

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D13.1	Finalised list of models for use in C3, and list of data requirements for each model	1	10.00	R	PU	6
D13.2	New version of DO3SE model	1	10.00	O	PP	18
D13.3	Report on performance of site-based and regional-scale models	1	9.00	R	PU	24
D13.4	Assessment of the effects of combined air pollution and climate change scenarios on ecosys	1	10.00	R	PU	36
		Total	39.00			

Description of deliverables

D13.1) Finalised list of models for use in C3, and list of data requirements for each model: [month 6]

D13.2) New version of DO3SE model: New version of DO3SE model to simulate the combined effects of O3, N, S, diffuse radiation and climate on plant CO2 uptake [month 18]

D13.3) Report on performance of site-based and regional-scale models: Report on performance of site-based and regional-scale models in tests against experimental site data, to inform large-scale model application in C4 [month 24]

D13.4) Assessment of the effects of combined air pollution and climate change scenarios on ecosys: Report on assessment of the effects of combined air pollution and climate change scenarios on ecosystem C/GHG balance, soil quality and vegetation change at all experimental sites, based on integrated models [month 36]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS56	Identification of priorities for model development	1	6	Identification of priorities for model development, final list of models for inclusion, and data requirements for parameterisation and testing
MS57	Collation of preliminary data from experimental sites for initial model application	1	12	
MS58	Initial application and testing of integrated models	1	18	Initial application and testing of integrated models to simulate biogeochemical and vegetation changes at C3 experimental sites
MS59	Update of experimental datasets, completed testing of site-based and regional-scale models	1	24	Update of experimental datasets, completed testing of site-based and regional-scale models at experimental sites, and provision of outputs to C4
MS60	Completion of scenario assessments of ecosystem responses to air pollution and climate change	1	36	

WT3:
Work package description

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP14	Type of activity [54]	RTD
Work package title	Air pollution-climate impacts on European carbon stocks and green house gas emissions		
Start month	1		
End month	44		
Lead beneficiary number [55]	11		

Objectives

The objectives of WP14 are:
1. To further develop dynamic global vegetation models (DGVMs) and dynamic soil vegetation models (DSVMs) by including interacting effects of nitrogen, ozone and climate on modelled ecosystem productivity
2. To link the DGVMs and DSVMs to large scale European databases on meteorology, deposition, air quality, soils and vegetation.
3. To assess the effects of combined air pollution and climate change scenarios on productivity and ecosystem C/GHG balance for forests, semi-natural and agricultural systems.

Description of work and role of partners

Task 14.1: Model improvement and linking to databases (ULUND (Arneth), NERC-WAL, JRC, MPG, ALTERRA),
Improve process descriptions and evaluate dynamic global vegetation models (DGVMs) and dynamic soil vegetation models (DSVMs), as described in Table 1.5 by applying knowledge derived from C2 model outputs, climatic parameters, soil and vegetation databases. Activities will include:
DGVMs:
• LPJ-Guess (ULUND) will be further developed with an improved process description of O3 uptake and phytotoxic effects in refining the approach by Stitch et al. (2009) and including the potential protective role of BVOCs.
• JULES (NERC-WAL) will be further developed through improving the existing leaf level O3 uptake model using observations of stomatal conductance and photosynthetic capacity available from NERC(BAN) and by linking with the existing soil N uptake and vegetation N uptake models.
• CLM (JRC) and O-CN (MPG) will be further developed through inclusion of a deposition model to estimate the total and stomatal flux of O3. The model will be based on the detailed modelling of stomatal conductance available in CLM and O-CN and will aim at quantifying the reductions in photosynthetic capacities and plant growth.
DGSMs:
• The Forspace model linked to VSD+ will be further developed by including the availability of base cations, the impact of soil pH and the effects of O3 uptake on the photosynthetic machinery, plant growth and soil carbon sequestration for non-agricultural soils. and scaling of model results to reference databases on productivity of forests (EFISCEN), crops (FAO) and grasslands (MODIS data) (ALTERRA).
• The updated version of JULES including above mentioned developments will be linked to MADOC (NERC(BAN)) to provide NPP as input for simulations of soil carbon sequestration (WP14) and plant species diversity (see WP15).

Task 14.2: Model application (JRC (Cescatti) + all WP Partners)
Application to non-agricultural ecosystems
• An ensemble model application and intercomparison will assess the long-term impacts of various scenarios of climate change, air quality change (exposure to O3, PM and CO2) and deposition of nutrients (N, S, P, base cations) on plant production/carbon sink strength and nutrient cycling of forests and semi-natural systems), using the integrated DGVMs and DSVMs (ULUND, NERC-WAL, JRC, MPG, ALTERRA, RIVM, IPBPSS).
• Results of regional-scale models that are also applied on test sites in C3 will be compared to the outputs of large-scale model runs for the same regions and ecosystem types (NERC(BAN), ULUND).

• A detailed ensemble application and intercomparison is also foreseen between ROMUL, a model which is oriented to analyzing of dynamics of C,N and BC in forest soils, and VSD+-Forspace to representative case studies from European forest areas and Russia for boreal and temperate zones (ALTERRA, IPBPSS).

Application to agricultural ecosystems
• By using DSVMs and DGVMs, the long-term impacts of various scenarios on historic and future changes (period 1900-2100) in climate, air quality (exposure to ozone and PM) and agricultural management will be assessed in terms of crop production and soil carbon sequestration at the European scale.
• Model results will be compared with independent datasets of NPP of grasslands and crop lands.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	NERC	54.00
2	ULUND	10.00
4	ALTERRA	9.00
5	IIASA	1.00
11	JRC	8.00
14	RIVM	3.00
32	MPG	12.00
33	IPBPSS	24.00
	Total	121.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D14.1	Synthesis of applicable data on impacts of ozone on photosynthesis	11	15.00	O	PP	6
D14.2	Updated versions of DGVMs and DSVMs	11	15.00	O	PP	18
D14.3	Validated and evaluated version of models (DGVMs and DSVMs) using databases on plant productivity	11	15.00	O	PP	24
D14.4	Model runs (DGVMs and DSVMS) using the ÉCLAIRE scenarios of future emissions and climate change	11	15.00	O	PP	30
D14.5	Dataset of model runs to assess the impact of combined air pollution, climate change scenarios	11	15.00	O	PP	36
D14.6	Report on the comparison of regional-scale models	11	15.00	R	PU	40
D14.7	Report on ensemble application of DGVMs and DSVMs	11	15.00	R	PU	42

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D14.8	Report on the impacts of historic and future changes (period 1900-2100) in climate, air quality	11	15.00	R	PU	44
		Total	120.00			

Description of deliverables

D14.1) Synthesis of applicable data on impacts of ozone on photosynthesis: Synthesis of applicable data on impacts of ozone on photosynthesis, stomatal conductance and plant functioning [month 6]

D14.2) Updated versions of DGVMs and DSVMs: Updated versions of DGVMs and DSVMs that include O3 uptake model and N deposition on carbon uptake [month 18]

D14.3) Validated and evaluated version of models (DGVMs and DSVMs) using databases on plant productivity: [month 24]

D14.4) Model runs (DGVMs and DSVMS) using the ÉCLAIRE scenarios of future emissions and climate change: [month 30]

D14.5) Dataset of model runs to assess the impact of combined air pollution, climate change scenarios: Ensemble dataset of model runs to assess the impact of combined air pollution and climate change scenarios on ecosystem C/GHG balance [month 36]

D14.6) Report on the comparison of regional-scale models: Report on the comparison of regional-scale models applied on test sites in C3 with large-scale model runs [month 40]

D14.7) Report on ensemble application of DGVMs and DSVMs: Report on ensemble application of DGVMs and DSVMs and intercomparison of model results on plant production/carbon sink strength in response to scenarios for the period 1900-2100 [month 42]

D14.8) Report on the impacts of historic and future changes (period 1900-2100) in climate, air quality: Report on the impacts of historic and future changes (period 1900-2100) in climate, air quality and agricultural management on crop production [month 44]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS61	Upgraded version of DGVMs and DSVMs operational	11	18	
MS62	ÉCLAIRE modelling platform linking DGVMs, DSVMs, climate and air pollution fields operational	11	24	
MS63	Database with ensemble runs of DGVM on common climate and air pollution scenarios released	11	36	Database with ensemble runs of DGVM on common climate and air pollution scenarios released, improved understanding of where models provide robust

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
				projections and where largest uncertainties lie

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP15	Type of activity [54]	RTD
Work package title	Air pollution-climate impacts on biodiversity and soil quality		
Start month	1		
End month	42		
Lead beneficiary number [55]	4		

Objectives

The objectives for this WP are
1. To further develop a plant species diversity model EUMOVE that links plant species occurrence in Europe to atmospheric deposition and climate.
2. To couple updated (see WP14) dynamic soil vegetation models (DSVM) to EUMOVE and link the coupled model to large scale European databases on meteorology, deposition, air quality, soils and vegetation.
3. To forecast future changes in soil quality and plant species diversity under different air pollution and climate scenarios (same as under WP14) for forests and semi-natural systems.

Description of work and role of partners

Task 15.1: Model inter-linkage and linking to databases (NERC(BAN)(Evans), ALTERRA, RIVM). This task will interlink the updated FORSPACE-VSD+ with EUMOVE (ALTERRA, RIVM) and the updated JULES-MADOC with EUMOVE (NERC(BAN)). Link the combined models to European databases on meteorology, deposition, air quality, soils and vegetation to predict the combined biodiversity and soil quality impacts of air pollution and climate change (in combination with task WP14).
Task 15.2: Model application (ALTERRA (De Vries), NERC(BAN), RIVM). This task will parameterize the VSD+ and MADOC model by including the novel use of a collated European dataset of radiocarbon (14C) data to constrain estimates of soil carbon turnover rates by vegetation and soil type. The work will assess the long-term impacts of climate change and nutrient deposition based on various scenarios (see WP4.1), on plant species diversity and soil quality using the integrated soil model VSD+ and multi-plant species model EUMOVE (ALTERRA, RIVM). The coupled JULES-MADOC model will be applied across Europe to predict combined air pollution and climate impacts on soil quality. The combined models will also be linked to EUMOVE to predict biodiversity impacts.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	NERC	7.00
4	ALTERRA	7.00
14	RIVM	3.00
	Total	17.00

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D15.1	The model EU MOVE	4	3.00	O	PP	24
D15.2	Collated dataset of European soil 14C data	4	4.00	O	PP	24
D15.3	The VSD+-EUMOVE and MADOC-EUMOVE models linked to European databases	4	4.00	O	PP	30
D15.4	Assessments of the effects of combined air pollution and climate change scenarios on plant species	4	2.00	O	PP	42
		Total	13.00			

Description of deliverables

D15.1) The model EU MOVE: [month 24]

D15.2) Collated dataset of European soil 14C data: Collated dataset of European soil 14C data used to define soil turnover times as a function of soil/vegetation type, for model parameterisation [month 24]

D15.3) The VSD+-EUMOVE and MADOC-EUMOVE models linked to European databases: [month 30]

D15.4) Assessments of the effects of combined air pollution and climate change scenarios on plant species: Assessments of the effects of combined air pollution and climate change scenarios on plant species diversity and soil quality and derive thresholds based on criteria for soil quality and plant species diversity [month 42]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS64	VSD+ and MADOC model developed for regional application using gridded European data	4	12	
MS65	FORSPACE-VSD+ and JULES-MADOC models coupled for prediction of air pollution	4	24	FORSPACE-VSD+ and JULES-MADOC models coupled for prediction of air pollution and climate impacts on soil quality
MS66	Parameterisation and linking of DSVMs with EUMOVE at a European scale	4	32	Parameterisation and linking of DSVMs with EUMOVE at a European scale, to support final large-scale scenario assessments of plant species and soil quality impacts (15.4)

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP16	Type of activity [54]	RTD
Work package title	European maps of novel thresholds and exceedances		
Start month	6		
End month	40		
Lead beneficiary number [55]	14		

Objectives

The aims for this WP are:
1. To map model-based climate dependent critical nitrogen thresholds, based on criteria for impacts on plant species diversity and accounting for differences in NOx and NHy, and their exceedances.
2. To map model-based critical thresholds for O3 uptake, based on criteria for impacts on productivity, and their exceedances.
3. To consider the implications of other novel thresholds to be developed by ÉCLAIRE (i.e., WP11, WP12) and where possible incorporate these effects into thresholds and dose-response relationships for consideration at the European scale.
The first two objectives reflect the core activity with an emphasise on the development of robust, climate sensitive outcomes, while the third objective represents more exploratory novel considerations, and their implications for policy relevant messages.

Description of work and role of partners

Task 16.1: Assessment of effect indicators for critical load mapping (RIVM (Posch), ALTERRA). Indicators for geo-chemical and biological endpoints and related critical limits of nitrogen and ozone will be designed to enable the mapping of critical loads on a regional scale (Task 4.3.2 and Task 4.3.3) and to allow also the comparison of adverse effects between scenarios (linkage with WPs 4.1, 4.2 and 5.2).
Task 16.2: Mapping model based critical N loads for plant protection and their exceedances, including aerosol interactions (ALTERRA (De Vries), ONU, IPBPSS, RIVM, met.no, IIASA). The mapping of N critical loads exceedances will contain the following tasks:
• Databases on soils and vegetation will be further improved with a specific emphasis on Russia (IPBPSS) and the Ukraine (ONU).
• The combined dynamic soil-vegetation model VSD+, with the dynamic multi-plant species model EUMOVE will be applied in an inverse way, to assess climate dependent critical N loads (RIVM, Alterra).
• Based on identified thresholds and experimental data, an attempt will be made to map critical thresholds for oxidized versus reduced nitrogen, representing different source activities (NH3 from agriculture versus NOx from industry/ transport) (Alterra, RIVM).
• Mapping exceedances of critical nitrogen loads by comparing present nitrogen loads based on the updated EMEP model (WP7) with updated critical nitrogen loads. (Alterra, RIVM, met.no).
• Consideration of the outcomes of novel relationships and threshold identification (WP11, 12), and assessment of the potential to map the consequences of these effects in the context of climate change (e.g. consequences of altered dry and wet partitioning, oxidized and reduced nitrogen, including the direct and indirect aerosol effects via light plant water relations and light scattering).
• The newly acquired critical thresholds will be evaluated by the GAINS model to investigate the possibility to asses critical load exceedances in the future under different air pollution and climate scenarios (same scenarios as in WPs 14 and 15; linkage with WP5.2) (IIASA).
Task 16.3: Mapping critical thresholds for ozone uptake and their exceedances (met.no (Simpson), RIVM, ALTERRA). Results of the combined EMEP chemical transport model with an updated stomatal exchange component of the DO3SE model (WP7) consist of maps of phyto-toxic ozone dose (POD) and N-deposition to generalised ecosystems (e.g. coniferous forest, semi-natural, grasslands). In WP16 the results of these model runs will be adapted (re-running the EMEP model where appropriate) to assess critical thresholds and their exceedances for important tree species and crop types. Tasks include:

• Mapping of critical ozone uptake thresholds, based on a spatial explicit assessment of tree species (using EFISCEN-space) and crop types (using CAPRI) with different ozone critical limits in view of adverse effects (ALTERRA, RIVM).
• Mapping ozone uptake for specific tree species (focusing on birch, beech, Norway spruce, Holm oak) and crop types (focusing on wheat, and tomato) and related exceedances of critical ozone uptake thresholds for those vegetations by applying the updated photosynthesis-based DO3SE approach coupled to the EMEP model developed under (WP) (7met.no and ALTERRA).
• Consideration of the consequences of novel interactions based on the results of WP11, 12, including the role of plant physiological O3/VOC interactions and how these may affect regional mapping of thresholds and exceedances in the context of climate change.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
4	ALTERRA	5.00
5	IIASA	1.00
6	met.no	3.00
14	RIVM	5.00
21	ONU	2.00
33	IPBPSS	24.00
	Total	40.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D16.1	Indicators for geo-chemical and biological endpoints	14	8.00	O	PP	12
D16.2	Map of critical ozone uptake thresholds at European scale	14	8.00	R	PU	24
D16.3	Map of critical N loads based on an inverse VSD+-EUMOVE approach at European scale	14	8.00	R	PU	34
D16.4	Map of critical N load and critical ozone uptake exceedances based on a comparison with EMEP model	14	8.00	R	PU	40
D16.5	Feedback from the GAINS model on the applicability of the newly acquired critical thresholds	14	8.00	R	PU	36
		Total	40.00			

Description of deliverables

D16.1) Indicators for geo-chemical and biological endpoints: [month 12]

D16.2) Map of critical ozone uptake thresholds at European scale: [month 24]

D16.3) Map of critical N loads based on an inverse VSD+-EUMOVE approach at European scale: [month 34]

D16.4) Map of critical N load and critical ozone uptake exceedances based on a comparison with EMEP model: Map of critical N load and critical ozone uptake exceedances based on a comparison with EMEP model results [month 40]

D16.5) Feedback from the GAINS model on the applicability of the newly acquired critical thresholds: Feedback from the GAINS model on the applicability of the newly acquired critical thresholds in scenario analysis [month 36]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS67	Indicators for geo-chemical and biological endpoints identified	14	12	Indicators for geo-chemical and biological endpoints are identified to enable the mapping of critical thresholds.
MS68	Inverse updated model approaches available	14	18	Inverse updated model approaches are available relating quantifiable indicators of well specified natural endpoints to the dose of N deposition and concentration
MS69	An updated dataset of European soil and vegetation data	14	24	An updated dataset of European soil and vegetation data is available for use in European scale model application
MS70	Analysis of exceedances of critical thresholds for N-compounds (concentrations and depositions)	14	44	Analysis of exceedances of critical thresholds for N-compounds (concentrations and depositions) and ozone uptake and their interlinkages

WT3:
Work package description

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP17	Type of activity [54]	RTD
Work package title	Local variation in threshold exceedance		
Start month	1		
End month	44		
Lead beneficiary number [55]	23		

Objectives

Mapping at a European scale with low resolution models hides a substantial amount of subgrid variation, which may have significant policy consequences. The aims for this WP are to:
1. To establish common databases containing atmospheric concentrations of reactive nitrogen compounds and nitrogen deposition data for the regional and landscape scales (from WP8)
2. To establish common databases containing current soil and vegetation data for the regional and landscape scales
3. To assess critical N thresholds and their exceedances at a range of grid resolutions from 5 x 5 km2 down to 50 x 50 m2 and evaluate the uncertainty in these values due to grid resolution, drawing on the results of modelling approaches in WP8, WP14, WP15.

Description of work and role of partners

Task 17.1: Data collection for regional and landscape scale assessments. (NERC(EDI) (Dragosits), ALTERRA). This task will further improve existing soil and vegetation databases at 5 km x 5 km, 1 km x 1 km and 50 m x 50 m in two study regions and landscapes:
ALTERRA:
☐ Study region: The Netherlands, with soil and vegetation data at 1 x 1 km and 5 x 5 km resolution.
☐ Study landscape: Noordelijke Friese Wouden (NFW), with high resolution soils and vegetation input data and measured NH3 concentrations at 60 locations for on-site verification.
NERC (EDI):
☐ Study region (central Scotland) with soil and vegetation data at 1 x 1 km2 and 5 x 5 km resolution (NERC(EDI)).
☐ Study landscape: Burnsmuir, with high resolution soils and vegetation input data. The landscape includes Deepsyke forest, Whim Bog and Auchencorth Moss as verification points (NERC(EDI)).
Task 17.2: Model application (UPM (Theobald), NERC(EDI), ALTERRA, NERC(BAN)). Assessment of critical nitrogen thresholds and their exceedances for Scotland and The Netherlands for the current period (e.g. 2010), where we consider the following scales: EMEP unified model (50 km x 50 km) (in WP4.2); EMEP4UK (includes Scotland and the Netherlands) at 5 x 5 km2; EMEP4UK zoom at 1 km x 1 km for central Scotland and the Netherlands; NitroScape model for landscape scale assessment at 50 m x 50 m (atmospheric concentration and deposition data from WP8).
For the impacts/critical loads assessment, use will be made of the GBMOVE/SUMO/MAGIC model by NERC and of the VSD+-EUMOVE model by ALTERRA.
Task 17.3: Uncertainty assessment (UPM (Theobald), NERC(EDI), ALTERRA). An assessment of the uncertainty in critical thresholds for N and their exceedances at the European scale will be carried out by comparing the modeling results at the European, regional and landscape scales (UPM, ALTERRA, NERC(EDI)).

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	NERC	5.00
4	ALTERRA	4.00

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
23	UPM	8.00
	Total	17.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D17.1	Database of soil and vegetation data for the regional and landscape domains	23	5.00	O	PP	12
D17.2	Database of ammonia concentration and nitrogen deposition data for the regional and landscape domain	23	5.00	O	PP	18
D17.3	Assessments of uncertainty of critical thresholds for N and their exceedances at the European scale	23	6.00	R	PU	44
		Total	16.00			

Description of deliverables

D17.1) Database of soil and vegetation data for the regional and landscape domains: Database of soil and vegetation data for the regional (5 x 5 km and 1 x 1 km) and landscape (~ 50 x 50 m) domains [month 12]

D17.2) Database of ammonia concentration and nitrogen deposition data for the regional and landscape domain: Database of ammonia concentration and nitrogen deposition data (from WP2.4) for the regional (5 x 5 km and 1 x 1 km) and landscape (~ 50 x 50 m) domains, where available [month 18]

D17.3) Assessments of uncertainty of critical thresholds for N and their exceedances at the European scale: Assessments of the uncertainty of critical thresholds for N and their exceedances at the European scale (50 x 50 km) due to model resolution for the present period and for simple future climate/emission/land cover scenarios [month 44]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS71	Assessment of existing soil and vegetation data resources and their availability	23	6	
MS72	All requests for external soil and vegetation data submitted (if necessary)	23	9	
MS73	Regional and landscape scale soil and vegetation databases complete	23	12	
MS74	Database of atmospheric concentrations and deposition for the present period	23	16	Database of atmospheric concentrations and

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
				deposition (from WP2.4) for the present period (e.g. 2010) at the regional and landscape scales complete
MS75	Soil/vegetation model testing complete at the regional and landscape scales	23	28	
MS76	Critical threshold and exceedance modelling complete for regional and landscape scales	23	36	
MS77	Uncertainty assessment complete and peer-review article submitted	23	40	

WT3:
Work package description

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP18	Type of activity [54]	RTD
Work package title	Deriving economic impacts and valuation of ecosystem services		
Start month	1		
End month	48		
Lead beneficiary number [55]	34		

Objectives

Recent work on valuation in terms of impacts on ecosystems defined in terms of provisioning, regulating, supporting and cultural services, provides a route by which benefits of air pollution and climate policies in Europe can be quantified. While a full economic assessment will not be achievable, those elements that can be quantified in accordance with the latest science will be evaluated. The objectives of this work package are therefore:
1. To link the concept of ecosystem services with existing mapping of European ecosystems and pollutant impacts.
2. To characterise the links between pollutant exposure, impact and value to permit quantification of pollutant damage.
3. To assess change in the value of ecosystem services across different scenarios using a marginal approach to the extent possible.
4. To prioritise gaps in the existing knowledge base such that further research can be targeted on the parameters likely to have the greatest economic impact.
The work will require extensive linkage to Components 3 and 4

Description of work and role of partners

The work towards achieving the objectives in WP18 will proceed through the following seven tasks:
Task 18.1: Review ESA for European application (EMRC (Holland), RIVM, SEI-Y, UoY, NERC(BAN)) Review applications of the ecosystem services approach (ESA) to date and consider how they may be applied in the air pollution context at a European scale.
Task 18.2: Prioritisation (NERC(BAN) (Mills), SEI-Y, UoY, EMRC) A comprehensive assessment of the effects of pollutants on ecosystem services in Europe is beyond the scope of this project. It will therefore be necessary to focus the work on areas that are important and in which it is likely that good progress can be made. The second task will therefore define a protocol for prioritising ecosystems and ecosystem services for specific investigation. Criteria may include importance of an ecosystem/service across Europe, strength of pollutant-ecosystem interaction, representativeness of ecosystem, perceived availability of data, etc., much of which will use results from Component 3 of ÉCLAIRE.
Task 18.3: Define protocols for uncertainty (EMRC (Holland), RIVM, NERC(BAN)). Define protocols for managing uncertainty, drawing on existing systems (e.g. work currently being developed under the LIFE+ EC4MACS Project). It may be appropriate in some areas to approximate data where a robust evidence base is lacking, for the purpose of demonstrating that the rest of the impact pathway can be characterised.
Task 18.4: Link ecosystem services to European ecosystems (SEI-Y, UoY (Emmerson), NERC(BAN)). Link ecosystem services to European ecosystems for the priority areas, using available information on dose-response, again linking with ÉCLAIRE Component 3. Describe associated uncertainties in a way that fits with the wider modelling of the costs and benefits of air pollution in Europe.
Task 18.5: Identify valuation data. (IVL (Karlsson), AU). Identify data appropriate for valuation of the prioritised ecosystem services, including the role of benefits transfer.
Task 18.6: Scenario analysis (EMRC (Holland), IIASA, RIVM). Calculate impacts and benefits for the scenarios of interest linking to the scenario analysis of WP19 and WP20 and following a marginal approach to the extent that this is possible.
Task 18.7: Dissemination (EMRC (Holland)). Disseminate information to stakeholders. This will provide an opportunity for 2-way discussion. For example, it will be useful to identify national research projects that are not

available in the open literature and may be of use to the project, whilst also gaining feedback on perceptions of the quality of output and the extent to which it can inform future decision making.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	NERC	0.80
5	IIASA	3.00
12	SEI-Y, UoY	2.00
14	RIVM	3.00
31	IVL	2.00
34	EMRC	8.00
35	AU	3.00
	Total	21.80

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D18.1	Report on existing applications of the ESA in Europe	34	5.00	R	PU	12
D18.2	Description of data for quantifying ecosystem effects and for valuation	34	6.00	O	PP	24
D18.3	Elaboration of the modelling approach, to include illustrative applications	34	6.00	R	PU	30
D18.4	Scenario analysis to include policy recommendations and advice to other interest groups	34	4.00	O	PP	38
		Total	21.00			

Description of deliverables

D18.1) Report on existing applications of the ESA in Europe: Report on existing applications of the ESA in Europe and prioritisation of ecosystems and ecosystem services for detailed assessment [month 12]

D18.2) Description of data for quantifying ecosystem effects and for valuation: Description of data for quantifying ecosystem effects and for valuation, including protocols for handling uncertainties [month 24]

D18.3) Elaboration of the modelling approach, to include illustrative applications: [month 30]

D18.4) Scenario analysis to include policy recommendations and advice to other interest groups: [month 38]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS78	Agreed prioritisation of ecosystems and ecosystem services (Component 5 status workshop)	34	12	
MS79	Agreed modelling framework in place	34	24	
MS80	First complete set of scenario results (part of a joint Component 5 workshop)	34	30	
MS81	Results finalized for evaluation and dissemination (part of a joint component 5 workshop)	34	42	

WT3:
Work package description

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP19	Type of activity [54]	RTD
Work package title	Integrating effects of air pollution under climate change		
Start month	1		
End month	44		
Lead beneficiary number [55]	14		

Objectives

1. To operationalize novel critical thresholds (or comparable parameters) for the GAINS assessment of adverse effects of air pollution under climate change to geo-chemistry, plant species diversity and ecosystem services
2. To provide operational indicators for the assessment of scenario specific adverse effects [for policy support]
3. To analyse the robustness, the magnitudes and location of scenario specific adverse effects under climate change on a regional and European scale

Description of work and role of partners

Task 19.1 Critical thresholds (RIVM (Hettelingh), IIASA, met.no). Implement novel modelled and empirical critical thresholds of nitrogen and flux-based critical levels of ozone within the GAINS system (Fig. 1.5).
Task 19.2 Dynamic modelling (RIVM (Hettelingh), ALTERRA). Analyse dynamics of effects until 2100: Dynamic soil and vegetation models and indicators are linked and implemented in the GAINS assessment system (see Fig. 1.5) to support the scenario analysis of air quality under climate change to meet targets for biodiversity and ecosystem services in 2050 or later in natural areas in Europe (in connection with WP16).
Task 19.3: Dose response relationships (RIVM (Hettelingh), ALTERRA). Tailor available dose-response relationships, based on empirical critical loads for nitrogen and flux-based critical levels of ozone, to requirements for a comprehensive quantification of the response of GAINS scenarios on a regional scale for natural (Natura 2000) areas in Europe.
Task 19.4: Robustness (RIVM (Hettelingh), IIASA). Use information on the magnitude and location of adverse effects as established with critical thresholds, dynamic models and dose-response relationships to assess the robustness of effect based assessments in GAINS.
Task 19.5: Workshops (RIVM (Hettelingh)). Organize workshops for the review and revision of the current GAINS impact assessment module by RIVM / the Coordination Centre for Effects (CCE) in collaboration with different ICPs (International Cooperative Programmes) and National Focal Centres under the Working Group on Effects of the LRTAP Convention.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	NERC	0.80
4	ALTERRA	2.00
5	IIASA	7.00
6	met.no	3.00
14	RIVM	4.00
	Total	16.80

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D19.1	Progress report on the implementation of effect indicators and critical thresholds in GAINS system	14	4.00	R	PU	12
D19.2	Report on the modelling system for the impacts assessment under ÉCLAIRE	14	4.00	R	PU	24
D19.3	Report on magnitude, location and robustness of assessments of adverse effects of GAINS scenarios	14	5.00	R	PU	36
D19.4	Final report on the development, implementation and scenario application of methods	14	3.00	R	PU	44
		Total	16.00			

Description of deliverables

D19.1) Progress report on the implementation of effect indicators and critical thresholds in GAINS system: Progress report on the implementation of effect indicators and critical thresholds in the GAINS modelling system [month 12]

D19.2) Report on the modelling system for the impacts assessment under ÉCLAIRE: [month 24]

D19.3) Report on magnitude, location and robustness of assessments of adverse effects of GAINS scenarios: [month 36]

D19.4) Final report on the development, implementation and scenario application of methods: Final report on the development, implementation and scenario application of methods and data to assess adverse effects [month 44]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS82	First presentation of progress to the Working Group on Effect under the UNECE Convention on LRTAP	14	9	First presentation of progress to the Working Group on Effect under the UNECE Convention on LRTAP including its International Co-operative Programmes
MS83	Second presentation of progress to the Working Group on Effect under the UNECE Convention on LRTAP	14	21	Second presentation of progress to the Working Group on Effect under the UNECE

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
				Convention on LRTAP including its International Co-operative Programmes
MS84	Third presentation of progress to the Working Group on Effect under the UNECE Convention on LRTAP	14	33	Third presentation of progress to the Working Group on Effect under the UNECE Convention on LRTAP
MS85	Final presentation of progress to the Working Group on Effect under the UNECE Convention on LRTAP	14	45	Final presentation of progress to the Working Group on Effect under the UNECE Convention on LRTAP
MS86	Effect indicators and critical thresholds	14	12	Agreed within component 5 and between other components, set of effect indicators and critical thresholds (component 5 status workshop)
MS87	First presentation to - and review by ICPC M&M	14	16	First presentation to - and review by International Coperative Programme on the Modelling and Mapping of Critical Levels and Loads, Air Pollution effects, Risks and Trends (ICP M&M)
MS88	Second presentation to - and review by ICPC M&M	14	28	Second presentation to - and review by International Coperative Programme on the Modelling and Mapping of Critical Levels and Loads, Air Pollution effects, Risks and Trends (ICP M&M)
MS89	Final presentation to - and review by ICPC M&M	14	40	Final presentation to - and review by International Coperative Programme on the Modelling and Mapping of Critical Levels and Loads, Air Pollution effects, Risks and Trends (ICP M&M)

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS90	Modeling framework in place, agreed within Component 5 and between other components (see Fig. 1.5)	14	24	
MS91	Discussion of preliminary set of scenario specific adverse effects (Component 5 workshop)	14	30	
MS92	First complete set of scenario specific adverse effects made available	14	36	
MS93	Results finalized for evaluation and dissemination (Component 5 workshop)	14	42	

WT3:
Work package description

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP20	Type of activity [54]	RTD
Work package title	Implications for mitigation and adaptation strategies		
Start month	7		
End month	48		
Lead beneficiary number [55]	5		

Objectives

1. To analyse climate scenarios and their impact on effects
2. To evaluate current strategies to minimize ecosystems effects of air pollution
3. To assess the impact of possible climate adaptation strategies on ecosystem responses

These objectives will be met based on input from Components 2 (chemistry-transport model), 3 and 4 (newly developed effect indicators and thresholds), and in close interaction with WP5.2 on GAINS implementation and WP5.1 on cost-benefit analysis.

Description of work and role of partners

Task 20.1: Interact with policy makers (IIASA (Winiwarter), NERC(EDI)). A workshop will be organized to establish the needs of environmental policy with respect to air pollution effects of climate change. Scientists working close to decision makers (stakeholders) will be invited, e.g., along the Network for Integrated Assessment Modelling (NIAM: http://www.niam.scarp.se). Close collaboration will be established as well with the Task Force on Reactive Nitrogen (TFRN), the Task Force on Measurement and Modelling (TFMM), the Task Force on Integrated Assessment Modelling (TFIAM) and the Task Force on Emission Inventories and Projections (TFEIP).
Task 20.2: Extend GAINS into more distant future years (IIASA (Winiwarter)). IIASA's GAINS model (Greenhouse gas – Air pollution INteractions and Synergies) is currently only available till 2030. This extension to 2050 will entail establishing potential abatement measures further into the future than currently available, based on the scope of the RCP emission scenarios (scenario selection guided by the "scenario team", Task 21.1). Methodological developments needed (to be implemented adjacent to GAINS) will include backcasting and strategies to cover the dynamics. Moreover, a "future beyond 2050" will aim towards the year 2100, based on the available scenario selection and following the principles as outlined above for 2050.
Task 20.3: Analyze scenarios with respect to policy options (ALTERRA (de Vries), ECN, RIVM, IIASA). Consider management changes, and their impact on emissions as well as climate scenarios in order to appropriately reflect climate adaptation strategies (in consideration of scenario-relevant recommendations from WP6.1).
Use impact functions derived from WP19, to assess cost minimized emission reduction in GAINS to achieve pre-defined reduction targets of ecosystem effects. Compare cost minimized approaches with current strategies on ecosystems protection.
Task 20.4 Cost-benefit analysis and conclusions (IIASA (Winiwarter), ECN, NERC(EDI)). Prepare results for cost-benefit analysis (with WP5.1). Provide policy recommendations and advice to the general public, in accordance with the "dissemination" task of ÉCLAIRE. Target groups include the Task Forces to the Convention on Long Range Transboundary Air Pollution as mentioned in Task 20.1, the International Cooperative Programmes named in Task 19.5, DG Environment and the European Environment Agency.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	NERC	3.00
4	ALTERRA	0.90

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
5	IIASA	18.00
8	ECN	3.00
14	RIVM	0.85
	Total	25.75

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D20.1	Report from stakeholder workshop	5	1.00	R	PU	9
D20.2	Detailed description of model integration to establish 2050 scenarios	5	4.00	R	PU	14
D20.3	Detailed description of modelling system beyond 2050	5	4.00	R	PU	19
D20.4	Description of the consequences of management change	4	4.00	R	PU	22
D20.5	Preliminary report on cost optimization for 2050 scenarios	4	4.00	R	PU	28
D20.6	Assessment of sensitivities and uncertainties of the scenarios	4	4.00	R	PU	34
D20.7	Final cost optimization scenarios for 2050 and beyond	5	3.00	R	PU	44
D20.8	Policy recommendations and advice to other interest groups	5	1.00	R	PU	48
		Total	25.00			

Description of deliverables

D20.1) Report from stakeholder workshop: [month 9]

D20.2) Detailed description of model integration to establish 2050 scenarios: [month 14]

D20.3) Detailed description of modelling system beyond 2050: [month 19]

D20.4) Description of the consequences of management change: Description of the consequences of management change as an adaptation strategy on the scenarios investigated [month 22]

D20.5) Preliminary report on cost optimization for 2050 scenarios: [month 28]

D20.6) Assessment of sensitivities and uncertainties of the scenarios: Assessment of sensitivities and uncertainties of the scenarios, considering the effects of management changes [month 34]

D20.7) Final cost optimization scenarios for 2050 and beyond: [month 44]

D20.8) Policy recommendations and advice to other interest groups: Policy recommendations and advice to other interest groups – joint report with D18.4 [month 48]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS94	Stakeholder workshop (in collaboration with NIAM, the National Integrated assessment modelling group	5	7	
MS95	Component 5 status workshop	5	12	
MS96	Setup of modelling system complete (workshop)	5	19	
MS97	First complete set of scenario results	5	30	First complete set of scenario results (2050 and beyond, cost-optimized emission abatement following the metrics as recommended by ÉCLAIRE) - Component 5 workshop
MS98	Results finalized for evaluation and dissemination (component 5 workshop)	5	42	

WT3:
Work package description

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP21	Type of activity [54]	RTD
Work package title	Standards and Data Management		
Start month	1		
End month	48		
Lead beneficiary number [55]	28		

Objectives

The overall aim of this cross-cutting component is to ensure effective integration, communication, standardization, and management of data between the different Science Components of ÉCLAIRE, with the specific objectives:
1. To facilitate the selection and harmonisation of scenarios used throughout the project
2. To develop and implement common measurement protocols across all measurement activities within the project
3. To establish, document and implement common modelling protocols to ensure reliable and transparent model results
4. To establish and implement methods for assessing uncertainties in modelling
5. To ensure data quality and implement procedures for quality control
6. To set up a Data management Committee (DMC), consisting of a Data Manager for each of the ÉCLAIRE Science Components (C1 – C5), the ÉCLAIRE web portal manager, the consultancy services of the NERC(EDI) Informatics Liaison Team, the IP secretariat.
7. To produce a Data Policy and a comprehensive, working Data Management Plan.
8. To establish two Data Centres appropriate to (i) ÉCLAIRE Components 1-3, and (ii) ÉCLAIRE Components 4-5.
9. To establish a single data portal, to harmonize and make available spatial data and model output, and to provide easy, secure upload and data access facilities for the field and laboratory measurements.

Description of work and role of partners

Task 21.1: Harmonization of Scenarios (IIASA (Winiwarter), SMHI, JRC, NERC(EDI)). A scenario team will be formed to address a harmonized use of scenarios across ÉCLAIRE. The scenario team will advise the ÉCLAIRE community (especially C2, C4 and C5) on the proper selection of scenarios. This concerns climate scenarios, scenarios of atmospheric emissions and land use / land management scenarios for the years 2030, 2050 and beyond (~2100). While ÉCLAIRE will not create its own scenarios, it will take advantage of scenario developments under the IPCC framework as much as this is publicly accessible. As research is developing rapidly in that community, ÉCLAIRE will benefit most if guidance is maintained continuously on data availability and recommended data sets rather than providing access to a static set of data. The recommendations will consider information transfer within ÉCLAIRE to make sure final results have been produced as much as possible along compatible scenario input. The “scenario reference” will serve as a reference document to describe in detail the final information flow in ÉCLAIRE regarding scenarios.
Task 21.2: Common measurement Protocols (FDEA-ART (Ammann), ULUND, ALTERRA). In close collaboration with the leaders of components C1 and C3, common protocols for the measurement activities in these components will be established. They will inform about choice of measurement methods, quality control procedures, and uncertainty specification. Taking the link with process modellers will ensure that the protocols are consistent with the data requirements for initializing, driving, and validating the models. The produced measurement protocols will be based partly on existing protocols developed and successfully applied in previous and current European projects (CarboEurope-IP, NitroEurope-IP, COST-ES0804). In collaboration with Task 21.4, the consistency of measurement protocols and data reporting procedures will be ensured.
Task 21.3: Model protocols reliability & uncertainty (UEDIN (Howard)). Harmonizing model protocols (relating to input parameters, output, model sub-model interfaces and the treatment of input and output uncertainty) will be developed for all models involved in the project, in collaboration with the relevant component leaders,

activity leaders and model developers. A short review phase (reviewing model protocols and uncertainty work from previous projects involving similar models, such as the FP6 NitroEurope IP), will be followed by a meeting to develop, discuss and document model and uncertainty protocols for the ÉCLAIRE project. Assessment of uncertainty is an integral part of all 5 components and this Task (in collaboration with Tasks 21.1, 21.2 & 21.4) will provide overall co-ordination and support of this activity. Forward propagation of input uncertainty will be assessed with the co-operation of Tasks 21.1, 21.2 & 21.4 – and standardized output (prescribed by model protocols) will allow an assessment of output uncertainty due to structural model elements at the end of years 3 and 4.

Task 21.4: Data quality & Database Management (NERC(EDI) (Owen)). The Data Management Committee (DMC) will meet twice during the first 6 months of the project, and then at regular intervals. It will be chaired by Dr Susan Owen (NERC(EDI)), with support of the IP Secretariat. The DMC will ensure that data management is consistent across the project and will compile the ÉCLAIRE Data Policy and Data Management Plan, liaising closely with the Measurement and Modelling Protocol development teams. The Database serving data centre-1 (site-based data, Components 1-3) will reside at NERC(EDI), and will be based on the user-friendly and accessible bespoke software developed for the NitroEurope Field Measurements Database. Any software enhancements necessary for ÉCLAIRE will be discussed, commissioned, tested and deployed before the first data capture at the end of year 1. The Database serving data centre-2 (regional upscaling, Components 4-5) will be hosted by JRC linked to the AFOLU database.

The hosts for the Databases will be responsible for technical aspects of the data storage, such as (i) providing storage space, (ii) providing utilities for up- and down-loading of data, routines for checking for completeness and consistency and tools for data format conversion, (iii) data safety and (iv) long-term storage. A data portal will be established to (i) provide news and information to the ÉCLAIRE community, (ii) provide a single entry site for all data, (iii) ensure that all data and model output are easily uploadable, QA checked, and accessible to the ÉCLAIRE community during the project's lifetime, and (iv) to ensure that IPR and security measures are in place for when the data are released to the public domain. It will make use of FME software to facilitate QA checks and to present a unified view of spatial and temporal datasets.

At least two Data Quality workshops will be organised with the data providers, to ensure that data uploaders are complying with requirements, and to check for problems that are not possible to detect with automatic QA checks.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	NERC	13.00
2	ULUND	8.00
4	ALTERRA	3.00
5	IIASA	3.00
11	JRC	4.00
15	FDEA-ART	1.00
26	SMHI	1.00
28	UEDIN	1.30
	Total	34.30

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D21.1	Initial scenario guide as an updatable, internal web page	5	2.00	D	PP	6
D21.2	ÉCLAIRE scenario reference	5	6.00	O	PP	42
D21.3	Agreement on common measurement protocols for components C1 and C3	15	9.00	D	PP	8
D21.4	Agreement on common modelling and uncertainty assessment protocols across components C1-5	15	0.25	O	PP	9
D21.5	First report on uncertainty in model output due to structural elements	28	0.25	O	PP	36
D21.6	Final report on uncertainty in model output due to structural elements	28	0.25	O	PP	48
D21.7	ÉCLAIRE Data Management Plan & Data Policy Documents	1	1.00	O	PP	6
D21.8	ÉCLAIRE Data Portal	1	1.00	O	PP	6
D21.9	Database training sessions for users – online tutorials	1	1.00	O	PP	8
D21.10	Database documentation and guides for users	1	1.00	R	PU	8
D21.11	First database report on intermediate content, including QA/QC report	1	3.00	R	PU	12
D21.12	Second database report on intermediate content, including QA/QC report	1	3.00	R	PU	24
D21.13	Third database report on intermediate content, including QA/QC report	1	3.00	R	PU	36
D21.14	Final database report on intermediate content, including QA/QC report	1	3.00	R	PU	48
		Total	33.75			

Description of deliverables

D21.1) Initial scenario guide as an updatable, internal web page: [month 6]

D21.2) ÉCLAIRE scenario reference: [month 42]

D21.3) Agreement on common measurement protocols for components C1 and C3: [month 8]

D21.4) Agreement on common modelling and uncertainty assessment protocols across components C1-5: [month 9]

D21.5) First report on uncertainty in model output due to structural elements: [month 36]

D21.6) Final report on uncertainty in model output due to structural elements: [month 48]

D21.7) ÉCLAIRE Data Management Plan & Data Policy Documents: [month 6]

D21.8) ÉCLAIRE Data Portal: [month 6]

D21.9) Database training sessions for users – online tutorials: [month 8]

D21.10) Database documentation and guides for users: [month 8]

D21.11) First database report on intermediate content, including QA/QC report: [month 12]

D21.12) Second database report on intermediate content, including QA/QC report: [month 24]

D21.13) Third database report on intermediate content, including QA/QC report: [month 36]

D21.14) Final database report on intermediate content, including QA/QC report: [month 48]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS99	Information exchange between internal users and scenario team established	5	12	
MS100	Common measurement protocols for C1 and C3 agreed and distributed	15	8	
MS101	Modelling and uncertainty assessment protocols written and distributed	28	9	
MS102	First report on uncertainty in model output due to structural elements	28	36	
MS103	Final report on uncertainty in model output due to structural elements	28	48	
MS104	DP and DMP first drafts written and agreed by DMC	1	6	
MS105	ÉCLAIRE data portal online with user registration	1	6	
MS106	Database software ready to accept data	1	12	Database software ready to accept data for all components, documentation and guides complete and posted on the portal
MS107	Data uploaded and QA checked for months 1-18	1	24	
MS108	Data uploaded and QA checked for months 19-36	1	40	
MS109	Final data uploaded, final reports	1	48	

WT3:
Work package description

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP22	Type of activity [54]	MGT
Work package title	Coordination & Management		
Start month	1		
End month	48		
Lead beneficiary number [55]	1		

Objectives

1. To establish and operate the ÉCLAIRE project office
2. To provide scientific coordination of the project
3. To provide financial and administrative coordination of the project
4. To facilitate and ensure comprehensive, complete and timely reporting to the EC
5. To facilitate and organise an annual report for policymakers on progress with the 'Objectives, Key Questions and Specific Questions' of the project
6. To organise the General Assembly and other project meetings
7. To support the Executive Steering Committee and the Scientific Advisory Board
8. To oversee the appointment of a Gender Action Committee and its associated activities

Description of work and role of partners

Task 22.1: Scientific project co-ordination and management (NERC(EDI) (Sutton)). The scientific co-ordination of ÉCLAIRE will be provided by partner 1 (NERC) with Dr. Mark Sutton acting as co-ordinator, supported by a scientific project manager (Dr. Clare Howard) and a finance officer, forming the Project Office.
The scientific project manager will be responsible for the day-to-day operations of ÉCLAIRE, facilitating the communication and integration between science components and activities and supports the project bodies, namely the Executive Steering Committee, the General Assembly and the Scientific Advisory Board. The scientific project manager will be responsible for collating and editing the periodic scientific reports to the EC, the 'Annual Progress Reports' and facilitate synthesis and integration activities across the consortium, including organizing 'policy days' in association with other general meetings.
Task 22.2: Project administration and financial management (NERC(EDI) (Sutton)). The project office serves as the main hub for all communication between project partners and between ÉCLAIRE and the European Commission. It will work in close cooperation with the co-ordinator and the finance officer will be responsible for the collation of management and financial reports and work with project partners on delivering timely, correct and complete annual management reports to the European Commission.
In addition to the reporting tasks, the project office is responsible for the planning and organisation of the annual project meetings and supports the WPs on Training and Dissemination & Networking in budgeting and finance.
Task 22.3 Gender Action Plan activities (NERC(EDI) (Sutton)). A Gender Action Plan will be established for ECLAIRE, to defend gender equality and to facilitate the role of female scientists in ÉCLAIRE. This will be facilitated and overseen by the project office, through four sub-activities –the creation of a Project Gender Group, a Forum on gender issues on the project website, facilitated recruitment of female researchers and the provision of a 'Periodic Gender Action report' (see section B5 of the Description of Work for further information on all these activities). Please note that after the 'Project Gender Committee' is established they will work autonomously on their activities – reporting and liaising with the Project Office and ESG as necessary.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	NERC	52.00
28	UEDIN	24.00

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
	Total	76.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D22.1	Annual progress report year 1	1	1.00	R	PU	13
D22.2	Annual progress report year 2	1	1.00	R	PU	25
D22.3	Annual progress report year 3	1	1.00	R	PU	37
D22.4	Annual progress report year 4	1	1.00	R	PU	48
D22.5	First periodic Gender Action Report	1	0.25	R	PU	19
D22.6	Second periodic Gender Action Report	1	0.25	R	PU	37
D22.7	Final periodic Gender Action Report	1	0.25	R	PU	48
		Total	4.75			

Description of deliverables

D22.1) Annual progress report year 1: The Annual progress reports of year I, 2, 3 and 4 will cover in a synthetic way the progress of the project towards meeting its Overall and specific Objectives as described in the concept and objectives section. The answers to the key questions identified and the progress towards achieving the proposed advances beyond the state of the art should be clearly detailed in every annual report. Every annual report should include a short policy briefing. (For the intermediate reports, the gradual progress should be shown). [month 13]

D22.2) Annual progress report year 2: The Annual progress reports of year I, 2, 3 and 4 will cover in a synthetic way the progress of the project towards meeting its Overall and specific Objectives as described in the concept and objectives section. The answers to the key questions identified and the progress towards achieving the proposed advances beyond the state of the art should be clearly detailed in every annual report. Every annual report should include a short policy briefing. (For the intermediate reports, the gradual progress should be shown). [month 25]

D22.3) Annual progress report year 3: The Annual progress reports of year I, 2, 3 and 4 will cover in a synthetic way the progress of the project towards meeting its Overall and specific Objectives as described in the concept and objectives section. The answers to the key questions identified and the progress towards achieving the proposed advances beyond the state of the art should be clearly detailed in every annual report. Every annual report should include a short policy briefing. (For the intermediate reports, the gradual progress should be shown). [month 37]

D22.4) Annual progress report year 4: The Annual progress reports of year I, 2, 3 and 4 will cover in a synthetic way the progress of the project towards meeting its Overall and specific Objectives as described in the concept and objectives section. The answers to the key questions identified and the progress towards achieving the proposed advances beyond the state of the art should be clearly detailed in every annual report. Every annual report should include a short policy briefing. (For the intermediate reports, the gradual progress should be shown). [month 48]

D22.5) First periodic Gender Action Report: [month 19]

D22.6) Second periodic Gender Action Report: [month 37]

D22.7) Final periodic Gender Action Report: [month 48]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS110	Project office established and operational	1	1	
MS111	1st periodic project meeting held	1	18	
MS112	2nd periodic project meeting held	1	36	
MS113	Final periodic project meeting held	1	48	
MS114	Gender Action Group established	1	3	
MS115	First periodicGender Action Report	1	19	
MS116	Second periodic Gender Action Reports	1	37	
MS117	Final periodic Gender Action Report	1	48	

WT3:
Work package description

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP23	Type of activity [54]	OTHER
Work package title	Training		
Start month	1		
End month	48		
Lead beneficiary number [55]	23		

Objectives

This work package coordinates training activities across the ÉCLAIRE. Its objectives are to
1. To organise specialised training events for postgraduate students and young scientists with the aim to train participants in advanced measurement techniques and modelling methodologies,
2. To develop a plan for and organise, run and evaluate a summer school for young scientists from within ÉCLAIRE and related projects around the topic of air pollution effects on ecosystems under climate change conditions.
Most of the budget of this Work Package is reserved for travel and subsistence to support young scientist training activities, including attendence from outside the ÉCLAIRE consortium. A reserve budget is also included to be able to respond to developments during the life of the project. The seed activities listed here will be conducted in the context of other training instruments (e.g. Marie Curie, COST 0804, European Science Foundation) in order to maximize synergies and overall effectiveness.

Description of work and role of partners

Task 23.1: Co-ordination of ÉCLAIRE training activities (UPM (Theobald), UEDIN, NERC(EDI)). Task leader UPM (Mark Theobald) has been involved in the training activities and the Young Scientists Forum of the NitroEurope integrated project and the organisation of science-communication workshops in that context. For ÉCLAIRE, a training plan will be developed in the early stage of the project, including a survey of Ph.D. students and other young scientists in the project (D8.1). This training plan will be reported to the Executive Steering Committee for adoption. The implementation and monitoring of training activities, including communication with other related projects and networks (e.g. Marie Curie, FP7 PEGASOS, ESF, COST etc.) to identify opportunities for joint activities, will be the core aspect of this task. It will deliver an annual status report to the General Assembly and for inclusion in the management reports to the European Commission.
Task 23.2: Organisation of Summer Schools and dedicated workshops (UPM (Theobald), UEDIN, NERC(EDI)). Based on the training plan completed in Task 23.1, a concept for a summer school to be held in year 2 will be developed and reported to the Executive Steering Committee and the General Assembly after the first year of ÉCLAIRE (D23.3). The topics and layout of this summer school will be informed by the specific needs of the young scientists within ÉCLAIRE, and the early stage findings of the project, specifically regarding measurements and manipulation experiments, as well as deriving new model parameters. The concept will comprise the plan for the summer school as such, training objectives and outline materials and experiences from NitroEurope IP or ALTER-Net summer schools will be drawn upon to ensure an effective and useful event for participants and the project alike.
The summer school will be organised in year 2 for approximately 25 participants, with funding provided by ÉCLAIRE for travel and subsistence costs for participants and tutors from the project consortium. An evaluation report will be compiled after the event in order to assess the achievement of training objectives, including questionnaire feedback from participants (D23.4).

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	NERC	1.00

WT3:
Work package description

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
12	SEI-Y, UoY	0.20
22	BOKU	0.20
23	UPM	2.00
28	UEDIN	1.30
	Total	4.70

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D23.1	ÉCLAIRE Training plan	23	0.50	O	PP	6
D23.2	First periodic report on training activities	23	0.50	R	PU	19
D23.3	Second periodic report on training	23	1.00	R	PU	37
D23.4	Final periodic report on training	23	1.00	R	PU	48
D23.5	Concept for an ÉCLAIRE Summer School in year 2	23	1.00	O	PP	12
D23.6	Report on ÉCLAIRE Summer School	23	0.50	R	PU	22
		Total	4.50			

Description of deliverables

D23.1) ÉCLAIRE Training plan: [month 6]

D23.2) First periodic report on training activities: [month 19]

D23.3) Second periodic report on training: [month 37]

D23.4) Final periodic report on training: [month 48]

D23.5) Concept for an ÉCLAIRE Summer School in year 2: [month 12]

D23.6) Report on ÉCLAIRE Summer School: [month 22]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS118	ÉCLAIRE Training plan adopted	23	7	
MS119	Concept for an ÉCLAIRE Summer School in year 2 adopted for implementation	23	13	
MS120	ÉCLAIRE Summer School held and evaluated	23	24	

WT3:
Work package description

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

One form per Work Package

Work package number [53]	WP24	Type of activity [54]	OTHER
Work package title	Networking & Dissemination		
Start month	1		
End month	48		
Lead beneficiary number [55]	1		

Objectives

1. To coordinate networking activities with other projects and international bodies
2. To facilitate dissemination activities across the project
3. To develop and maintain a project web portal for project internal and external communication

Description of work and role of partners

Task 24.1: Networking (NERC(EDI) (Sutton), ULUND, DTU, Alterra, IIASA). Research conducted within ÉCLAIRE and expected results are of relevance for a wide range of scientific and policy activities. It is essential for the project to be closely linked to other research projects conducting complementary research (e.g. PEGASOS, ACTRIS) and to working groups and other international bodies to ensure a seamless communication of ÉCLAIRE results. This task will establish links e.g. to activities under the UNECE Convention on Long-Range Transboundary Air Pollution (CLRTAP) such as the Task Force on Measurement and Modelling, the Task Force on Reactive Nitrogen, the Task Force on Integrated Assessment Modelling, the Joint Expert Group on Dynamic Modelling, ICP Mapping and Modelling, ICP Forests, ICP Vegetation and others.
Task 24.2: Dissemination (NERC(EDI) (Sutton), ULUND, DTU, Alterra, IIASA). Effective and proactive dissemination of project results are a key requirement to ensure that underpinning scientific evidence is available as a basis for informed policy decision making. Within this task, a sophisticated web portal will be established by the start of the project to act as a central information hub for both project internal information and communication with a wider community of stakeholders and parties interested in the projects' results. Further to that, a dissemination and communication concept will be developed and implemented which will ensure the effective dissemination of project results. This concept will be developed in close cooperation with the Executive Steering Committee and the Scientific Advisory Board and reported to the General Assembly. This concept will include outline plans for the publication of special issues and project brochures and other outreach activities.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	NERC	1.00
2	ULUND	5.00
3	DTU	0.50
4	ALTERRA	0.33
5	IIASA	0.50
	Total	7.33

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D24.1	A project web portal for internal and external project communication	1	1.00	O	PP	1
D24.2	First dissemination & communication plan	1	1.00	O	PP	18
D24.3	Second dissemination & communication plan	1	0.20	O	PP	36
D24.4	Final dissemination & communication plan	1	1.00	O	PP	48
D24.5	First report to the General Assembly on networking activities	1	1.00	R	PU	18
D24.6	Second report to the General Assembly on networking activities	1	1.00	R	PU	36
D24.7	Final report to the General Assembly on networking activities	1	1.00	R	PU	48
		Total	6.20			

Description of deliverables

D24.1) A project web portal for internal and external project communication: [month 1]

D24.2) First dissemination & communication plan: [month 18]

D24.3) Second dissemination & communication plan: [month 36]

D24.4) Final dissemination & communication plan: [month 48]

D24.5) First report to the General Assembly on networking activities: [month 18]

D24.6) Second report to the General Assembly on networking activities: [month 36]

D24.7) Final report to the General Assembly on networking activities: [month 48]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS121	ÉCLAIRE web portal launched	1	1	
MS122	Established links with relevant research projects	1	3	
MS123	Established links with relevant policy bodies	1	3	
MS124	Dissemination & communication plan published	1	12	

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

List and Schedule of Milestones

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS1	First 6 months data from flux network in database	WP1	1	18	
MS2	Final 9 months data from flux network in database	WP1	1	24	
MS3	Data from 1st synchronised campaign in database	WP1	1	20	
MS4	Data from 2nd synchronised campaign in database	WP1	1	24	
MS5	Data from integrated forest campaign in database	WP1	1	16	
MS6	Data on soil and litter emissions under changing climate conditions in database	WP2	22	44	
MS7	Description of drying-re-wetting effects on soil NO emissions	WP2	10	24	Improved description of drying-re-wetting effects on soil NO emissions for different soil types, management and climate zones handed available for inclusion in models
MS8	BVOC exchange rates under simulated combined climate change and pollution available to modellers	WP2	9	24	
MS9	O3 balance data for Mediterranean and Boreal forest species for input in models	WP2	7	29	
MS10	O3 balance for Mediterranean and Boreal forest species	WP2	7	45	O3 balance for Mediterranean and Boreal forest species considering heat and drought stress for input in models

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS11	Workshop for summarizing state of the art of the different models	WP3	10	6	Workshop for summarizing state of the art of the different models/ modules and to outline in detail the upcoming developing work and strategies for model uncertainty assessment (joined with WP4)
MS12	Summary report	WP3	13	24	Summary report on site applications of improved NH3/NO and VOC models, including uncertainty assessment and comparison with original approaches
MS13	Provision of site based estimates of NH3/NO and VOC	WP3	10	44	Provision of site based estimates of NH3/NO and VOC exchange for ÉCLAIRE core sites for present and future environmental conditions
MS14	Measurement network established for monthly Nr concentrations at the ÉCLAIRE effect study sites.	WP4	13	12	Measurement network established for monthly Nr concentrations at the ÉCLAIRE effect study sites. Start of monitoring for years 2 and 3
MS15	Literature review	WP4	18	12	Literature review completed on the effects of O3 and Nr deposition on stomatal functioning and on the influence of surface wetness on total O3 deposition
MS16	New ÉCLAIRE experimental datasets	WP4	12	18	New ÉCLAIRE experimental datasets used to develop dose-response functions in collaboration with WPs3 & 12
MS17	Improved representation of the influence of environmental drivers	WP4	12	24	Improved representation of the influence of environmental drivers on stomatal conductance and the partitioning between stomatal and non-stomatal deposition of O3 and their incorporation in EMEP model
MS18	Incorporation of results from flux	WP4	13	24	Incorporation of results from flux monitoring data

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
	monitoring data generated within ÉCLAIRE into modelling framework				generated within ÉCLAIRE into process modelling framework
MS19	Calibration of model parameterisation completed	WP4	13	30	Preliminary estimates of Nr and O3 fluxes at the effects study sites inferred from monitored concentrations
MS20	Estimates of Nr and O3 fluxes at the effects study sites inferred from monitored concent	WP4	13	30	
MS21	Comparison of inferential model estimates with EMEP model results	WP4	13	33	
MS22	Provision of site based estimates of NH3/NO and VOC exchange for ÉCLAIRE core sites	WP4	13	44	Provision of site based estimates of NH3/NO and VOC exchange for ÉCLAIRE core sites for present and future environmental conditions
MS23	Evaluation of AR5 and other simulations with climate and chemistry global models	WP5	11	18	
MS24	Future simulations with improved biogenic and soil emissions	WP5	11	24	
MS25	WP meeting and decision on emission-model experimental protocol	WP6	2	8	WP meeting and decision on emission-model experimental protocol, including spatial and temporal profiles (in coordination with the other C2 WPs)
MS26	First improved emission estimates, based on model development	WP6	2	24	
MS27	Improved emission estimates, evaluated against ÉCLAIRE results	WP6	2	30	Improved emission estimates, documented to other groups in ÉCLAIRE, evaluation against ÉCLAIRE results

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS28	Implementation and initial testing of coupled model system	WP7	6	24	Implementation and initial testing of coupled model system: EMEP with C1 (preliminary) DO3SE and canopy-chemistry models, combined with WP2.1 boundary conditions and WP2.2 emissions and landcover chan
MS29	Initial ensemble runs for current conditions	WP7	6	18	
MS30	Incorporation of sub-grid methodology from WP2.4 into EMEP model	WP7	6	30	
MS31	Future scenario data-sets ready	WP7	6	30	
MS32	“Final” model-system ready. Commencement of source-receptor calculations	WP7	6	36	
MS33	Inventory of relevant local scale models	WP8	8	10	
MS34	Report on local scale models inventory	WP8	8	12	
MS35	Update of NitroScape to reflect ÉCLAIRE needs	WP8	8	16	
MS36	Concentration/ Deposition maps	WP8	8	16	Concentration/Deposition maps (e.g. NH3 on 5 km x 5 km, 1 km x 1 km, up to 50 m x 50 m resolution) available for further use in ÉCLAIRE (e.g. WP4.4)
MS37	Description of local scale interactions between air quality and climate change	WP8	8	30	Description of local scale interactions between air quality and climate change, based on e.g. NitroScape / EMEP4UK
MS38	Sub-grid module available for implementation in EMEP model	WP8	8	40	
MS39	Compilation of data from published	WP9	1	12	

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
	papers and list of knowledge gaps				
MS40	Completion of data compilation	WP9	1	18	
MS41	Completion of meta-analysis and handing over of data for use in WP12 and 13	WP9	1	24	
MS42	Component-kick off meeting – discussion of experimental approaches and responses	WP10	3	2	
MS43	Protocol for experimental approaches and interactions	WP10	3	3	
MS44	Protocol for response measurements	WP10	3	6	
MS45	Data- model interaction and initial model application workshop	WP10	3	20	
MS46	Data-model interaction and final model application	WP10	3	30	
MS47	Completion of experimental set-up	WP11	9	6	
MS48	Completion of data collection on NEE, GHG, soil pore water C and N	WP11	9	12	Completion of data collection on NEE, GHG, soil pore water C and N and M3.3.3 species change
MS49	Completion of measurements of ozone uptake, water exchange, chemical analysis	WP11	9	18	Completion of measurements of ozone uptake, water exchange, chemical analysis and gas exchange
MS50	Submission of data to database for modelling purposes	WP11	9	24	
MS51	Completion of analysis of water use efficiency, water deficit, analysis of gas fluxes	WP11	9	24	Completion of analysis of water use efficiency, water deficit, analysis of gas fluxes and soil pore water chemistry and

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
					assessment of release of induced volatiles that signal hypersensitive responses
MS52	Assignment of thresholds of O3 damage and BVOC-mediated O3 detoxification capacity	WP11	9	33	Assignment of thresholds of O3 damage and BVOC-mediated O3 detoxification capacity, to be delivered for modelling refinement (WP13)
MS53	Identification of empirical data	WP12	12	6	Identification of empirical data required for model application to derive dose-response relationships and novel thresholds
MS54	Identification of key response variables for ozone and N pollution	WP12	12	12	
MS55	Application of DOSE_C to develop dose-response relationships	WP12	12	24	
MS56	Identification of priorities for model development	WP13	1	6	Identification of priorities for model development, final list of models for inclusion, and data requirements for parameterisation and testing
MS57	Collation of preliminary data from experimental sites for initial model application	WP13	1	12	
MS58	Initial application and testing of integrated models	WP13	1	18	Initial application and testing of integrated models to simulate biogeochemical and vegetation changes at C3 experimental sites
MS59	Update of experimental datasets, completed testing of site-based and regional-scale models	WP13	1	24	Update of experimental datasets, completed testing of site-based and regional-scale models at experimental sites, and provision of outputs to C4
MS60	Completion of scenario	WP13	1	36	

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
	assessments of ecosystem responses to air pollution and climate change				
MS61	Upgraded version of DGVMs and DSVMs operational	WP14	11	18	
MS62	ÉCLAIRE modelling platform linking DGVMs, DSVMs, climate and air pollution fields operational	WP14	11	24	
MS63	Database with ensemble runs of DGVM on common climate and air pollution scenarios released	WP14	11	36	Database with ensemble runs of DGVM on common climate and air pollution scenarios released, improved understanding of where models provide robust projections and where largest uncertainties lie
MS64	VSD+ and MADOC model developed for regional application using gridded European data	WP15	4	12	
MS65	FORSPACE-VSD+ and JULES-MADOC models coupled for prediction of air pollution	WP15	4	24	FORSPACE-VSD+ and JULES-MADOC models coupled for prediction of air pollution and climate impacts on soil quality
MS66	Parameterisation and linking of DSVMs with EUMOVE at a European scale	WP15	4	32	Parameterisation and linking of DSVMs with EUMOVE at a European scale, to support final large-scale scenario assessments of plant species and soil quality impacts (15.4)
MS67	Indicators for geo-chemical and biological endpoints identified	WP16	14	12	Indicators for geo-chemical and biological endpoints are identified to enable the mapping of critical thresholds.
MS68	Inverse updated model approaches available	WP16	14	18	Inverse updated model approaches are available relating quantifiable indicators of well specified

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
					natural endpoints to the dose of N deposition and concentration
MS69	An updated dataset of European soil and vegetation data	WP16	14	24	An updated dataset of European soil and vegetation data is available for use in European scale model application
MS70	Analysis of exceedances of critical thresholds for N-compounds (concentrations and depositions)	WP16	14	44	Analysis of exceedances of critical thresholds for N-compounds (concentrations and depositions) and ozone uptake and their interlinkages
MS71	Assessment of existing soil and vegetation data resources and their availability	WP17	23	6	
MS72	All requests for external soil and vegetation data submitted (if necessary)	WP17	23	9	
MS73	Regional and landscape scale soil and vegetation databases complete	WP17	23	12	
MS74	Database of atmospheric concentrations and deposition for the present period	WP17	23	16	Database of atmospheric concentrations and deposition (from WP2.4) for the present period (e.g. 2010) at the regional and landscape scales complete
MS75	Soil/vegetation model testing complete at the regional and landscape scales	WP17	23	28	
MS76	Critical threshold and exceedance modelling complete for regional and landscape scales	WP17	23	36	
MS77	Uncertainty assessment complete and	WP17	23	40	

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
	peer-review article submitted				
MS78	Agreed prioritisation of ecosystems and ecosystem services (Component 5 status workshop)	WP18	34	12	
MS79	Agreed modelling framework in place	WP18	34	24	
MS80	First complete set of scenario results (part of a joint Component 5 workshop)	WP18	34	30	
MS81	Results finalized for evaluation and dissemination (part of a joint component 5 workshop)	WP18	34	42	
MS82	First presentation of progress to the Working Group on Effect under the UNECE Convention on LRTAP	WP19	14	9	First presentation of progress to the Working Group on Effect under the UNECE Convention on LRTAP including its International Co-operative Programmes
MS83	Second presentation of progress to the Working Group on Effect under the UNECE Convention on LRTAP	WP19	14	21	Second presentation of progress to the Working Group on Effect under the UNECE Convention on LRTAP including its International Co-operative Programmes
MS84	Third presentation of progress to the Working Group on Effect under the UNECE Convention on LRTAP	WP19	14	33	Third presentation of progress to the Working Group on Effect under the UNECE Convention on LRTAP
MS85	Final presentation of progress to the Working Group on Effect under the UNECE Convention on LRTAP	WP19	14	45	Final presentation of progress to the Working Group on Effect under the UNECE Convention on LRTAP
MS86	Effect indicators and critical thresholds	WP19	14	12	Agreed within component 5 and between other components, set of effect indicators and critical thresholds (component 5 status workshop)

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS87	First presentation to - and review by ICPC M&M	WP19	14	16	First presentation to - and review by International Coperative Programme on the Modelling and Mapping of Critical Levels and Loads, Air Pollution effects, Risks and Trends (ICP M&M)
MS88	Second presentation to - and review by ICPC M&M	WP19	14	28	Second presentation to - and review by International Coperative Programme on the Modelling and Mapping of Critical Levels and Loads, Air Pollution effects, Risks and Trends (ICP M&M)
MS89	Final presentation to - and review by ICPC M&M	WP19	14	40	Final presentation to - and review by International Coperative Programme on the Modelling and Mapping of Critical Levels and Loads, Air Pollution effects, Risks and Trends (ICP M&M)
MS90	Modeling framework in place, agreed within Component 5 and between other components (see Fig. 1.5)	WP19	14	24	
MS91	Discussion of preliminary set of scenario specific adverse effects (Component 5 workshop)	WP19	14	30	
MS92	First complete set of scenario specific adverse effects made available	WP19	14	36	
MS93	Results finalized for evaluation and dissemination (Component 5 workshop)	WP19	14	42	
MS94	Stakeholder workshop (in collaboration with NIAM, the National Integrated	WP20	5	7	

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
	assessment modelling group				
MS95	Component 5 status workshop	WP20	5	12	
MS96	Setup of modelling system complete (workshop)	WP20	5	19	
MS97	First complete set of scenario results	WP20	5	30	First complete set of scenario results (2050 and beyond, cost-optimized emission abatement following the metrics as recommended by ÉCLAIRE) - Component 5 workshop
MS98	Results finalized for evaluation and dissemination (component 5 workshop)	WP20	5	42	
MS99	Information exchange between internal users and scenario team established	WP21	5	12	
MS100	Common measurement protocols for C1 and C3 agreed and distributed	WP21	15	8	
MS101	Modelling and uncertainty assessment protocols written and distributed	WP21	28	9	
MS102	First report on uncertainty in model output due to structural elements	WP21	28	36	
MS103	Final report on uncertainty in model output due to structural elements	WP21	28	48	
MS104	DP and DMP first drafts written and agreed by DMC	WP21	1	6	
MS105	ÉCLAIRE data portal online with user registration	WP21	1	6	

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS106	Database software ready to accept data	WP21	1	12	Database software ready to accept data for all components, documentation and guides complete and posted on the portal
MS107	Data uploaded and QA checked for months 1-18	WP21	1	24	
MS108	Data uploaded and QA checked for months 19-36	WP21	1	40	
MS109	Final data uploaded, final reports	WP21	1	48	
MS110	Project office established and operational	WP22	1	1	
MS111	1st periodic project meeting held	WP22	1	18	
MS112	2nd periodic project meeting held	WP22	1	36	
MS113	Final periodic project meeting held	WP22	1	48	
MS114	Gender Action Group established	WP22	1	3	
MS115	First periodicGender Action Report	WP22	1	19	
MS116	Second periodic Gender Action Reports	WP22	1	37	
MS117	Final periodic Gender Action Report	WP22	1	48	
MS118	ÉCLAIRE Training plan adopted	WP23	23	7	
MS119	Concept for an ÉCLAIRE Summer School in year 2 adopted for implementation	WP23	23	13	
MS120	ÉCLAIRE Summer School held and evaluated	WP23	23	24	
MS121	ÉCLAIRE web portal launched	WP24	1	1	

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS122	Established links with relevant research projects	WP24	1	3	
MS123	Established links with relevant policy bodies	WP24	1	3	
MS124	Dissemination & communication plan published	WP24	1	12	

WT5:
Tentative schedule of Project Reviews

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

Tentative schedule of Project Reviews

Review number [65]	Tentative timing	Planned venue of review	Comments, if any
RV 1	18	To be confirmed	
RV 2	36	To be confirmed	
RV 3	48	To be confirmed	

WT6:
Project Effort by Beneficiary and Work Package

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

Indicative efforts (man-months) per Beneficiary per Work Package

Beneficiary number and short-name	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8	WP 9	WP 10	WP 11	WP 12	WP 13	WP 14	WP 15	WP 16	WP 17	WP 18	WP 19
1 - NERC	24.00	1.00	2.00	4.00	0.00	1.50	0.00	7.00	7.00	14.00	19.00	6.00	12.00	54.00	7.00	0.00	5.00	0.80	0.80
2 - ULUND	0.00	0.00	3.00	0.00	4.00	7.00	9.00	0.00	0.00	0.00	0.00	0.00	5.00	10.00	0.00	0.00	0.00	0.00	0.00
3 - DTU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	26.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 - ALTERRA	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	1.90	0.00	0.00	0.00	6.00	9.00	7.00	5.00	4.00	0.00	2.00
5 - IIASA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	3.00	7.00
6 - met.no	0.00	0.00	0.00	1.00	1.00	0.00	17.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	3.00
7 - Juelich	1.00	11.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8 - ECN	10.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9 - CNR	2.00	18.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10 - KIT	1.00	1.00	9.00	0.00	0.00	3.00	0.00	2.00	0.00	0.00	0.00	0.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00
11 - JRC	12.00	0.00	0.00	0.00	7.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00	0.00	0.00	0.00
12 - SEI-Y, UoY	0.00	0.00	0.00	6.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	11.00	9.00	0.00	0.00	0.00	0.00	2.00	0.00
13 - INRA	49.00	0.00	11.00	27.00	0.00	0.00	0.00	21.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14 - RIVM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	0.85	3.00	3.00	5.00	0.00	3.00	4.00
15 - FDEA-ART	36.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16 - UGOT	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17 - ERTI - FRI	30.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18 - FMI	5.00	0.00	0.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19 - UHEL	13.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

WT6:
Project Effort by Beneficiary and Work Package

Beneficiary number and short-name	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8	WP 9	WP 10	WP 11	WP 12	WP 13	WP 14	WP 15	WP 16	WP 17	WP 18	WP 19
20 - UNICATT	22.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21 - ONU	18.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00
22 - BOKU	0.00	24.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23 - UPM	6.00	0.00	4.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00
24 - CIEMAT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25 - CNRS	0.00	0.00	0.00	0.00	16.00	5.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26 - SMHI	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27 - DHMZ	0.00	0.00	0.00	16.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28 - UEDIN	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29 - UBO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30 - WSL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31 - IVL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.80	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00
32 - MPG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.00	0.00	0.00	0.00	0.00	0.00
33 - IPBPSS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.00	0.00	24.00	0.00	0.00	0.00
34 - EMRC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00
35 - AU	0.00	0.00	0.00	0.00	0.00	4.00	0.00	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00
36 - WU	0.00	0.00	0.00	6.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37 - ULB	1.20	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38 - BAS - IFRG	0.00	13.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39 - TNO	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	230.20	68.00	29.00	70.00	28.00	25.50	52.00	46.50	23.70	100.00	74.00	26.85	39.85	121.00	17.00	40.00	17.00	21.80	16.80

WT6:
Project Effort by Beneficiary and Work Package

Beneficiary number and short-name	WP 20	WP 21	WP 22	WP 23	WP 24	Total per Beneficiary
1 - NERC	3.00	13.00	52.00	1.00	1.00	235.10
2 - ULUND	0.00	8.00	0.00	0.00	5.00	51.00
3 - DTU	0.00	0.00	0.00	0.00	0.50	30.50
4 - ALTERRA	0.90	3.00	0.00	0.00	0.33	41.13
5 - IIASA	18.00	3.00	0.00	0.00	0.50	33.50
6 - met.no	0.00	0.00	0.00	0.00	0.00	26.00
7 - Juelich	0.00	0.00	0.00	0.00	0.00	15.00
8 - ECN	3.00	0.00	0.00	0.00	0.00	20.00
9 - CNR	0.00	0.00	0.00	0.00	0.00	44.00
10 - KIT	0.00	0.00	0.00	0.00	0.00	23.00
11 - JRC	0.00	4.00	0.00	0.00	0.00	35.00
12 - SEI-Y, UoY	0.00	0.00	0.00	0.20	0.00	31.20
13 - INRA	0.00	0.00	0.00	0.00	0.00	108.00
14 - RIVM	0.85	0.00	0.00	0.00	0.00	20.55
15 - FDEA-ART	0.00	1.00	0.00	0.00	0.00	39.00
16 - UGOT	0.00	0.00	0.00	0.00	0.00	12.00
17 - ERTI - FRI	0.00	0.00	0.00	0.00	0.00	30.00
18 - FMI	0.00	0.00	0.00	0.00	0.00	12.00
19 - UHEL	0.00	0.00	0.00	0.00	0.00	13.00
20 - UNICATT	0.00	0.00	0.00	0.00	0.00	58.00
21 - ONU	0.00	0.00	0.00	0.00	0.00	20.00
22 - BOKU	0.00	0.00	0.00	0.20	0.00	31.20
23 - UPM	0.00	0.00	0.00	2.00	0.00	23.00
24 - CIEMAT	0.00	0.00	0.00	0.00	0.00	22.00
25 - CNRS	0.00	0.00	0.00	0.00	0.00	29.00
26 - SMHI	0.00	1.00	0.00	0.00	0.00	6.00

WT6:
Project Effort by Beneficiary and Work Package

Beneficiary number and short-name	WP 20	WP 21	WP 22	WP 23	WP 24	Total per Beneficiary
27 - DHMZ	0.00	0.00	0.00	0.00	0.00	16.00
28 - UEDIN	0.00	1.30	24.00	1.30	0.00	29.60
29 - UBO	0.00	0.00	0.00	0.00	0.00	24.00
30 - WSL	0.00	0.00	0.00	0.00	0.00	5.00
31 - IVL	0.00	0.00	0.00	0.00	0.00	4.80
32 - MPG	0.00	0.00	0.00	0.00	0.00	12.00
33 - IPBPSS	0.00	0.00	0.00	0.00	0.00	48.00
34 - EMRC	0.00	0.00	0.00	0.00	0.00	8.00
35 - AU	0.00	0.00	0.00	0.00	0.00	8.50
36 - WU	0.00	0.00	0.00	0.00	0.00	8.00
37 - ULB	0.00	0.00	0.00	0.00	0.00	5.20
38 - BAS - IFRG	0.00	0.00	0.00	0.00	0.00	13.00
39 - TNO	0.00	0.00	0.00	0.00	0.00	4.00
Total	25.75	34.30	76.00	4.70	7.33	1,195.28

WT7:
Project Effort by Activity type per Beneficiary

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

Indicative efforts per Activity Type per Beneficiary

Activity type	Part. 1 NERC	Part. 2 ULUND	Part. 3 DTU	Part. 4 ALTERRA	Part. 5 IIASA	Part. 6 met.no	Part. 7 Juelich	Part. 8 ECN	Part. 9 CNR	Part. 10 KIT	Part. 11 JRC	Part. 12 SEI-Y,	Part. 13 INRA	Part. 14 RIVM
1. RTD/Innovation activities														
WP 1	24.00	0.00	0.00	0.00	0.00	0.00	1.00	10.00	2.00	1.00	12.00	0.00	49.00	0.00
WP 2	1.00	0.00	0.00	0.00	0.00	0.00	11.00	0.00	18.00	1.00	0.00	0.00	0.00	0.00
WP 3	2.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.00	0.00	0.00	11.00	0.00
WP 4	4.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	6.00	27.00	0.00
WP 5	0.00	4.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	7.00	0.00	0.00	0.00
WP 6	1.50	7.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00
WP 7	0.00	9.00	0.00	0.00	0.00	17.00	3.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00
WP 8	7.00	0.00	0.00	0.00	0.00	1.00	0.00	7.00	0.00	2.00	0.00	0.00	21.00	0.00
WP 9	7.00	0.00	2.00	1.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00
WP 10	14.00	0.00	26.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 11	19.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.00	0.00	0.00	0.00	0.00	0.00
WP 12	6.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.00	0.00	0.85
WP 13	12.00	5.00	0.00	6.00	0.00	0.00	0.00	0.00	0.00	7.00	0.00	9.00	0.00	0.85
WP 14	54.00	10.00	0.00	9.00	1.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00	3.00
WP 15	7.00	0.00	0.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
WP 16	0.00	0.00	0.00	5.00	1.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
WP 17	5.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 18	0.80	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	3.00
WP 19	0.80	0.00	0.00	2.00	7.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
WP 20	3.00	0.00	0.00	0.90	18.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.85
WP 21	13.00	8.00	0.00	3.00	3.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00

WT7:
Project Effort by Activity type per Beneficiary

1. RTD/Innovation activities														
Total Research	181.10	46.00	30.00	40.80	33.00	26.00	15.00	20.00	44.00	23.00	35.00	31.00	108.00	20.55

2. Demonstration activities														
Total Demo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3. Consortium Management activities														
WP 22	52.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Management	52.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

4. Other activities														
WP 23	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00
WP 24	1.00	5.00	0.50	0.33	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total other	2.00	5.00	0.50	0.33	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00

Total	235.10	51.00	30.50	41.13	33.50	26.00	15.00	20.00	44.00	23.00	35.00	31.20	108.00	20.55

WT7:
Project Effort by Activity type per Beneficiary

Activity type	Part. 15 FDEA-AR	Part. 16 UGOT	Part. 17 ERTI -	Part. 18 FMI	Part. 19 UHEL	Part. 20 UNICATT	Part. 21 ONU	Part. 22 BOKU	Part. 23 UPM	Part. 24 CIEMAT	Part. 25 CNRS	Part. 26 SMHI	Part. 27 DHMZ	Part. 28 UEDIN
1. RTD/Innovation activities														
WP 1	36.00	0.00	30.00	5.00	13.00	22.00	18.00	0.00	6.00	0.00	0.00	0.00	0.00	0.00
WP 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00
WP 4	0.00	3.00	0.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.00	0.00
WP 5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.00	0.00	0.00	0.00
WP 6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	3.00
WP 7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	5.00	0.00	0.00
WP 8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00
WP 9	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 10	2.00	0.00	0.00	0.00	0.00	36.00	0.00	0.00	0.00	22.00	0.00	0.00	0.00	0.00
WP 11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 12	0.00	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 16	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00	0.00	0.00	0.00
WP 18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WP 21	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.30
Total Research	39.00	12.00	30.00	12.00	13.00	58.00	20.00	31.00	21.00	22.00	29.00	6.00	16.00	4.30

WT7:
Project Effort by Activity type per Beneficiary

2. Demonstration activities														
Total Demo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3. Consortium Management activities														
WP 22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.00
Total Management	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.00

4. Other activities														
WP 23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	2.00	0.00	0.00	0.00	0.00	1.30
WP 24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	2.00	0.00	0.00	0.00	0.00	1.30

Total	39.00	12.00	30.00	12.00	13.00	58.00	20.00	31.20	23.00	22.00	29.00	6.00	16.00	29.60

WT7:
Project Effort by Activity type per Beneficiary

Activity type	Part. 29 UBO	Part. 30 WSL	Part. 31 IVL	Part. 32 MPG	Part. 33 IPBPSS	Part. 34 EMRC	Part. 35 AU	Part. 36 WU	Part. 37 ULB	Part. 38 BAS - I	Part. 39 TNO	Total
1. RTD/Innovation activities												
WP 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.20	0.00	0.00	230.20
WP 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.00	0.00	68.00
WP 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	29.00
WP 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0.00	0.00	0.00	70.00
WP 5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	28.00
WP 6	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	25.50
WP 7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	4.00	52.00
WP 8	0.00	0.00	0.00	0.00	0.00	0.00	1.50	0.00	4.00	0.00	0.00	46.50
WP 9	0.00	5.00	1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.70
WP 10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
WP 11	24.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	74.00
WP 12	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.85
WP 13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	39.85
WP 14	0.00	0.00	0.00	12.00	24.00	0.00	0.00	0.00	0.00	0.00	0.00	121.00
WP 15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.00
WP 16	0.00	0.00	0.00	0.00	24.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00
WP 17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.00
WP 18	0.00	0.00	2.00	0.00	0.00	8.00	3.00	0.00	0.00	0.00	0.00	21.80
WP 19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.80
WP 20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.75
WP 21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	34.30
Total Research	24.00	5.00	4.80	12.00	48.00	8.00	8.50	8.00	5.20	13.00	4.00	1,107.25

WT7:
Project Effort by Activity type per Beneficiary

2. Demonstration activities												
Total Demo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3. Consortium Management activities												
WP 22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	76.00
Total Management	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	76.00

4. Other activities												
WP 23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.70
WP 24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.33
Total other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.03

Total	24.00	5.00	4.80	12.00	48.00	8.00	8.50	8.00	5.20	13.00	4.00	1,195.28

WT8:
Project Effort and costs

Project Number [1]	282910	Project Acronym [2]	ECLAIRE

Project efforts and costs

Benefi-ciary number	Beneficiary short name	Estimated eligible costs (whole duration of the project)						Total receipts (€)	Requested EU contribution (€)
		Effort (PM)	Personnel costs (€)	Subcontracting (€)	Other Direct costs (€)	Indirect costs OR lump sum, flat-rate or scale-of-unit (€)	Total costs		
1	NERC	235.10	837,000.00	0.00	644,000.00	988,000.00	2,469,000.00	0.00	1,424,000.00
2	ULUND	51.00	240,000.00	0.00	17,292.00	154,375.20	411,667.20	0.00	310,000.00
3	DTU	30.50	168,466.30	0.00	52,834.00	190,367.00	411,667.30	0.00	310,000.00
4	ALTERRA	41.13	311,583.00	0.00	26,694.00	208,723.00	547,000.00	0.00	412,000.00
5	IIASA	33.50	230,276.00	0.00	9,510.00	131,882.00	371,668.00	0.00	280,001.00
6	met.no	26.00	195,000.00	0.00	30,000.00	195,000.00	420,000.00	0.00	210,000.00
7	Juelich	15.00	85,424.00	0.00	33,611.00	80,965.00	200,000.00	0.00	150,000.00
8	ECN	20.00	168,933.00	0.00	31,067.00	126,667.00	326,667.00	0.00	245,000.00
9	CNR	44.00	186,000.00	0.00	8,920.00	145,080.00	340,000.00	0.00	170,000.00
10	KIT	23.00	154,000.00	0.00	8,000.00	98,000.00	260,000.00	0.00	130,000.00
11	JRC	35.00	218,667.00	0.00	14,667.00	140,000.40	373,334.40	0.00	280,000.00
12	SEI-Y, UoY	31.20	170,250.00	0.00	18,500.00	113,250.00	302,000.00	0.00	227,000.00
13	INRA	108.00	324,000.00	0.00	32,000.00	213,600.00	569,600.00	0.00	285,000.00
14	RIVM	20.55	169,000.00	0.00	4,334.00	160,000.00	333,334.00	0.00	250,000.00
15	FDEA-ART	39.00	145,000.00	0.00	13,334.00	95,000.40	253,334.40	0.00	190,000.00
16	UGOT	12.00	98,000.00	0.00	18,000.00	69,600.00	185,600.00	0.00	105,000.00
17	ERTI - FRI	30.00	37,000.00	0.00	52,000.00	17,800.00	106,800.00	0.00	80,000.00
18	FMI	12.00	58,072.00	0.00	10,533.00	51,395.00	120,000.00	0.00	90,000.00
19	UHEL	13.00	46,000.00	0.00	29,000.00	45,000.00	120,000.00	0.00	90,000.00
20	UNICATT	58.00	109,782.00	0.00	56,885.00	100,000.20	266,667.20	0.00	200,000.00
21	ONU	20.00	37,334.00	0.00	8,500.00	27,500.40	73,334.40	0.00	55,000.00

WT8:
Project Effort and costs

Benefi-ciary number	Beneficiary short name	Estimated eligible costs (whole duration of the project)						Total receipts (€)	Requested EU contribution (€)
		Effort (PM)	Personnel costs (€)	Subcontracting (€)	Other Direct costs (€)	Indirect costs OR lump sum, flat-rate or scale-of-unit (€)	Total costs		
22	BOKU	31.20	137,250.00	0.00	27,500.00	98,850.00	263,600.00	0.00	132,000.00
23	UPM	23.00	89,658.00	0.00	16,667.00	78,675.00	185,000.00	0.00	115,000.00
24	CIEMAT	22.00	76,556.00	0.00	80,000.00	83,444.00	240,000.00	0.00	120,000.00
25	CNRS	29.00	122,500.00	0.00	15,000.00	82,500.00	220,000.00	0.00	110,000.00
26	SMHI	6.00	35,000.00	0.00	11,000.00	35,000.00	81,000.00	0.00	60,000.00
27	DHMZ	16.00	32,000.00	0.00	30,500.00	37,500.00	100,000.00	0.00	50,000.00
28	UEDIN	29.60	182,747.00	0.00	0.00	170,920.00	353,667.00	0.00	327,000.00
29	UBO	24.00	45,000.00	0.00	13,334.00	35,000.40	93,334.40	0.00	70,000.00
30	WSL	5.00	33,500.00	0.00	4,000.00	22,500.00	60,000.00	0.00	45,000.00
31	IVL	4.80	33,000.00	0.00	8,334.00	32,000.00	73,334.00	0.00	55,000.00
32	MPG	12.00	26,400.00	0.00	3,307.00	36,960.00	66,667.00	0.00	50,000.00
33	IPBPSS	48.00	17,000.00	0.00	27,445.00	8,889.00	53,334.00	0.00	40,000.00
34	EMRC	8.00	85,002.00	0.00	4,166.00	17,833.60	107,001.60	0.00	80,000.00
35	AU	8.50	56,000.00	0.00	19,000.00	45,000.00	120,000.00	0.00	60,000.00
36	WU	8.00	50,189.00	0.00	5,001.00	38,144.00	93,334.00	0.00	70,000.00
37	ULB	5.20	20,000.00	0.00	13,334.00	20,000.40	53,334.40	0.00	40,000.00
38	BAS - IFRG	13.00	13,450.00	0.00	10,250.00	29,650.00	53,350.00	0.00	40,000.00
39	TNO	4.00	17,267.00	0.00	4,987.00	31,080.00	53,334.00	0.00	40,000.00
	Total	1,195.28	5,062,306.30	0.00	1,413,506.00	4,256,152.00	10,731,964.30	0.00	6,997,001.00

1. Project number

The project number has been assigned by the Commission as the unique identifier for your project. It cannot be changed. The project number **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

2. Project acronym

Use the project acronym as given in the submitted proposal. It cannot be changed unless agreed so during the negotiations. The same acronym **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

53. Work Package number

Work package number: WP1, WP2, WP3, ..., WPn

54. Type of activity

For all FP7 projects each work package must relate to one (and only one) of the following possible types of activity (only if applicable for the chosen funding scheme – must correspond to the GPF Form Ax.v):

• **RTD/INNO =** Research and technological development including scientific coordination - applicable for Collaborative Projects and Networks of Excellence

• **DEM =** Demonstration - applicable for collaborative projects and Research for the Benefit of Specific Groups

• **MGT =** Management of the consortium - applicable for all funding schemes

• **OTHER =** Other specific activities, applicable for all funding schemes

• **COORD =** Coordination activities – applicable only for CAs

• **SUPP =** Support activities – applicable only for SAs

55. Lead beneficiary number

Number of the beneficiary leading the work in this work package.

56. Person-months per work package

The total number of person-months allocated to each work package.

57. Start month

Relative start date for the work in the specific work packages, month 1 marking the start date of the project, and all other start dates being relative to this start date.

58. End month

Relative end date, month 1 marking the start date of the project, and all end dates being relative to this start date.

59. Milestone number

Milestone number:MS1, MS2, …, MSn

60. Delivery date for Milestone

Month in which the milestone will be achieved. Month 1 marking the start date of the project, and all delivery dates being relative to this start date.

61. Deliverable number

Deliverable numbers in order of delivery dates: D1 – Dn

62. Nature

Please indicate the nature of the deliverable using one of the following codes

R = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

63. Dissemination level

Please indicate the dissemination level using one of the following codes:

• **PU =** Public

• **PP =** Restricted to other programme participants (including the Commission Services)

• **RE =** Restricted to a group specified by the consortium (including the Commission Services)

• **CO =** Confidential, only for members of the consortium (including the Commission Services)

• **Restreint UE =** Classified with the classification level "Restreint UE" according to Commission Decision 2001/844 and amendments

• **Confidentiel UE =** Classified with the mention of the classification level "Confidentiel UE" according to Commission Decision 2001/844 and amendments

• **Secret UE =** Classified with the mention of the classification level "Secret UE" according to Commission Decision 2001/844 and amendments

64. Delivery date for Deliverable

Month in which the deliverables will be available. Month 1 marking the start date of the project, and all delivery dates being relative to this start date

65. Review number

Review number: RV1, RV2, ..., RVn

66. Tentative timing of reviews

Month after which the review will take place. Month 1 marking the start date of the project, and all delivery dates being relative to this start date.

67. Person-months per Deliverable

The total number of person-month allocated to each deliverable.

PART B: Description of Work

Contents

B 1. CONCEPT AND OBJECTIVES, PROGRESS BEYOND STATE-OF-THE-ART, S/T METHODOLOGY AND WORK PLAN

B 1.1 Concept and project objective(s)

Exceedances of threshold levels for ecosystem impacts of ozone (O_3) result in significant impacts on semi-natural ecosystems, while an estimated ~€7 billion in the year 2000 were lost due to phyto-toxic impacts of O_3 on arable crops (Holland et al., 2006). Due to intercontinental transport, future O_3 concentrations will depend crucially on how emissions of nitrogen oxides (NO_x) and volatile organic compounds (VOCs) evolve in the developing world, outside Europe, but it is likely to have severe implications for the economy and global food security (Derwent et al., 2004; Ashmore et al., 2005; The Royal Society, 2008).

At the same time, atmospheric reactive nitrogen compounds (N_r) represent an increasingly important pollution driver of European land ecosystems, especially as emissions of sulphur dioxide (SO_2) in the EU-27 have decreased by nearly 70% between 1990 and 2007, with much smaller reductions for NO_x (~30%) and ammonia (NH_3, ~15%) over the same period (CEIP, 2010). Together, wet and dry deposition of both oxidized and reduced nitrogen are having multiple impacts on terrestrial ecosystems, in some cases increasing productivity and carbon storage (de Vries et al., 2009). However, nitrogen deposition also is threatening ecosystem functioning and plant community composition in many areas (Bobbink et al., 2010), representing an annual loss of ~€10-70 billion (TFRN, 2010a; Brink et al. 2011).

Last but not least, many atmospheric pollutants that affect ecosystems, like ozone, nitrogen and secondary aerosols, are not only important climate forcing agents (Andreae et al., 2005; Arneth et al., 2009; Forster et al., 2007), but their atmospheric burden strongly responds to climate change in turn (Dentener et al., 2001; Johnson et al., 2001; Racherla & Adams, 2006). The interactions of climate change, change in nitrogen deposition, increasing atmospheric CO_2 concentration, changing aerosol burdens and changing ozone background and peak levels make projections of pollution impacts on terrestrial ecosystems challenging. This is especially so, since these affect ecosystem physical and biogeochemical responses on different spatial and temporal scales, and individually in either positive or negative ways (e.g., on ecosystem productivity, water use efficiency, carbon storage or biodiversity; Arneth et al., 2010a; Mercado et al., 2009; Sitch et al., 2007). What is more, changing biogenic emissions in response to air pollution and/or climate change can affect air pollution and climate change in turn, in a complex system that contains multiple, interacting feedbacks (Arneth et al., 2010b; Raes et al., 2010).

To optimise the efficacy of European emission control strategies in the global pollution-climate change context, it is vitally important that we develop a consistent and process-based observational and modelling framework to understand how interactive atmospheric pollutants will impact ecosystems in response to climate and air pollution change.

Focusing especially on the role of ozone and nitrogen, and where relevant their interactions with volatile organic compounds, aerosols and sulphur, the Overall Objectives of ÉCLAIRE are therefore:

O 1. to provide robust understanding of air pollution impacts on European land ecosystems including soils under changing climate conditions, and

O 2. to provide reliable and innovative risk assessment methodologies for these ecosystem impacts of air pollution, including the economic implications, to support EU policy.

ÉCLAIRE will target climate-ecosystem-atmosphere interactions and their implications for ecosystem effects at the European scale, combining observations and experiments in the field and laboratory with modelling experiments from plot to European scales, while accounting for changes in global background.

The new scientific understanding and risk-assessment methodologies under climate change will be of central importance in the next stage of EU negotiations under the Convention on Long-range Transboundary Air Pollution (CLRTAP). Already, with current revision of the Gothenburg Protocol, air pollution - climate interactions are beginning to be addressed (e.g., TFRN, 2010b). Given the need to quantify the policy co-benefits, the outputs of ÉCLAIRE will be even more important in supporting the CLRTAP 'Long-Term Strategy' (UNECE, 2010a).

To reach its Overall Objectives, ÉCLAIRE will address the following **Key Questions**:

Q1: What are the expected impacts on ecosystems due to changing ozone and N-deposition under a range of climate change scenarios, taking into consideration the associated changes in atmospheric CO_2, aerosol and acidification?
Q2: Which of these effects off-set and which aggravate each other, and how do the mitigation and adaptation measures recommended under climate change relate to those currently being recommended to meet air pollution effects targets?
Q3: What are the relative effects of long-range global and continental atmospheric transport vs. regional and local transport on ecosystems in a changing climate?
Q4: What are the appropriate metrics to assess ozone and nitrogen impacts on plants and soils, when considering state-of-the-art understanding of interactions with CO_2 and climate, and the different effects of wet vs. dry deposition on physiological responses?

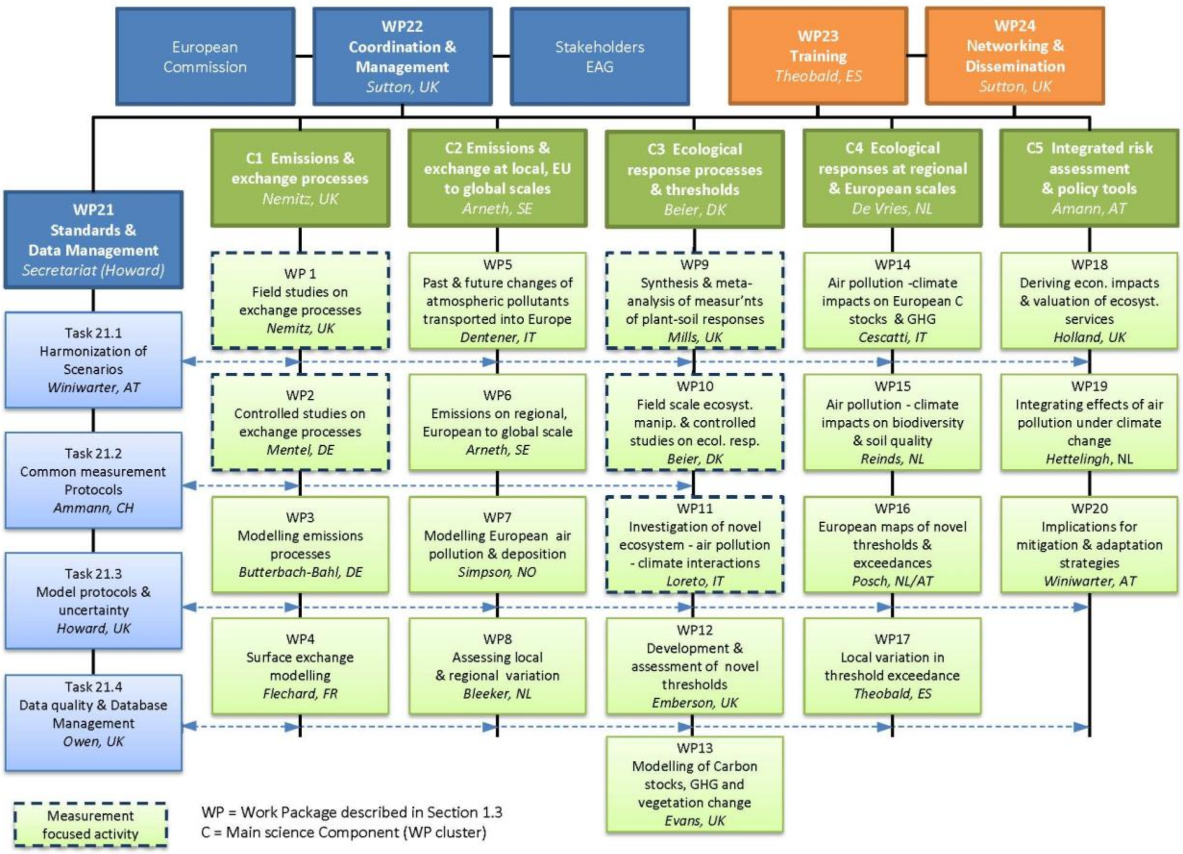

Fig. 1.1. Schematic of ÉCLAIRE highlighting the main science Components and Work Packages.

Q5: What is the relative contribution of climate dependence in biogenic emissions and deposition vs. climate dependence of ecosystem thresholds and responses in determining the overall effect of climate change on air pollution impacts?

Q6: Which mitigation and/or adaptation measures are required to reduce the damage to "acceptable" levels to protect carbon stocks and ecosystem functioning? How do the costs associated with the emission abatement compare with the economic benefits of reduced damage?

Q7: How can effective and cost-efficient policies on emission abatement be devised in the future?

To be able to answer these questions the project will improve the understanding of the interactions and feedbacks in the coupled biosphere-chemistry-climate system and develop novel approaches to quantifying ecosystem effects and threats together with improved tools for upscaling to Europe and extrapolating to future climates. The integration of these issues will focus on the following **Specific Objectives** (for Work Package numbers see Fig. 1.1 – 'Month', refers to the completion month for work concerning each Specific Objective):

S1. To develop improved process-based emissions parameterization of NH_3, NO and VOCs from natural and agricultural ecosystems in response to climate and pollutant deposition for incorporation into atmospheric Chemistry-Transport Models (CTMs), based on existing and new flux measurements in the field and laboratory, applying these to develop spatially resolved emission scenarios in response to climate, CO_2 and air pollutant change [WPs 1, 2, 3, 6./Month 42].

S2. To determine the chief processes in atmospheric chemistry that respond to climate and air pollution change and the consequences for ozone and aerosol production and atmospheric lifetimes, in the context of the global O_3 background [WPs 5, 7/Month 36 & through collaboration with PEGASOS FP7 project].

S3. To develop improved multi-layer dry deposition / bi-directional exchange parameterisations for O_3, NO_x, NH_3, VOCs and aerosols, taking into account near-surface chemical interactions and the role of local/regional spatial interactions, based on existing and new flux measurements and high resolution models and to estimate European patterns of air concentrations and deposition under climate change [WPs 1, 2, 4, 7, 8/Month 42].

S4. To integrate the results of meta-analyses of existing datasets with the results of targeted experiments for contrasting European climates and ecosystems, thereby assessing the climate-dependence of thresholds for land ecosystem responses to air pollution, including the roles of ozone, N-deposition and interactions with VOCs, nitrogen form (wet/dry deposition) and aerosol [WPs 9, 10, 11, 12/Month 30].

S5. To develop improved process-based parameterizations in dynamic global vegetation models (DGVMs) and soil vegetation models (DSVMs) to assess the combined interacting impacts of air quality, climate change and nutrient availability on plant productivity, carbon sequestration and plant species diversity and their uncertainties [WP13; WP14; WP15, WP17/Month 44].

S6. To develop novel thresholds and dose-response relationships for air pollutants (especially for O_3 and N) under climate change, integrated into process-based models verified by experimental studies at site scales and mapped at the European scale, quantifying the effect of climate change scenarios [WPs 12, 13, 14, 15, 16/Month 44].

S7. To assess the extent to which climate change alters the transport distance and spatial structure of air pollution impacts on land ecosystems considering local, regional, continental and global interactions, focusing on nitrogen and ozone effects [WPs 5, 6, 7, 8, 9/Month 44].

S8. To apply the novel metrics to quantify multi-stress response of vegetation and soils, including effects on carbon storage and biodiversity to improve the overall risk assessments of pollution-climate effects on ecosystems at the European scale as the basis for development of mitigation options [WPs 12, 13, 14, 15, 16, 19, 20/Month 44].

S9. To quantify the overall economic impacts of air pollution effects on land ecosystems and soils, including the valuation of ecosystem and other services, and the extent to which climate change contributes by altering emissions versus ecosystem vulnerability [WPs 3, 4, 6, 7, 12, 14, 15, 16, 18/Month 42].

S10. To reassess the current recommendations regarding air pollution emission abatement policies, considering the interactions between ecosystem and other effects under conditions of climate change and to perform cost-benefit analysis of policy options under different scenarios [WPs 18, 19, 20/Month 48].

As can be seen from Fig. 1.1, ÉCLAIRE is organised around **five chief science components**, supported by a smaller number of strategic and management actions, to provide end-to-end science from measurements and improved process understanding, over model integration, to the advice on mitigation and adaptation strategies. The work packages in each component are designed to provide novel understanding from small-scale biogeochemical processes to European and global simulations.

Component 1 derives the process understanding to link biogenic/agricultural emissions and deposition to vegetation and soils, to meteorological conditions and to pollutant inputs, through meta-analysis of existing flux data, fluxes from a 9-site flux network across the European climate space and targeted controlled measurements of emission, deposition and chemical conversion processes. The emerging parameterisations will be used in **Component 2** to develop improved, more mechanistic, modeling frameworks that simulate the effect of the interactions of the climate-atmosphere-biosphere system on biogenic emission and bi-directional exchange, providing emission, deposition and concentration fields at the European scale that respond to global change. Using these exposure and deposition maps, and data from ecosystem manipulation experiments addressing air pollution – climate interactions, **Component 3** will improve dose/response relationships under changing climate, develop new thresholds and improved models to simulate the effect of pollutants on above- and below-ground carbon stocks. Upscaling of ecological responses, thresholds and exceedances to the regional and European scale and its spatial variability is provided by **Component 4**, while the implications for the economy and ecosystem services is assessed by **Component 5**, which will also consider the implications for mitigation and adaptation strategies.

ÉCLAIRE and PEGASOS: It should be noted that, while ÉCLAIRE is fully self-standing, it will benefit significantly from parallel work in the FP7 project PEGASOS (2011-2014) which investigates the interactions between air quality and climate change. PEGASOS will provide a more detailed look at climate effects on air chemistry processes, future projections of anthropogenic emissions, and effects of air pollution and climate change on human health, thereby providing significant synergy with ÉCLAIRE. Conversely, ÉCLAIRE will provide major advances in the description of ecosystem / atmosphere exchange that will feed into PEGASOS. The mutual exchange will be ensured through the involvement of key groups (NERC, ULund, WU, JRC, FZJ, UHEL, CNR-ISAC, CNRS, FMI, IIASA, met.no) and models (EMEP, GAINS, LPJ-GUESS) in both projects.

Scenarios: ÉCLAIRE will build upon latest anthropogenic emission scenarios and the associated projections of climate and land use / land cover change that are currently being performed for IPCC AR5. Depending on the speed of this independent development, the fall-back option for early work in ÉCLAIRE will be to use existing IPCC AR4 output. Several groups in ÉCLAIRE are actively involved in AR5 to ensure timely access to the latest results (SMHI, JRC, IIASA, CNRS, FMI), with scenario coordination managed under Task 21.1 (see Fig. 1.1). Subject to agreement with CLRTAP, IPCC and other stakeholders it is proposed to focus on 2030, 2050 and 2100.

B 1.2 Progress beyond the state of the art

B 1.2.1 Overview

Over the last century, air pollutants resulting from industry, agriculture, transport, households and biogenic processes have come to pose an important threat to European land ecosystems and soils. At the same time, these pollutants directly or indirectly contribute to climate change, while climate change can be expected to modify the magnitude of pollutant emissions, the atmospheric transport distance and the ecosystem sensitivity to air pollutants.

As a result, patterns of anthropogenic emissions are simultaneously changing in response to economic development, while climate and land use / land cover changes are affecting the ratio of pollutant deposition to biogenic pollutant emissions. Together with the modification of ecosystem sensitivity, climate and other changes can therefore substantially alter the scale of air pollution damage to ecosystems. To understand and quantify these effects, ÉCLAIRE will improve methods to quantify the combined impacts of air pollutants and climate change on Europe's ecosystems and soils as a basis to predict the scale of the interacting impacts over the coming century.

Changing air pollution profiles this century: The complexity of predicting future air pollutant concentrations with our current scientific understanding is illustrated by the example of tropospheric O_3. Formed by multiple photochemical reactions involving NO_x, non-methane volatile organic compounds (VOCs), methane (CH_4) and carbon monoxide (CO) together with climatic factors, tropospheric O_3 concentrations in Europe are influenced by both man-made and biogenic pollutant precursors from local and long-range, including hemispheric sources. Although European peak concentrations of tropospheric O_3 have decreased with the introduction of emission NO_x and VOC control measures (Jonson et al., 2006), Northern Hemisphere background concentrations of O_3 have continued to increase (e.g. Dentener et al., 2005). Current methodology indicates that there will be a doubling of the hemispheric baseline O_3 concentration during the latter half of the 20th century (Dentener et al., 2006a), but this prediction does not take into account changes in the biogenic emissions of precursors nor feedbacks between the vegetation, climate and O_3 that influence the amount of O_3 being absorbed with consequences for the remaining atmospheric concentration.

Similarly, for other air pollutants, predictions of future concentrations also require an improved understanding of changes in both anthropogenic and biogenic sources. What is more, changes in climate will also affect atmospheric burdens and deposition in complex pattern. For instance, warmer temperatures will enhance emissions and chemical reaction rates, altered precipitation will change wet deposition patterns, while changed soil water balance and stomatal conductance will affect rates of dry deposition (e.g. Andersson & Engardt, 2010). Finally, parallel conversion of natural ecosystem into croplands or pastures, and the management of these systems not only affects the carbon cycle (Houghton, 2003), but also alters biogenic trace gas emissions to a degree that may override climate change impacts (Arneth et al., 2008a; Bowman et al., 2009; Lathière et al., 2006; Ludwig et al., 2001). However, the net-effects of land use change and changes in trace gas and aerosol source / sink strength versus climate change effects on bi-directional biosphere-atmosphere exchange have so far not been investigated.

ÉCLAIRE will thus consider combined pollution-climate change impacts on terrestrial ecosystem services, including also their role as sources of atmospherically reactive compounds that are both relevant as pollution precursors and as climate change agents (Arneth et al., 2009; Dentener et al., 2006b). Among the most relevant to predictions of impacts are NH_3 and NO_x emissions from soils (Jaegle et al., 2005), biogenic volatile organic compounds (BVOC, i.e., 400-700 Tg C a^{-1} as isoprene and monoterpenes; Simpson et al., 1999; Arneth et al., 2008b) from vegetation, and gas and particle emissions from wildfires (ca. 2-4 Pg C a^{-1}; Andreae & Merlet, 2001; Bowman et al., 2009).

Processes and impacts on European land ecosystems: For ozone, we know that current concentrations are already damaging many species of European crops, (semi-) natural vegetation and trees (Ferretti et al, 2007; Braun et al., 2007; Mills et al., 2010), with typical effects being leaf damage, reduced seed production, reduced growth and terrestrial carbon sink and reduced capacity to over-winter (e.g. Hayes et al., 2006, 2007; Mills et al., 2007; Booker et al., 2009). At the same time, nitrogen fosters plant growth and ecosystem carbon uptake, but in Europe it is the most important air pollutant affecting plant species diversity. Current evidence suggests that increasing N availability often causes an overall decline in plant species diversity (Bobbink et al., 1998; Tilman, 1987) even at low but prolonged N inputs (Clark & Tilman, 2008). Effects of N deposition, either in the form of ammonia (NH_3), ammonium (NH_4^+), nitrogen oxides (NO_x) or nitrate (NO_3^-), are now recognised in nearly all oligotrophic and mesotrophic (semi-) natural ecosystems (Bobbink et al., 2010). Most attention to date has focused on the net effect of total N deposition, even though N form (wet *vs*. dry, NO_y *vs*. NH_x) may substantially alter the productivity and species responses (Sheppard et al., 2008). Emerging mechanisms affecting impacts also need to be considered, including the potential for hygroscopic aerosol to induce drought stress (Burkhardt, 2010) and the potential for BVOC emissions to self-protect against O_3 (Loreto & Velikova 2001; Behnke et al., 2010). Although the problems associated with O_3 and N have been considered separately, it is becoming clear that plant physiology and soil processes demand a combined treatment of their impacts, which also needs to consider effects of enhanced CO_2 concentration, since all of these will affect plant growth in complex, non-linear ways. For the first time, ÉCLAIRE will consider the combined impacts of these co-occurring pollutants, including their climate sensitivity and CO_2 interaction. For example, increasing temperature may increase annual net primary productivity (NPP) by lengthening the growing season (Hasenauer & Monserud, 1997) and by increasing N availability through accelerated mineralization (Reichstein et al., 2000; Qin et al., 2009). With sufficient water, warming increases stomatal opening, increasing both the stimulatory effect of CO_2 and the adverse effect of O_3 (Mauzerall & Wang, 2001). By contrast, drought stress reduces photosynthesis and therefore C uptake (Körner, 2003), while O_3 reduces drought tolerance (Mills et al., 2009; Wilkinson & Davies, 2010). In general, field studies have suggested N control on the long-term response of land ecosystems to climate change and especially to elevated atmospheric CO_2 levels (e.g. Reich et al., 2006; De Graaff et al., 2006; Finzi et al., 2007).

Development of thresholds: Critical loads for N and acidity, above which damaging environmental effects can be expected, have played an important role in European air pollution abatement (Hettelingh et al., 2001; Spranger et al., 2008). Results show that the area where critical loads of acidity are exceeded will continue to decrease, mainly due to reducing SO_2 emissions, while high exceedances for critical N loads remain widespread especially in areas in north-western European that are dominated by NH_3 emissions (Hettelingh et al. 2007). These results are, however, based on empirical critical loads and simple model based calculations focusing on the impacts of N deposition on soil quality only, and the model based regional estimates do not provide “scientifically sound” thresholds for protecting plant ecosystems, nor for distinguishing the effects of different nitrogen forms. These will be better characterized in ÉCLAIRE, linked with assessment of how climate change alters the proportions of wet and dry N deposition.

Critical levels for O_3 have also been derived based initially on the concentration of O_3 in air above the vegetation, and more recently on the accumulated stomatal flux of ozone determined, e.g. using the DO_3SE model (Mills et. al., 2007). The latter critical levels have been derived to protect against the damaging effects of ozone on food security, carbon storage capacity of woodlands and other forest-related ecosystem services, and the vitality of grassland ecosystems. Critical levels/loads do not currently exist for the combined effects of

O_3 and N, nor for their effects under the modifying influence of climate change and climate stresses such as drought. Moreover, O_3 stomatal flux may not be the most appropriate metric if BVOC production at the leaf surface or inside the leaf aids the plant to withstand oxidative stress (Loreto and Fares, 2007; Loreto and Velikova, 2001). The programme of ÉCLAIRE will allow these issues to be considered in the development of new threshold approaches.

Predictive modelling of impacts: Chemical transport models (CTMs) are essential for the calculation of air pollutant concentrations in Europe. Among other benefits, these models allow for spatially comprehensive estimates of pollutant concentrations and for the mapping of deposition patterns over large areas. CTMs address emissions, dispersion and transport over multiple scales, chemical transformation, and dry and wet removal of pollutants. Crucially for this project, CTMs are the only means to predict future pollution levels, including 'what-if' scenarios in which different policy options or scientific possibilities are explored. In Europe, the EMEP chemical transport model (Simpson et al. 2003a, 2006, 2007) has been developed in close cooperation with the biological community, including the ICP Vegetation of the LRTAP Convention. The EMEP model incorporates the so-called DO_3SE deposition module (Emberson et al., 2001; Simpson et al., 2003b, 2007; Tuovinen et al., 2004), which parameterises ozone uptake as functions of light, temperature, humidity, soil moisture and time of year. Although this empirical model has proven very successful, it cannot be applied for future scenarios as there is no explicit dependence on changing CO_2, O_3 or N deposition levels (Bueker et al., 2007). Development of a new photosynthesis-based stomatal conductance algorithm in ÉCLAIRE will allow these interactions to be addressed. Similarly, the N deposition algorithms in the EMEP model are insufficiently sensitive to meteorological parameters, pollutant inputs and chemical interactions, to provide robust N_r deposition fields under conditions of future climate and pollutant levels, a deficiency that will be addressed under ÉCLAIRE.

Various dynamic global vegetation models (DGVMs) have been developed to quantify the impacts of climate and CO_2 concentration on terrestrial vegetation-carbon cycle dynamics on regional to continental scales (Cramer et al., 2001; Friedlingstein et al., 2006). Since C accumulation may be constrained by N (Hungate et al., 2003; Thornton et al., 2007), the interactions of CO_2, climate and N availability has been included in several of these DGVMs (Thornton et al., 2009; Zaehle & Friend, 2010; Zaehle et al., 2010). By contrast, impacts of O_3 have hardly been included (e.g. Sitch et al., 2007), while the interactions between CO_2, climate, O_3 exposure and N availability have not yet been studied in relation to terrestrial vegetation-carbon cycle dynamics (Arneth et al., 2010b; Mercado et al., 2009; Sitch et al., 2007; Zaehle et al., 2010). Recently, dynamic soil-vegetation models (DSVMs) models have been developed that focus on the interactions of N deposition and climate on species community composition and soil quality (Belyazid et al., 2006; De Vries et al., 2010; Sverdrup et al., 2007). The principle is that: (i) a dynamic soil model predicts the changes in water and nutrient status and soil acidity in response to atmospheric deposition, while (ii) a coupled model predicts successional changes in plant species composition in response to the modelled changes in water, nutrient and acidity status, using species specific information on habitat preferences (De Vries et al., 2010). Currently, the interacting impacts of climate, O_3 and CO_2 exposure, and N availability are not yet included, which will be a major focus for advances in ÉCLAIRE.

Integrated risk assessment for European land ecosystems and soils: Science-informed decision making has proved to be a successful strategy in European environmental policy. This policy approach requires scientific results to be made available at a highly aggregated level. Tools for such aggregation are integrated assessment models (IAMs) which are able to accommodate very detailed scientific analysis via integration and parameterization into workable assessment tools (Amann et al., 2004; Bouwman et al., 2006; Alcamo, 1994). The Greenhouse gas and Air pollution INteractions and Synergies (GAINS) model is a specific IAM application that has been successfully used for European air quality policy (Amann et al., 2005, 2007). Both in GAINS (Cofala et al., 2007) and in EuRuralis (Rienks, 2008), currently available results extend to 2030 only, whilst the Millenium Ecosystem Assessment (MA, 2005) provides data to 2050, albeit in less detail. Monetariing environmental risks is a concept that has been successfully applied to health risks (Holland et al., 2005; Hurley et al., 2005) in the "Clean air for Europe" and EC4MACS activities. Preliminary work on the extension of such a system to ecosystems risks, specifically with regard to nitrogen, has been presented by Brink et al. (2011) and by Gren (2008) and is able to provide guidance for ÉCLAIRE to conceptualize cost-benefit analyses. Based on these foundations, ÉCLAIRE will provide the developments of the GAINS model required to integrate a wider range of effects, especially for combined air pollutants, and to extend predictions to 2050 and beyond.

The following sections detail the progress to be achieved under ÉCLAIRE according to the 5 main scientific components outlined in Fig. 1.1. The inter-component flow of information is summarized in Fig. 1.6.

B 1.2.2 Emissions and Exchange Processes (Component 1).

State-of-the-art: Terrestrial ecosystems (soils & vegetation), agriculture and fire contribute significant emissions of NO and dominate the emissions of NH_3 and VOCs globally (Jaegle et al., 2005; Guenther et al., 1995; Bowman et al., 2009), with these emission sources being strongly affected by climate and air pollutant inputs. Soil emissions of NO, for example increase with soil N content and temperature, and also depend on water content and soil type (e.g., Shaufler et al., 2010), while plant NO emissions have been observed under oxidative stress conditions (Velikova et al., 2008). The potential of vegetation to emit NH_3 is closely linked to atmospheric N deposition (Massad et al., 2010) while NH_3 volatilisation from agricultural sources (e.g. fertilisers, manure etc.) depends on temperature and wind speed (Ellermann et al., 2004), with NH_3 emission potentials doubling every 5 ºC (Flechard et al., 2010). Emissions of most biogenic VOCs (BVOCs) increase sharply with temperature and often radiation (PAR) (Guenther et al., 2006), while rising levels of CO_2 inhibit isoprene emissions (Young et al., 2009).

Total dry deposition critically governs the pollutant's atmospheric residence time and thus the transport distance. Importantly, the effect on plants of some pollutants is often not only controlled by total deposition, but is more closely related to the amount that enters the leaves through the stomata, where it can cause oxidative injury. For O_3, the fraction of deposition taken up by stomata or destroyed on leaf-surfaces appears to depend on meteorology, while in-canopy air chemistry and soil updake can be equally important (e.g., Fowler et al., 2001, 2009; Goldstein et al., 2004). Thus, critical levels approaches for O_3 are moving from a concentration-based to a flux based approach (Mills et al., 2010), requiring more accurate quantification of the stomatal uptake under current and future climate conditions. Stomatal opening, in return, responds to factors such as water availability, oxidative stress, but also the availability of light throughout the canopy. For example, increased aerosol levels enhance diffuse radiation, which can penetrate more deeply into the plant canopy than direct radiation, increasing overall gross primary productivity of the ecosystem (Knohl & Baldocchi, 2008; Mercado et al., 2009).

Despite these interactions, current calculations of emissions and deposition are poorly linked to meteorology and pollutant inputs: NH_3 emissions are usually calculated offline in bottom-up emission inventories, using tabulated emission factors, without being coupled to meteorology, although notable exceptions exist for limited areas: for example, Denmark uses a process based NH_3 emission model (Gyldenkærne et al., 2005), which is nevertheless scaled to provide a pre-determined country total, for policy reasons. While NO may be modelled in relation to meteorology at the plot scale, spatial up-scaling remains uncertain because the response curves for different soil types are lacking. By contrast, BVOC emissions are often calculated online by chemical transport models, in relation to temperature and radiation, e.g. using the MEGAN model (Guenther et al., 2006), but this has so far focussed on isoprene and, to a lesser extent, monoterpenes, and the spatial performance for Europe remains poor (Curci et al., 2010). With the development of more process-based isoprene emissions models, initial predictions of future developments of isoprene emissions are available but remain uncertain (Arneth et al., 2008a).

Existing parameterisations for dry deposition most commonly date back to the 1980s (e.g. Wesely 1989; Hicks and Matt 1988), are based on look-up tables, and, if at all, include only very crude descriptions of the response to environmental drivers. The next generation of meteorology-dependent parameterisations is far from complete, partly owing to a shortage in reliable flux data for key ecosystems and pollutants. For example, the large spread of predictions for NH_3 dry deposition parameterisations in current CTMs demonstrates the major uncertainty in treating this compound, which often dominates total N deposition (Flechard et al., 2010). Bi-directional exchange schemes of NH_3 with vegetation are emerging (Massad et al., 2010; Zhang et al., 2010), but have yet to be implemented into regional models. Drought periods affect stomatal opening and thus the uptake of phytotoxic O_3 and its removal from the atmosphere. Major uncertainties for O_3 include the wetness and radiation dependence of its destruction on leaf surfaces (Zhang et al., 2002; Fowler et al., 2009).

Fluxes of reactive trace gases and aerosols are also modified by chemical interactions, some of which take part near and within the canopy and cannot be resolved by current CTMs (e.g. Fowler et al., 2009). This alters net exchange fluxes and leads to the flux measurement above the canopy diverging from the true vegetation exchange: soil NO reacts with O_3 to form NO_2, which is partially taken up by the canopy (e.g. Ganzeveld et al., 2002a); volatile NH_4NO_3 evaporates close to the ground to form NH_3 and HNO_3 which deposit at rates much greater than the original aerosol (Nemitz et al., 2004); BVOCs partially or fully react within the canopy (e.g. Stroud et al., 2005) and can provide a significant sink for atmospheric O_3 (Goldstein et al., 2004).

Progress over state-of-the-art offered by ÉCLAIRE: Component 1 (C1) of ÉCLAIRE will improve our process understanding and model representation of the effect of climate change on the emissions of atmospheric direct pollutants (e.g., NH_3, NO_x) and indirect pollutant precursors (e.g., VOCs for O_3 and aerosols) and pollutant dry deposition. This will form the mechanistic basis for deriving more accurate estimates of pollutant inputs and their response to a changing climate (C2) and for developing improved dose/response relationships (C3).

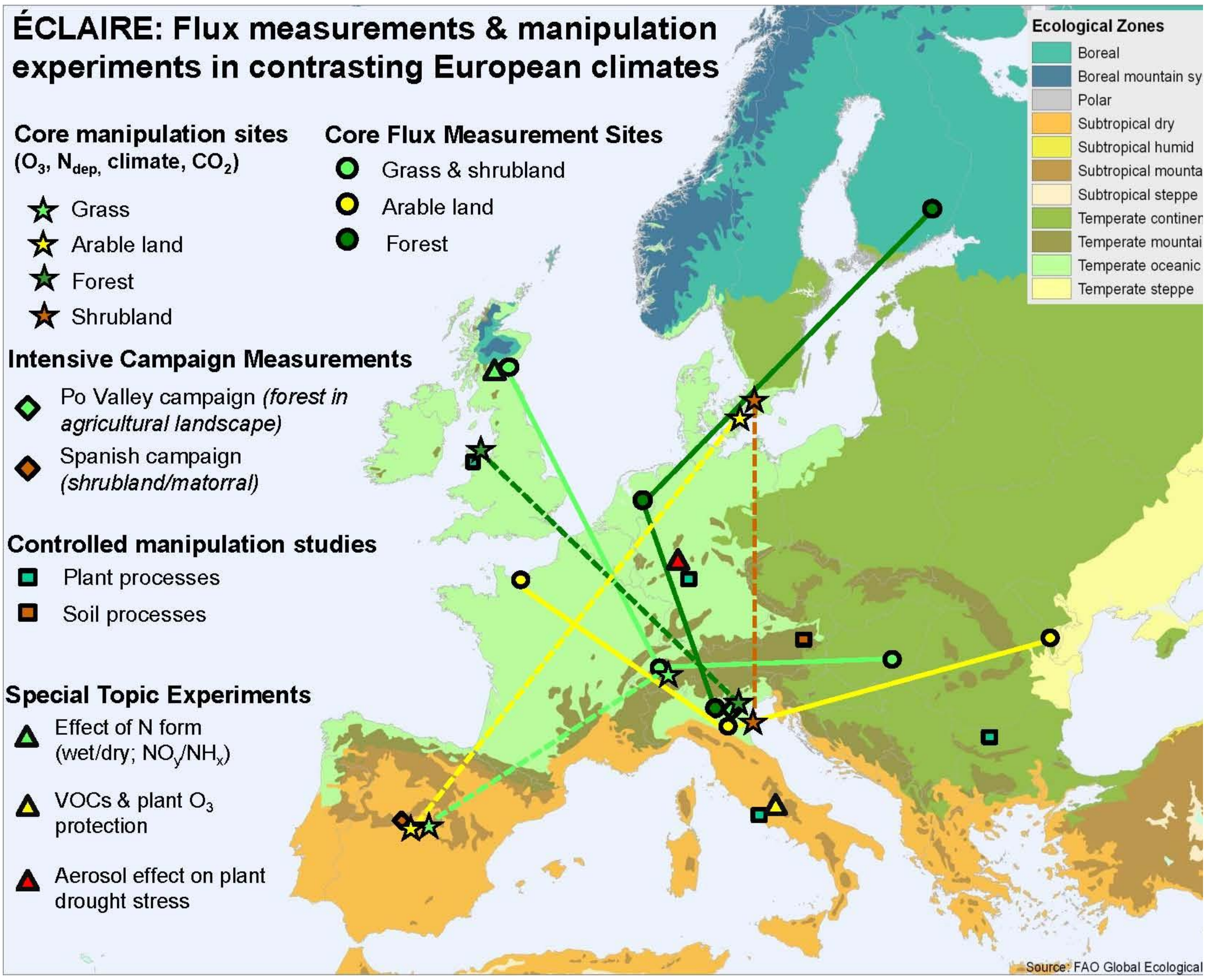

Fig. 1.2. ÉCLAIRE flux measurement network in contrasting European climates.

Field studies of exchange processes (WP1) Targeted measurements will fill key gaps in the database needed to improve the process understanding and parameterisations of emission / deposition in relation to climate variables. Benefiting from previous experience in making long-term flux measurements of reactive trace compounds (e.g. Erisman et al., 2001; Sutton et al., 2001; Skiba et al., 2009), we will make high-quality, high time-resolution (30-60 min.) long-term (15-months) flux measurements of key compounds (e.g., CO_2, O_3, soil NO) across a 9-site European flux network, covering forests, grassland and arable land (Fig. 1.2). These sites cover both Northern and Southern Europe (including a campaign in the Po Valley, Italy and one in Spain) allowing for the comparison of results across Europe (see Fig. 1.2 for more detail). Additional compounds (e.g. NO_2, VOCs, NH_3, aerosol) will be measured during two 6-week intensive measurement periods (IMPs; winter vs. summer), which will be synchronised to maximise the utility of the overall dataset for the assessment of CTM performance. The natural climatic differences between and meteorological variability at the sites, will provide the information needed to understand the response of deposition / emission rates in relation to climatic change parameters such as temperature, solar radiation, leaf surface wetness and soil moisture. These measurements will include the first synchronised European flux measurements of VOCs and long-term European O_3 flux measurements by eddy-covariance. It is anticipated that the IMPs will form the backbone of a larger network to be coordinated with the UNECE/EMEP programme, providing a comprehensive dataset for model development and evaluation. At the forest sites, measurements will include estimates of absorbed radiation to further understand the effect of aerosol on light penetration into the canopy and gross primary productivity.

To characterise in-canopy chemical processes and to compile a well constraint dataset for the development of coupled in-canopy chemistry / exchange models, a major collaborative field campaign will be conducted at a natural mixed oak forest in the Po Valley, Italy, under polluted conditions in a warm climate. This effort will be co-ordinated with the planned regional experiment of PEGASOS across the Po Valley to maximize the data synergy. In addition to the forest flux measurements, ÉCLAIRE will provide targeted ground-level concentration measurements during the campaign and evaluation of satellite data for NH_3, O_3, HNO_3, CO, CH_3OH and HCOOH (Clarisse et al., 2009; Razavi et al., 2010) to further evaluate the environmental drivers on air concentrations and hence emissions and deposition. No high-quality NH_3 flux measurements currently exist over Mediterranean semi-natural vegetation, providing a major gap in the understanding of NH_3 deposition rates to drought stressed vegetation. Targeted measurements above Spanish matorral are planned during two campaigns, to study the controls of exchange with active and dormant (drought stressed) vegetation.

Controlled studies on exchange processes (WP2) The control of environmental conditions on selected emission / deposition processes will be studied under controlled laboratory conditions to fill key gaps in the mechanistic understanding of control mechanisms: soil emissions of trace gases are governed by soil type, nutrient pools and microbial populations, but strongly respond to meteorological conditions, primarily soil temperature and soil water content. Within NitroEurope IP, two-parametric parametrisations were established for the emissions of NO, CO_2, CH_4 and N_2O using soil monoliths from selected sites (Schaufler et al., 2010). ÉCLAIRE will extend this work to study emissions/deposition for additional soils, for additional gases (e.g. NH_3, O_3) and to include emissions from plant litter, which is an important, but poorly understood source of many trace gases (e.g. Sutton et al., 2009a; Derendorp et al., 2010). Some progress has been made in improving the ability of models to predict NO and N_2O emissions following freeze/thaw events (e.g. Norman et al., 2008). Wetting through individual rainfall events is the second mechanism that often dominates the annual emission of NO from soils. A focussed study will be conducted to investigate the mechanism causing the emissions to understand how annual emissions will respond to changing weather patterns (soil temp.; precipitation frequency & amount).

Controlled environment studies will be conducted on the BVOC emission response to single and combined drivers of increased temperature, CO_2, drought, and in response to O_3 episodes. At the same time we will measure plant emissions of NO, which can be produced under stress conditions, together with BVOCs (Velikova et al., 2008). The work will target the behaviour of both "constitutive" compounds (e.g. terpenes) as well as "induced" BVOCs (methanol, acetaldehyde, C6-OVOC) and BVOC oxidation products (MVK, MACR, formaldehydes), for which we will attempt to derive compensation points and parametrisations of the canopy uptake resistances. This element of work will provide an improved mechanistic understanding of BVOC exchange to complement ÉCLAIRE's work on O_3 losses and detoxification.

Drought stress diminishes the vegetation sink for O_3 and NO_x, while heat and drought periods change the emissions of BVOC from vegetation which, in combination with NO_x, act as photochemical O_3 precursors. Under future climate conditions in many parts of Europe, ecosystems may become a smaller sink for O_3, while becoming more important as sources for O_3 precursors, which would increase O_3 concentrations over ecosystems. To quantify the extent of this expected net increase for the first time, we propose simulation chamber research activities to obtain deeper insight in the changes of individual steps. Changes of O_3 and NO_x uptake will be determined as well as O_3 destruction by gas phase reactions of O_3 with the BVOC emitted from the plants. Furthermore, photochemical O_3 production from the BVOC will be studied. To determine the individual steps we will use the unique Jülich Plant Atmosphere Chamber, (JPAC; Behnke et al., 2009; Mentel et al., 2009; Kiendler-Scharr et al., 2009) consisting of coupled plant and reaction chambers. Real plants will be used as source and sink for the air pollutants allowing realistic determinations of stress impacts on the plants. Model calculations will allow the results obtained from the simulation chamber experiments to be scaled up to the regional scale (linked to WP7). In the real environment, photochemical O_3 production takes place on a time scale of few hours, during which the wind can transport the air over several tens of km. The increase of the concentrations of the air pollutant O_3 therefore will affect other ecosystems than that where the drought or heat might have influenced the O_3 balance. To find realistic estimates with respect to the O_3 balance over larger areas findings will be delivered to a regional model where quantitative estimates are included with respect of the impact of future stress induced BVOC emissions on HO_x chemistry and O_3 formation. The study will further include the ecosystem response to this secondary forcing.

Modelling emissions processes (WP3) For the bi-directional exchange of NH_3 the major challenge remains to clarify the climate dependence of net ammonia emission and deposition. Even though existing models of NH_3 exchange include environmental controls (e.g. temperature, air humidity), the transferability of empirical model parameters to predict NH_3 exchange under warmer climate conditions remains uncertain (Nemitz et al., 2001). Similarly, the concept of the temperature sensitivity of the plant NH_3 compensation point and the numerical description of kinetics of NH_3 volatilization following manure applications under different climatic conditions needs further clarification and a re-assessment of realized mechanisms (Fowler et al., 2009). ÉCLAIRE will address these issues, developing parametrizations to examine the consequences of changing precipitation patterns (e.g. wetter winters and drier summers) are hypothesized to lead to a significant net increase in NH_3 emissions.

Major drivers of soil NO emissions are not only changes in environmental conditions such as changes in temperature or soil moisture, but also the relative abundance of N substrate and the competition for soil N between microoroganisms and plants (Butterbach-Bahl et al., 2009). Advanced mechanistic models already include a dynamic simulation of microbial biomass and activity in dependence of environmental conditions and mimic plant-microbe interactions in the rhizosphere. Thus, they are in principal capable to simulate climate change effects on soil emissions. The priority to improve process parameterization in ÉCLAIRE will focus on simulating drying-rewetting effects on NO production and emission or characterization of NO consumption processes in soils and to assess the uncertainty of parameterization and model predictions.

The quantification of climate feedbacks on BVOC emission from vegetation requires a mechanistic treatment of different environmental controls of isoprene emissions within land-surface schemes (Pacifico et al., 2009). However, these efforts are hampered by major uncertainties about why plants emit isoprene and the relative importance of different environmental controls such as, e.g., atmospheric CO_2 concentrations on BVOC emissions. Model development will thus focus on translating existing experimental knowledge into model code, thereby improving the description of physiological and physico-chemical controls of BVOC emissions from plants. This will also require to including induction mechanisms of BVOC production and emission and consideration of induced emissions by “non-emitting” plant species to explain and predict BVOC emission profiles under future climates.

Model performance and model uncertainty will be assessed against benchmark datasets of trace gas exchange as obtained by ÉCLAIRE (WP1 & WP2) and in previous projects (e.g., NitroEurope, GRAMINAE). The developed models/modules will serve as a basis to analyse and predict changes in regional emission and deposition fluxes as outlined in WPs 6 & 7.

Modelling bi-directional exchange (WP4) is dedicated to improving turbulent exchange parameterisations and routines, and their sensitivity to climate and environmental drivers. The focus is on O_3 and the dominant atmospheric N_r species (NH_3, HNO_3, NO_2, NH_4^+, NO_3^-) through a meta-analysis of the data from the ÉCLAIRE measurement activities (WP1, WP2) and other European and national projects. Existing parameterisations of dry deposition of N compounds will be extended and refined to improve their response to future meteorology and chemical climate. Key processes to be addressed will include the response of NH_3 compensation points to N inputs (e.g. Massad et al., 2010), the effects of wetness and acid deposition on NH_3 leaf-surface resistances, the effect of drought on stomatal opening, and the effect of near-surface gradients in temperature, humidity, NH_3 and HNO_3 on the volatilisation of NH_4NO_3 near the canopy.

The existing parameterisations of non-stomatal O_3 uptake typically include very crude, if any, descriptions of environmental controls such as irradiance, temperature and surface wetness. Based on the new experimental data provided by WP1 and WP2, ÉCLAIRE will significantly advance the capability to simulate the climate dependence of this process. Similarly, the parameterisations of stomatal O_3 uptake will be enhanced by incorporating the effect of atmospheric CO_2 concentration and the feedback of O_3 on stomatal function in a photosynthesis-based model of stomatal conductance.

Existing routines in CTMs are often single-layered and do not account for in-canopy chemical processes. In addition, to the development of big-leaf formulations, the parameterisations for plant emission/deposition will be extended for integration into an existing coupled 1D multi-layer exchange / chemistry model (Ganzeveld et al., 2002a), which is sufficiently computationally fast for implementation in regional CTMs (Ganzeveld et al., 2002b). The current model treats NO_x and BVOC photo-chemistry and will be extended to include NH_3-HNO_3-NH_4NO_3 phase partitioning in relation to aerosol composition before it is implemented into the EMEP European CTM.

WP4 includes the provision of measured monthly concentrations of N_r compounds and O_3 for two years at the effects study sites of C3 and the calculation of atmospheric N and O_3 inputs, using the improved dry deposition modeling methods (e.g. Flechard et al., 2010), as well as bulk precipitation for wet deposition.

The parameterisations on emission and dry deposition will be developed in close collaboration with the groups involved in the spatial up-scaling of exchange processes (C2), to ensure that they are compatible with the modelling frameworks and that input data are available.

Overall, Component 1 will deliver:

- Long-term and campaign-based flux measurements of key components (O_3, NO, CO_2, NH_3, VOCs, aerosol) across a European 9-site network (covering both Nothern and Southern Europe) suitable for process development and model assessment, including the first European network flux measurements for O_3 and VOCs (WP1).
- Improved parameterisations of emissions of NO, NH_3 and VOCs in relation to meteorology and pollutant inputs (WP2, WP3).
- An improved modeling framework for the bi-directional exchange of NO, NO_2, O_3, VOCs, NH_3, aerosols in relation to meteorology, pollutant deposition and plant function, under consideration of in-canopy chemistry (WP1, WP2, WP4).
- Estimates of N_r and O_3 dry and wet deposition at the manipulation sites used in Component 3 (WP4).

B 1.2.3 Emissions & exchange at local, European to global scales (Component 2)

State-of-the-art: Poor understanding of the temporal evolution and spatial distribution of biogenic and pyrogenic bidirectional fluxes (emission and deposition/uptake) have been recognized as a fundamental uncertainty in simulations of atmospheric chemistry and pollution, and pollution-climate interactions and ecosystem impacts (Andreae et al., 2005; Arneth et al., 2009; Dentener et al., 2005; Fuzzi et al., 2006; Stevenson et al., 2006). The many direct and indirect interactions of climate change, ecosystem processes and chemistry can both amplify or dampen the impacts of air pollutants on ecosystems. The often applied, simple temperature correlations for emissions, or static parameterisation in deposition algorithms do not take these interactions into account. What is more, today, even for present day and even for well-studied regions like Europe, the required temporal resolution emissions for precise quantification of their impacts on regional atmospheric pollution levels inadequate to address the meteorological interactions properly. Temporal profiles used in current atmospheric transport models are too general and coarse, and based on work conducted in the mid 1990s (e.g. Friedrich & Reis, 2004).

Not only the resolution of emissions remains unsatisfying, modeling European air pollution and or deposition is also subject to many uncertainties. One of them is related to the resolution of the modelling work, normally done for grid sizes that range from 20 – 100 km (or even more). These large grid sizes can easily mask local variability of landscape scale effects of climate change and air pollution on emissions from ecosystems and deposition and impact patterns, which can be seen using gridscales of 50 m to 5 km (Theobald et al., 2004; Vieno et al. 2010). Examples of such landscape scale effects are those due to extreme weather events *vs.* long-term trends and differences in the response in drought-affected *vs.* well-watered systems. Another example is the local recapture of e.g. NH_3 emission from point sources, which is difficult to simulate in large scale models. This local recapture of NH_3 can be up to 60% within a few kilometers of a point source, and depends to a large extent on temperature- and wetness-related parameters including stomatal conductances, compensation point concentrations and cuticular absorption (Loubet et al. 2009), so that local recapture is expected to be highly climate sensitive. The effects of such landscape scale interactions are currently not included in European scale models, but are also relevant for NO_x, O_3 and HNO_3 related to climatic effects on local scale variation of NO_x and VOC transformations and effects of irrigation and drainage patterns on water balance and O_3 uptake.

For N-deposition the EMEP model has typically been run at 50 km resolution, with recent model versions also providing data down to 10 km grid sizes for Europe, or 5 km over the UK (Vieno et al., 2010). A sub-grid (mosaic) procedure is used for predictions of deposition over different landcover types. Ozone uptake into vegetation is represented by the phyto-toxic dose (POD) concept (e.g. Mills et al., 2010). A simpler metric is AOT40, the sum of daytime ozone concentrations over 40 ppb during the growing season, with O_3 fluxes included in the EMEP model using the DO_3SE deposition module. However, the empirical approach used for both stomatal and non-stomatal O_3 uptake processes limits the model applicability for future scenarios. For example, there is a strong need to evaluate the extent to which these non-stomatal losses are due to reactions with biogenic VOC and reactive N species in the canopy, as these factors will change under future climates. Such reactions have a potential to strongly modify the calculated stomatal uptake of ozone, and hence vegetation damage. For example, Goldstein et al. (2004) found that unmeasured VOC accounted for the majority of O_3 uptake in a pine forest.

Improved understanding on how processes in natural and agricultural ecosystems are affected simultaneously by climate change and air pollution has very recently found its way into terrestrial models (Arneth et al., 2010a), but so far, these interactions have been studied mainly in relation to terrestrial vegetation-carbon cycle dynamics and their climate interactions (Arneth et al., 2010b; Mercado et al., 2009; Sitch et al., 2007; Zaehle et al., 2010). They have not yet been incorporated into chemical transport or chemistry-climate models for assessing effects of these improved process-descriptions on simulations of air pollution, pollution-climate interactions, and impacts of combined pollution and climate change on ecosystems. However, when considering that the quantification of emissions as well as deposition and uptake of greenhouse gases, reactive trace gases and particles is one of the chief challenges to improve our understanding of combined pollution-climate impacts on ecosystems, a more concise representation of the underlying biological, physical and chemical mechanisms at different spatial scales must be a priority.

Progress over state-of-the-art offered by ÉCLAIRE: Component 2 will assimilate the advances in the process understanding of emissions, bi-directional exchange processes and in-canopy reactions from C1, the recent literature and models into spatial chemical transport models to compile modeling frameworks which are mechanistically responsive to changes in climate, land use/land cover and pollutant inputs. The work programme will aim to understand past and predict future trends in Northern Hemispheric O_3 concentrations (WP5), and provide frameworks to model spatially and temporally resolved emission fields in response to meteorology (WP6) and pollutant deposition fields both at the European (WP7) and global scale (relevant for WP 2.1), and better understand the air quality and climate change interactions at local and regional scales (WP8). These improved modeling systems will be used to provide exposure and deposition inputs for the development of metrics for ecosystem threats (C3) and to assess ecological responses under current and future climate (C4) (Fig. 1.6).

Past and future changes of atmospheric pollutants transported into Europe (WP5). An increasing trend in O_3 concentrations has been measured consistently at a number of remote sites across the Northern Hemisphere, suggesting an increase in the hemispheric baseline O_3 concentration of a factor of two during the latter half of the 20th century. The Hemispheric Transport of Air Pollutants (HTAP, 2010) assessment asserts that it is likely that much of this change is due to increases in anthropogenic emissions of O_3 precursors, with regional changes (either increases or decreases) and climate change complicating the interpretation (HTAP, 2010). A good understanding of global background changes is essential for further analysis of O_3 impacts on ecosystems and the services they provide on the European scale (Panish et al., 2009).

Recent model re-analyses, e.g. for the FP5 RETRO project (Schulze, 2007), have shown limited success in understanding these recent trends. Currently, in the context of the forthcoming IPCC AR5 report and within the FP7 PEGASOS project, further model experiments are being performed to analyze the consistency of models with the observed trends. We will immediately make use of the results of these activities, augmented with a limited amount of dedicated sensitivity simulations, to produce a best estimate and uncertainty range of recent changes in chemical boundary conditions at the western edge of Europe, where the main inflow of air pollution occurs.

With few exceptions, most studies on recent trends and future projections of O_3 have concentrated on anthropogenic emissions and ignored interactions with dynamically changing biogenic and pyrogenic emissions, and with climate change (Arneth et al., 2009; Schindell et al., 2008). State-of-the-art estimates of global and European scale changes in biogenic and fire emissions will be utilized in this WP, to evaluate their impact on future chemistry boundary conditions. We will use coupled atmospheric-chemistry-climate models (TM5, LMD_z-INCA-ORCHIDEE) to consistently evaluate the contributions of natural and anthropogenic emissions and other boundary conditions on inflows of air pollution into Europe. Additionally, chemistry transport models will be used to evaluate the impact or regional contributions to global atmospheric chemistry, and how they influence trends and their uncertainties in past and future, with a focus on the inflow regions of pollution into Europe.

Emissions on regional to global scale (WP6). In ÉCLAIRE, the focus on spatial emission modelling lies with process-based, dynamically changing emissions from natural and agricultural systems, as an integral part of the chemistry-climate-carbon cycle system. Dynamic parametrisations for emissions of NH_3, NO and BVOCs from terrestrial systems, taken from the literature and developed in C1, will be implemented into terrestrial models to calculate emissions online, in relation to meteorological conditions and pollutant interactions, including also interactions with the carbon cycle (as the basis for work in C4). Despite this emphasis on natural and agricultural systems, other anthropogenic emissions (from power generation, industry, transport etc.) also need to be considered in this context. The temporal emission patterns of all these sources are quite variable, driven by human activities and – in some sectors – meteorological parameters (e.g. energy demand, agricultural activities). This temporal variation has so far not been considered for pollution impact assessments although previous work for instance within the EUROTRAC-2 subproject GENEMIS (Friedrich and Reis, 2004) or by Hellsten et al. (2007) provide a good understanding of the mechanisms and temporal patterns for a range of sectors. Within ÉCLAIRE, a consistent approach will be applied to generate up-to-date temporal profiles for key source sectors to be implemented in atmospheric dispersion models on all scales, especially including the meteorological sensitivity of emissions.

Modelling European air pollution and deposition (WP7) in ÉCLAIRE will advance the state-of-the-art by incorporating a comprehensive treatment of the meteorologically-related emission and hemispheric transport effects discussed above. To do this, European-scale chemical transport modelling will focus on two main themes: (i) improved modules from C1 will be implemented in the EMEP CTM in order to allow mechanistically for climate related changes in future scenarios, and (ii) a small ensemble of CTMs will be applied to assess uncertainties in key model predictions under future climate scenarios. In WP7 we will significantly improve the EMEP model's capacity for applications in future climate through the use of a multi-layer canopy model to deal with in-canopy reactions and exchanges (in cooperation with WP4, building on Ganzeveld et al., 2002a and Flechard et al., 2010, focused on NH_3, HNO_3, NO_x, VOC, aerosol), through the implementation of a photo-synthesis based stomatal conductance algorithm (building on Bueker et al., 2007), and through links to the LPJ-GUESS model. Novel thresholds and methods arising from C3 will be incorporated. The goal of these changes is to enable the CTM model to incorporate the impacts of changing pollution, landcover and climate on the calculation of pollutant doses and hence to calculate new ecosystem metrics for current and future scenarios.

The use of a small ensemble of models has often been shown to generate a mean result which compares better with observations than any particular model (e.g., Dentener et al., 2006a; van Loon et al., 2007), an approach which is also seen to be essential within IPCC. We will use six different CTMs (EMEP, EURAD, LOTOS, TM5, LMD_Z-INCA-ORCHIDEE, MATCH; see Table 1.1). As the official model supporting EU and UNECE policy, the EMEP model will be the central tool to provide deposition fields, while the other models are required to estimate uncertainty and to explore smaller scale variability. An important outcome will be an assessment of model uncertainty for N-deposition. As part of the Nitro-Europe IP, Flechard et al. (2010) have shown large differences in predicted deposition rates between different deposition schemes. It is currently not known which scheme provides the most realistic estimate of N deposition. Some differences are due to model choices, others reflect uncertainties in the science. None of the models examined by Flechard et al. (2010) took account of in-canopy reactions, and only one accounted for compensation points. With six CTMs, and the possibility of including or excluding in-canopy processes in some models, and to run at different spatial resolutions, we aim at a much better understanding of the accuracy of modelled N-deposition, a well as of O_3 flux predictions.

Most climate model simulations make use of coarse grid sizes, typically 1-2 degrees. In ÉCLAIRE we will make use of downscaled meteorology for Europe generated with SMHI's regional climate model (Kjellström et al., 2005) to generate 50 km meteorology focused on 2030 and 2050. Coupled with the changes in chemical boundary conditions from WP5, emissions and landcover changes from WP6, and changes in meteorology (including e.g. changes in temperature and precipitation patterns), the EMEP and MATCH CTMs will explore changes in future ozone-damage metrics, and in wet and dry deposition of N and sulphur to different ecosystems.

Table 1.1. Summary of numerical models used in ÉCLAIRE.

Model type	Scale	Processes	Application	Used in ÉCLAIRE
Dynamic vegetation & trace gas emissions models (DGVMs)	Regional, Europe to globe, 2-D	Dynamic response of vegetation and soil to climate and CO_2 drivers, in some cases also to N-deposition and ozone levels. May be applied to potential natural vegetation or include crop cover and processes	Dynamically varying biogenic emissions (e.g., NO_x, BVOC, fire). Response of vegetation and soil C- and N- pools and cycles, to changing climate, atmospheric composition and in some cases N or O_3	CLM, LPJ-GUESS, JULES, ORCHIDEE
Soil process and trace gas emission models (DSVMs)	Point to Europe (2-D)	Soil C-N decomposition processes and nutrient chemistry. Relies on prescribed soil and vegetation properties, may be applied to natural or agricultural ecosystems	Response of soil C and N pools, trace gas emissions, nutrient levels to changes in emissions, climate, vegetation litter input or management	DNDC-MOBILE, DNDC-metamodel, FORSPACE, VSD-$N^{14}C$, SUMO
Deposition / bi-directional exchange models	Point / 1-D column	Within-and above canopy exchange (O_3, VOC, NO_x, aerosol) and in-canopy chemistry	O_3 stomata deposition-dose effects; N_r deposition; pollutant life-time	CanT, DO_3SE, various CTM sub-models
Regional Climate model (RCMs)	European	Calculates meteorology for future climate simulations, downscaling from large-scale GCM results to 50 km over Europe	Provides future climate meteorology for DVGM, DSVMS and CTMs, as well as future climate data	RCA
Chemistry transport model (CTMs)	Regional, Europe to globe, 3-D	Atmospheric reaction pathways, transport and deposition of natural and anthropogenic emissions, in some cases also in response to climate change	Variable O_3 & other gases or aerosol,, wet/dry deposition of O_3, N and other compounds; PODY (phytotoxic ozone dose)	EMEP, EURAD, LOTOS, TM5, LMD_Z-INCA-ORCHIDEE, MATCH
Biodiversity assessment model	Point (2-D)	Species composition response to changing soil properties (e.g., %C, %N, soil chemistry) or Ellenberg ecosystem indicators	Biodiversity indicators based on species prevalence	GBMOVE, MOVE
Integrated assessment model	Countries regions	Transfer coefficients, emission factors, optimisation targets, costs, etc	Optimised emissions and costs, translated into transfer matrix linked with CTM	GAINS

Assessing local and regional variation (WP8). Recognizing the importance of sub-grid interactions for air pollutant impacts on ecosystems, it is essential to quantify how climate change may alter fine-scale spatial patterns and transport distances. This will be taken forward in ÉCLAIRE by incorporating the climate-sensitive parametrisations from C1 and C2 into two modelling approaches (EMEP4UK, Vieno et al., 2010, and OPS, van Pul et al. 2004) for two case study areas. Application of EMEP4UK at 5 km (to UK and NL) and 1 km resolution (nested domains of c. 200 km x 200 km) will be compared with application OPS for the same 1 km resolution domains and at 50 m resolution (nested domains of 5 km x 5 km domains). The latter will exploit the NitroScape landscape model (incorporating OPS) and inventory datasets already established by NitroEurope IP, with the new developments focusing on the assessment of climate sensitivity (input to WP17). So far, such spatial interactions have not been included in large scale models. This will be addressed in ÉCLAIRE by developing a simplified sub-grid procedure for inclusion in the EMEP European model. The high resolution models will be used to characterize the local interactions between to climate and atmospheric deposition, as a basis to develop the sub-grid procedure (including effects of both landuse and emission heterogeneity). Incorporation of the procedure in the EMEP model (WP7) will allow more detailed European maps of ecosystem-relevant O_3 and N deposition metrics, as well as to assess the uncertainty associated with models that cannot include such fine-scale features.

Overall, Component 2 will deliver:

- Improved understanding of past, present and future global, hemispheric and European atmospheric pollution-climate interactions, including the relative pollutant contribution of local source and long-range transport.
- Quantification of the dynamically varying source contribution of emissions of pollutants and their precursors (i.e., NO_x, NH_3, BVOC, pyrogenic sources) from ecosystems (natural, semi-natural and agricultural) in response to changing climate, pollutant levels and changing CO_2 concentration.
- Novel maps of pollution metrics across Europe, taking into consideration climate and pollution change, and canopy-chemistry interactions, especially for wet and dry deposition processes.
- Case studies of local and landscape heterogeneity (input to WP17) and a novel sub-grid parameterization for high-resolution EMEP impacts assessment across Europe.

B 1.2.4 Ecological response processes and thresholds (Component 3)

State-of-the-art: Much of the current understanding of impacts of air pollution components on terrestrial ecosystems is based on field surveys of injury, growth effects, or species diversity changes, and controlled exposure experiments. Critical loads and levels have been derived from these data for the detrimental effects of N and O_3 pollution on a variety of plant types and ecosystems, including mosses, lichens and mycorrhizae, in crops, forests, grasslands, heathlands and oligotrophic wetlands (Achermann & Bobbink, 2003; Bobbink et al 2010). The detrimental effects of ground-level O_3 on vegetation have been addressed in developing international air pollution policies. The indicators used in both the CLRTAP Gothenburg Protocol and the EU Daughter Directive on O_3 were based on the accumulated O_3 concentrations above 40 ppb (AOT40). Based on developments over the last decade, the accumulated O_3 flux via plant stomata (Phytotoxic Ozone Dose above a threshold of Y nmol m^{-2} s^{-1}, POD_Y, previously described as $AF_{st}Y$) is now considered to provide a biologically more sound method for describing observed effects (CLRTAP, 2010). POD_Y is calculated from the effects of climate (temperature, humidity, light), ozone, soil (moisture availability) and plant development (growth stage) on the extent of opening of the stomatal pores on leaf surfaces through which O_3 enters the plant (Emberson *et al*., 2000). Ozone flux is modelled using DO_3SE, and O_3 flux-effect relationships have recently been derived for several species of crops, trees and natural vegetation (CLRTAP, 2010). Although models such as DO_3SE have the capacity to be expanded to include impacts of N, climate change and other pollutants, more data compilation and analysis together with new experimental work are required before this can be achieved. Air concentrations and N deposition can affect plant fitness, ecosystem functioning and biodiversity by direct toxicity (e.g. Britto & Kronzucker, 2002), reduced resistance to environmental stresses such as frost (e.g. Caporn et al., 2000), increased susceptibility to pests and disease (e.g. Brunstig & Heil, 1985), soil mediated effects of acidification and eutrophication (e.g. Stevens et al., 2006) as well as N stimulation of plant growth (e.g. Ciais et al., 2008), while the effect on C sequestration in the soil and the system is still debated (e.g. Sutton et al., 2008).

Despite knowledge of their importance in the setting of thresholds for effects, the actual contribution of biological processes that allow detoxification of pollutants inside leaves, or pollution removal at the leaf-open air boundary is still elusive (Vickers et al., 2009). Thus, the importance of biological processes that are altered and/or induced by exposure to pollutants awaits comprehensive assessment, especially with regard to those processes leading to the biosynthesis of molecules that alter pollution formation, uptake and detoxification (Loreto & Schnitzler, 2010).

The development of pollutant dose models (including links with WP4) will substantially improve our ability to assess future impacts of air pollution on terrestrial ecosystems, since it will provide a tool by which we can analyse experimental data to better understand the effects of interactions between different air pollution components and/or the effects of interactions with simultaneous atmospheric chemistry and climate change in determining the impacts on plants and ecosystems. Furthermore, since little is known about the impacts of combined air pollution components on ecosystem functioning, such as plant species composition, nutrient cycling and soil carbon storage, it will be imperative to be able to scale improved process-based understanding at the plant and community level to the ecosystem level. This will allow ÉCLAIRE to develop a clearer picture of the longer term effects of continued ecosystem exposure and how these effects may alter under changing climates. Importantly, an assessment of the interactions and feedbacks between ecosystem response and atmospheric composition will also provide an improved understanding of potential feedback processes on climate change.

Progress over state-of-the-art offered by ÉCLAIRE: Component 3 will improve our understanding of air pollution impacts on terrestrial ecosystem functioning and services through a combination of data mining and analyses of existing data, and by conducting field scale experiments and process studies on the impacts of air pollution components and their interactions with other important drivers such as climate, land use and land management. These experiments and process studies together with analysis of dose-response relationships will provide new data to develop and improve ecosystem models and threshold setting.

Table 1.2: Ecosystems addressed by the ÉCLAIRE partners in WP3.1.

Partner	DTU	CEH-Ba	IVL	York	Ugo	CEH-ed	ALTERRA	WSL
Forest		XX	XX				XX	XX
Grassland		XX		XX				
Arable		XX			XX			
Wetlands/ heathlands	XX					XX		

Data analyses and data mining (WP9). For the first time, pan-European data from survey, field-scale ecosystem manipulation and controlled exposure experiments conducted under near-ambient climatic conditions will be compiled according to a common protocol (coordinated with Task 21.2). This data mining exercise will be driven by the need to set novel thresholds (WP12) and requirements for modelling effects on ecosystem function including species change, C stocks and greenhouse gas interactions (WP13). Tasks will be split by ecosystem type (Table 1.2), with a common aim of collating data on: species composition, management practices, pollutant treatment regime, soil type and properties, atmospheric O_3, CO_2 concentration and N load, meteorological data, plant measurements (including leaf area index, photosynthesis and respiration, and above and below ground biomass) and soil parameters (including C and N pools, soil solution chemistry and CH_4 and N_2O fluxes and soil moisture). Assembly of this extensive pre-existing dataset will deliver to ÉCLAIRE quantitative relationships between N, S and O_3 exposure, and effects on plant physiology and growth processes, as well as impacts on terrestrial ecosystem functioning, C balance and ecosystem services, accounting for climatic variations. The analysis will also highlight knowledge gaps to be filled by new experiments (WP10).

Ecosystem experiments (WP10). Field scale experiments provide a unique tool to obtain realistic knowledge on the effects of perturbations on ecosystem processes and functioning, especially when combined with ecosystem modeling (Beier, 2004). At the European scale, a large number of manipulation experiments have been conducted to highlight the impacts of air pollution components such as SO_2, CO_2, gaseous N components and O_3. However, most of these have only involved the impacts of the individual factors and have often focused on individual plant stress responses. Therefore, our knowledge on interactions between air pollution components and simultaneous changes in other drivers such as climate, and the consequent changes in the overall ecosystem functioning and C balance is limited.

Understanding how air pollutants affect plant and soil processes directly and interact with other air pollutants, elevated CO_2 and climate change require experimental testing under various degrees of controlled conditions from laboratory studies with single plants to field scale experiments at natural/realistic ecosystem conditions. This work package will bring together eight existing experiments in forest, grassland, agriculture and shrubland ecosystems (4 ecosystems x 2 climate regimes for each; covering both Northern and Souther European sites, Table 1.3 & Fig. 1.2) where terrestrial ecosystems are exposed to air pollutants alone or in combination with climate drivers. The experiments will provide dose-response relationships for air pollutants including how these will affect plant fitness, plant growth and ecosystem carbon storage. Further, the experiments will quantify how the dose-response relationships are affected by climate and identify relevant thresholds for O_3 and N deposition below which damage would not be expected to occur. This will provide the process understanding necessary (including the contrast between Northern and Southern Europe) for the building and development of ecosystem models, while providing data for testing of these models (WP13).

Novel interactions (WP11). Interactions between the biosphere and the atmosphere may modify the air pollution deposition, uptake and impacts on terrestrial ecosystems. This activity will investigate and test novel hypotheses on these interactions in order to understand, evaluate and quantify the mechanisms involved in causing or modifying impacts of air pollutants in terrestrial ecosystems. For example, climate- air pollution interactions alter the emission of biogenic hydrocarbons with potential as indirect greenhouse gases and as catalysts of O_3 and particle formation, thus further shape the chemical climate, especially in heavily anthropic conditions. These interactions are not currently comprehensively considered when air pollution impacts on ecosystems are assessed.

ÉCLAIRE will advance understanding for three special topics under WP11: The work will: (1) investigate how climate change, including increasing background ozone concentration and dry or wet N deposition will enhance greenhouse gas release and increase the threat to vegetation by NH_3. A major long-term field experiment (8-11 years of treatment; Sheppard et al., 2008) contrasting wet NH_4^+, wet NO_3^- and dry NH_3 deposition on ombrotrophic mire will be applied to assess the differential sensitivity of N form on CO_2 exchange, O_3 sensitivity and other trace gas fluxes, combined with varying effects of temperature and moisture on exposed soil monoliths; (2) assess how much detoxification of O_3 by increased BVOC production at the leaf level will increase the O_3 uptake efficiency by vegetation, counteracting the effect of BVOC on increasing atmospheric O_3 from secondary production (WP3), and lead to improved antioxidant properties and reduced emission of other stress-induced, reactive BVOC (e.g. NO, lipoxygenase (LOX) compounds; Vickers et al., 2009). Use of controlled conditions will allow explicit assessment of the temperature and radiation relationships; and 3) examine the extent to which hygroscopic particles accumulating on leaves from aerosol and trace gas deposition may attract water and lead to enhanced transpiration and reduced drought tolerance (Burkhardt, 2010). The results will be integrated in the novel threshold definition (WP12) and will provide inputs to improve process-based modeling of pollutants (WP13).

Novel thresholds (WP12) Currently, critical loads and levels for N and O_3 are based on empirical data or first principle soil chemistry. There is little understanding of the plant physiological and growth processes that actually lead to impacts. This makes any assessment of the combined effects that a variety of pollutants (N, O_3 etc.) acting in combination extremely difficult. It also lessens our ability to quantify the effect that environmental factors (such as temperature, soil and atmospheric humidity status, atmospheric CO_2 concentrations) might play in modifying plant sensitivity to pollutant deposition. Firstly, this WP will take advantage of the improvements in the modeling of pollutant surface exchange (WP4) to model pollutant deposition and uptake at the ÉCLAIRE experimental study sites (WP10), allowing pollutant doses to be more reliably estimated and related to the plant/community responses observed in the experimental work. This information, coupled with the data derived from the data mining activities (WP9) relating pollutant exposure to key physiological and plant growth processes, will be used to establish an improved understanding of the physiological processes leading to plant and community effects. Secondly, the WP draw on the results of the ‘special topic’ experiments on novel interactions (WP11) to examine how the effects of: i) differences between N form (wet/dry, NO_y/NH_x), ii) anti-oxidant interactions with BVOC fluxes affecting O_3 effects and iii) aerosol exacerbation of plant drought stress could be incorporated in the development of novel threshold approaches.

The information gathered in ÉCLAIRE will be applied to simulate the effects of combinations of pollutants under varying environmental conditions to explore the consequences for the novel effects thresholds. Selecting the plant/soil responses for study will involve collaboration with WP18, to define key response parameters (e.g. yield losses, C sequestration, losses in amenity value of ecosystems) that are relevant for the assessment of impacts on ecosystem services conducted in C5. This work will lead to the definition of new dose-response relationships and novel thresholds for each of the key responses investigated in the experimental studies and inferred from the data mining exercise. Selected thresholds and relationships will be applied under WP16 to assess pollution impacts on key ecosystem services across Europe.

Table 1.3: Network of effects experiments contrasting 4 ecoystem types across Europe and ÉCLAIRE's contribution in WP10. Additional, 'special topic' experiments are discussed under WP11. See also Fig. 1.2 for geographical representation.

Location	Site	Institute	Plant species	Treatments	ÉCLAIRE focus
Forest					
N Europe	Bangor solardome	CEH (Ban), UK	Silver birch (Betula pendula) and alder (Alnus glutinosa)	O_3 (5 levels) + wet N + drought	Effects of combined stresses on whole tree carbon balance, transpiration and O_3 flux.
S Europe	Brescia OTC	UNICATT, IT	Beech, Ash, Oak, Poplar.	O_3 (3 levels) + drought (2 levels) + wet N	Effects of combined abiotic stresses on carbon assimilation, transpiration, photosynthesis, growth (epigean and ipogean).
Grassland					
S. Europe	Dehesa grasslands – OTC	CIEMAT, ES	Mix of 8 annual species (legumes/grass/forbs)	O_3 (4 levels) and N (3 levels) N (3 levels) and drought (2 levels)	Effects of combined stresses on C balance, gas exchange, species balance and O_3 flux. N and drought effects on N emissions and leaching.
C. Europe	Alp Flix	Agroscope ART, CH		O_3 (3 levels) and N (5 levels) exposure.	Interactive effect of O_3 and wet N under climate change. O_3/N response relationships for endpoints related to ecosystem C turnover and balance
Agriculture					
N. Europe	Risoe phytotron	Risoe, DK	Barley and oil seed rape	Elevated CO_2, T, precipitation and O_3	Effects of climate and O_3 interactions on plant stress, carbon uptake and disease vulnerability
S. Europe	Spain – OTC	CIEMAT, ES	Leafy crops (lettuce, spinach)	O_3 (4 levels) and N (3 levels)	Effects of combined stresses on gas exchange, O_3 flux, leave damage, quality and yield
Shrubland					
N. Europe	Brandbjerg/ CLIMAITE	Risoe, DK	Calluna vulgaris & Deschampsia flexuosa	Elevated CO_2, temperature and altered precipitation – interaction with O_3 (mesocosm transfer to phytotron).	Net and interactive effects of climate stress on plant growth, plant stress, ecosystem carbon storage and GHG exchange and interactions with O_3 exposure.
S. Europe	Macchia OTC	UNICATT, IT	Holm oak, Strawberry Tree, Phyillirea	O_3 (3 levels) + drought (2 levels)	Effects of combined abiotic stresses on carbon assimilation, transpiration, photosynthesis, growth (epigean and ipogean).

Ecosystem modeling (WP13) While short-term and direct impacts of air pollutants on plant tissue and plant biomass increments can be evaluated through dose-response and threshold experiments, the long-term impacts of these air pollutants on terrestrial ecosystems including interactions with elevated CO_2 and climate change, are difficult to verify directly through experiments and measurements. Therefore, engagement of proper and well tested dynamic ecosystem models is a fundamental requirement for overall assessment of the impacts and interactions. ÉCLAIRE will advance current capacity to predict air pollutant and climate impacts, for the first time combining and rigorously testing models of photosynthetic uptake, plant growth and competition, and soil biogeochemistry. A suite of existing process based plot scale models, including key models used for the CLRTAP, will be developed to model the deposition and impacts of O_3 exposure, N deposition, acidification change, increasing atmospheric CO_2, climate change (temperature and water availability) and nutrient availability. Since changes in ecosystem structure and composition critically determine the overall ecosystem functioning, potential changes in plant species composition driven by climate change need to be incorporated into the biogeochemical models. This will require the dynamic linking of existing biogeochemical and vegetation models to predict ecosystem feedbacks and effects of multiple drivers. Therefore, data from the experiments will be provided to test and validate vegetation change models. This activity will be closely integrated with C4, with models developed for site-based and regional application which have differing complexity and process descriptions, being tested and applied in parallel to the experimental datasets generated by WP10 and WP11. The results will provide both prediction of future air pollutant ecosystem impacts at the site scale, and a robust basis for large-scale prediction in C4.

Overall, Component 3 will deliver:

- A new database and results of meta-analysis on air pollution impacts on land ecosystems including soils.
- Ecosystem response data on plant responses and ecosystem C balance to experimental changes in air pollution and interacting drivers, including climate and land use differences.
- Parametrization of the fraction of O_3 that is taken up by leaves due to detoxification by constitutive BVOC, under associated environmental constraints and during leaf development, assessment of the relative effects of wet/dry and NO_y/NH_x deposition and the role of aerosol deposition in exacerbating drought stress.
- Novel thresholds for key dose-response relationships for application in regional scale modelling and mapping relevant for ecosystem service assessment.
- Assessments of the effects of combined air pollution and climate change scenarios on ecosystem C/GHG balance, soil quality and vegetation change at the experimental sites, based on integrated models.

B 1.2.5 Ecological responses at regional and European scales (Component 4)

State-of-the-art: To quantify the interacting impacts of air pollution and climate change on C balance and plant species, models are needed that represent the C and N cycle and make a link to soil quality and plant species diversity. Various dynamic global vegetation models (DGVMs) have been developed to assess shifts in vegetation and the associated exchange of energy, water and carbon as a response to shifts in climate and CO_2 concentration on a global scale (e.g. Cramer et al., 2004). These model studies have previously been criticized for overestimating both future terrestrial C sequestration and the potential carbon-climate feedback because C accumulation may be constrained by nutrients, particularly N (Hungate et al., 2003; Thornton et al., 2007), while O_3 may further reduce productivity. Recently, the interactions of CO_2, climate and N availability has been included in a DGVM by Zaehle et al. (2010), while the impact of O_3 exposure on photosynthesis has been included by Sitch et al. (2007). Furthermore, dynamic soil vegetation models (DSVMs) have been developed (Belyazid et al., 2006; De Vries et al., 2010; Sverdrup et al., 2007) that focus on the impacts of N and S deposition and climate change on soil quality (acidity and nutrients) and biodiversity, while including relative simple nutrient-driven growth models.

In line with experiments and field data, these modeling approaches have shown that, apart from changes in management (Ciais et al., 2008; Nabuurs et al., 2001), productivity and C sequestration in terrestrial ecosystems is strongly affected by changes in: (i) air pollution, including N deposition (Zaehle & Friend, 2010), O_3 exposure (e.g. Sitch et al., 2007), atmospheric CO_2 concentration (e.g. Friedlingstein et al., 1995) and aerosols/fine particulates (Mercado et al., 2009), (ii) climate change (Cramer et al., 2001; Friedlingstein et al., 2006) and (iii) soil acidity and availability of non-nitrogen nutrients (De Vries and Posch, 2010;

Wamelink et al., 2009). The various model approaches, however, do not yet account for the full effects of climate and air pollution on net primary production and C allocation, such as the effects of combined drivers (N, O_3, CO_2) on photosynthesis rates and stomatal O_3 uptake (Fowler et al., 2009; Hickler et al., 2008; Zaehle et al., 2010). Moreover, the phytoprotective role of BVOC (Fares et al., 2008; Loreto and Velikova, 2001) is not yet included in global models.

Drivers that affect C sequestration also affect plant species diversity of terrestrial ecosystems. N is considered as the most important air pollutant in this context. Empirical critical N loads have thus been derived by field studies (e.g. Achermann and Bobbink, 2003) and for regional assessments, model based critical N loads have been derived (e.g. De Vries et al., 2010). Until now, however, the model-based N critical load approach, used in European environmental policy making, is based on an ecosystem mass balance, in which the harmful effects are defined in terms of critical limits for N concentration in soil water, as a criterion to avoid N saturation of the system (Hettelingh et al., 2001; Spranger et al., 2008). The current model-based critical N loads therefore do not give “scientifically sound” thresholds for protecting plant ecosystems. A combination of dynamic soil-vegetation models (DSVMs) with dynamic multi-species models has the potential to both predict plant species composition as a function of N deposition and calculate “scientifically sound” critical N loads in relation to a prescribed protection level of the species composition (inverse model use). Until now, such an approach has only been used in a limited region by van Dobben et al. (2006), due to lack of data on plant species composition and abiotic factors, such as temperature, N availability and soil pH. With respect to O_3, critical uptake levels are based on impacts on productivity, since evidence for direct effects of O_3 exposure on plant species diversity is lacking. However, indirect effects may occur through impacts of O_3 on plant productivity and thereby on light interception (e.g. below forests), thus affecting the ground flora, and such effects need to be considered.

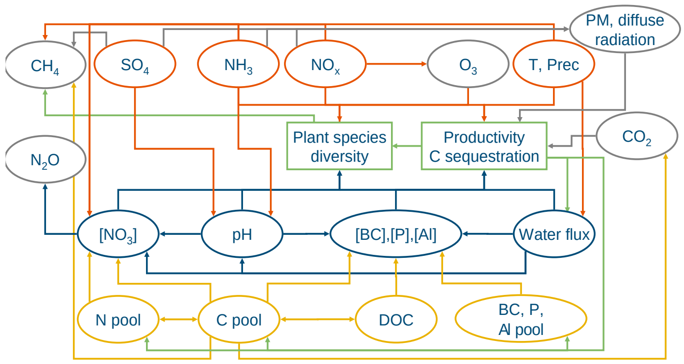

Fig. 1.3. Relationships that will be investigated between air quality and climate impacts on productivity (carbon and greenhouse gas emissions), soil quality and plant species community composition.

The assessment of threshold exceedances at the European scale is necessarily limited by both available data quality and model resolution. First of all, exposure to air pollution impacts is highly spatially variable, depending on the pattern of emissions, meteorological drivers (including future local variability in climate alteration) as investigated under C2.4. Secondly, receptor sensitivity and thereby the critical load for nitrogen varies in space. Consequently, the area exceeding critical loads varies with the spatial resolution. Insight in the effects of using fine resolution atmospheric input data on critical load exceedances is until now limited (Hallsworth et al., 2010).

Progress over state-of-the-art offered by ÉCLAIRE: Component 4 of ÉCLAIRE will develop and apply existing process-based models to upscale impacts of air quality, climate change and nutrient availability, and their interactions on plant productivity / C sequestration (WP14) and plant species diversity (WP15) (Fig. 1.3), at the continental scale and assess critical loads based on thresholds related to unacceptable impacts on those ecosystem services at this scale (WP16), while accounting for effects of spatial resolution on outputs (WP17).

The approach will advance the compatibility of diverse modeling tools, which currently exist for assessing air quality and climate impacts on productivity and/or plant species diversity and soil quality, including DGVMs and DSVMs (Table 1.1). The DGVMs will be further developed and applied in C4 to predict productivity / C sequestration in response to changes in climate, CO_2 concentration, N deposition, aerosols/fine particulates (effect of diffuse radiation) and O_3 exposure. The DSVMs will be further developed to predict both productivity / carbon sequestration and plant species diversity in response to changes in N and S deposition, climate and soil quality (soil acidity, phosphate and base cation availability), while adding effects of CO_2 and O_3 exposure. The DSVMs will also be used to derive European maps of novel thresholds for N and S deposition and O_3 exposure for protecting plant ecosystems and their exceedances (WP16). These maps will be based on approaches developed under WP11. Apart from impacts at the European scale, the DSVMs will finally be applied at fine-scale resolution to gain insight in uncertainties due to aggregation of high resolution estimates to the lower resolution in Europe-wide assessments (WP17). The innovation lies especially in cross-community collaboration to make integrated assessments possible and integrate aspects. The ensemble approach to the modelling (Table 1.1) will enable us to identify the most successful model formulations and levels of complexity required to describe each process (based on site-scale testing in C3 and regional testing in C4) and will provide an estimation of prediction uncertainty associated with different model structures (linked with Task 21.3). This is often ignored in uncertainty assessments that only account for parameter uncertainty.

By drawing together large-scale models and datasets, this component will allow ÉCLAIRE to provide a Europe-wide assessment of air pollution impacts under changing climate conditions in terms of plant productivity, plant community composition and plant/soil C sequestration. We will use the same models for simulating atmospheric and climate change impacts on productivity / C sequestration and GHG exchange in WP14 and for impacts on plant species diversity and soil and water quality in WP15. The last task holds for the SVGMs, since these models focus also on plant species diversity. The parallel improvement and application of SVGMs and DGVMs, linking specific experimental and monitoring studies in C3 (WP9 and WP10) with development, testing and application of models at larger scales in C4 (WP14 and WP15) will allow major advances in understanding, challenging the assumptions of the traditionally separate research communities (Fig. 1.4).

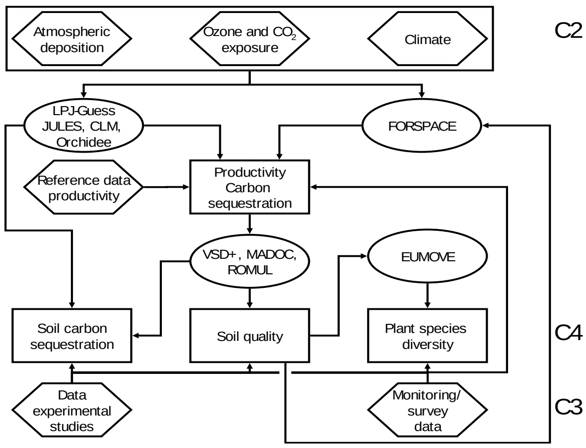

Figure 1.4. Role of DGVMs (LPJ, JULES, CLM) and SVGMs (VSD+, FORSPACE, ROMUL, EUMOVE) to assess air quality and climate impacts on productivity plant communities and soil quality at European scale (C4) and validate results on data (C3)

Air pollution-climate impacts on European C stocks and greenhouse gas emissions (WP14). ÉCLAIRE will provide European scale modelling of N, S and O_3 deposition fluxes in response to air emissions and climate change relationships, developed under C1/C2, with European-scale impact models, further developed under C3/C4. This activity focuses on C sequestration in both vegetation (productivity) and soils, while accounting for the impacts on N_2O emissions. The impact on CH_4 fluxes from wetlands will be included, but this will be limited to the impacts of changes in climate (in LPJ and ORCHIDEE). The simulations will include agricultural (grassland, arable land) and non-agricultural systems (forest and semi-natural vegetation) on both mineral and organic soils. Particular attention will be given to interactions between O_3, N and climate change (temperature and water availability) with respect to their impacts on plant productivity and soil C sequestration. Other interactions that will be accounted for in non-agricultural systems are changes in CO_2 and the acidifying impact of S and N deposition, necessary because of the role of pH in decomposition processes in soils. The role of particulate matter will be included in view of its effect on alteration of C sequestration through increasing diffuse radiation, and potentially (depending on the outcome of WP11) on plant drought stress.

Interactive air pollution-climate impacts on biodiversity and soil quality (WP15). Through this activity, ÉCLAIRE will investigate the coupling of S, N and O_3 fluxes at the European scale in response to climate change, developed under C2, focusing on plant species diversity as well as soil and water quality (in close cooperation with WP14). We aim for a single integrated modelling structure with feedbacks between vegetation change (EUMOVE), C and N cycles and soil and water quality (VSD+). Application of this model to the European scale for the period 1900-2100 will allow evaluation of the response to various air quality and climate scenarios (harmonized across ÉCLAIRE under Task 21.1), accounting for management changes. The simulations in WP15 will focus on non-agricultural systems (forest and semi-natural vegetation) on both mineral and peat soils.

European maps of novel thresholds & exceedances (WP16). Based on the outcomes of WP12, and drawing on WPs 14 and 15, this activity will map and assess novel thresholds N and O_3, in interaction with aerosol effects at the European scale. Part of the challenge will be to link the thresholds with new dose-response relationships, in combination with data on pollution concentrations and exposure from WP7, as a basis for quantifying Europe wide estimates of exceedance as an overall response. Key advances will include the application of:

- The DSVMs updated under WP15 to assess modelled critical N loads in interaction with climate change, using as criteria: (i) acceptable impacts on plant species and (ii) optimal plant production/C sequestration.
- The updated DO_3SE and other modules linked to the EMEP model to map the of phytotoxic ozone dose (POD) and N-deposition to specific tree species (focusing on birch, beech, Norway spruce, Holm oak) and crop types (focusing on wheat, and tomato) instead of generalised ecosystems, such as forest and arable lands (WP7).
- The first upscaling of new climate-air pollution interactions, such as the effect of altered of wet/dry and NO_y/NH_x deposition ratios, plant VOC self protection, and aerosol effects on radiation and drought stress. These novel interactions will be most uncertain, but will be important to inform the long-term research agenda.

Local variation in threshold exceedance (WP17). In order to assess the uncertainty in critical thresholds and their exceedances as a consequence of the grid resolution used at the European scale, WP17 will include novel zooming studies at the regional and local (landscape) scales. To demonstrate the effects, the focus will be on NH_3 and N deposition estimates from nested high-resolution CTMs (WP8), which will be coupled with matching databases on thresholds (novel and/or improved critical loads/levels) and dose-response relationships derived at a range of scales, varying from 50 km x 50 km (standard) 5 km x 5 km, 1 km x 1 km and 50 m x 50 m. This will be the first such assessment to relate this range of scales, which will build on products from NitroEurope IP (inc. inventories and models, EMEP4UK, OPS, NitroScape), coupled with the advances from WP15. The advances will be highly cost effective as the selected landscapes (Burnsmuir, Scotland; Noordelijke Friese Wouden, NL) have already been examined for N interactions with GHG balance and combine both agricultural and semi-natural habitats.

Overall, Component 4 will deliver:

- Updated versions of the DGVMs LPJ-Guess, JULES, LCM-CN and ORCHIDEE that predict the interacting effects of O_3 exposure, N deposition/ N availability, CO_2 fertilization, particulate matter and climate change on productivity / carbon sequestration.
- Updated version of DSVMs VSD+- FORSPACE and MADOC-JULES linked to a EUMOVE to predict impacts of drivers on abiotic soil conditions and plant species diversity.
- Predictions of carbon sequestration and plant species diversity at European scale in response to various ÉCLAIRE scenarios of future emissions and climate change using a

range of DGVMs and DSVMs, illustrating the uncertainty in predictions in view of uncertainties in representing processes in the models.

- European maps of novel thresholds for NO_x deposition, NH_3 deposition and O_3 exposure and their exceedance, with the spatial uncertainties illustrated by application of high resolution estimates in case-study areas.

B 1.2.6 Integrated risk assessment and policy tools (Component 5)

State-of-the-art: Integrated models have been created to assess the costs of air pollutant abatement measures in relation to positive environmental effects of reduced trace gas release. Such models have become standard tools in European environmental policies. Underlying research to the National Emission Ceilings Directive (Amann et al., 2007) and to the European Climate Change Programme (Höglund-Isaksson et al., 2010) has used cost-optimized scenarios from such models to attain certain environmental targets. Modelled emissions and emission abatement drive a suite of damage functions, ecosystems damage as well as health damage. Underlying economic projections which allow technology-specific assessment of abatement options (a precondition of proper cost estimates) cover the period 2000-2030. Indicators used to assess ecosystems damage are empirical critical loads and critical levels.

Economic valuation of environmental damage increasingly has been used for policy consultations, allowing to go beyond an assessment of the cost-efficiency of meeting certain environmental quality targets. Instead a direct comparison of costs with the benefits of action is possible, both in air pollution and in climate change discussions. Reliable and agreeable results are available predominantly with regard to health issues (Holland et al., 2005; Hurley et al., 2005), where societal cost estimates of indicators such as Years Of Life Lost (YOLL) or Disability Adjusted Life Years (DALY) have become available. As a consequence, the combination of economic and ecological modelling to better understand options has become state-of-the-art. Examples for an active consideration of such combinations are the EC4MACS project (www.ec4macs.int; Amann et al., 2010) and the Swedish CLEO project (www.cleoresearch.se) based on earlier work published by Karlsson et al. (2005), or relevant studies of the Stockholm Environment Institute (Hicks et al., 2008).

Progress over state-of-the-art offered by ÉCLAIRE: In order to meet the aims of ÉCLAIRE and to provide ÉCLAIRE output relevant for European environmental policy, considerable additions to the current approaches are needed. This starts from the valuation of economic damage. Despite the considerable difficulties involved, an extension of benefit estimation to include ecosystems damage (based on the costs of ecosystems services) will be performed. Next, the economic basis (and the measures for emission abatement) needs to be extended further into the future. The available toolset (currently limited to 2030) will be extended to 2050, with a scoping assessment beyond 2050 (target year: 2100). Finally, also the underlying CTM will be parameterized to cover future conditions under climate change and to include new indicators as developed elsewhere in ÉCLAIRE (C3 and C4).

ÉCLAIRE will use the GAINS model to assess the effects of air pollution on ecosystems. Impacts and novel thresholds will be integrated either directly into the GAINS model code or by external analysis. Costs of abatement measures will be determined and compared with the value of ecosystems service maintained against pollution damage. Valuation will use a marginal approach to the extent possible.

In contrast to previous assessments, modelling will explicitly refer to conditions of climate change, i.e. altered meteorological conditions that may also affect species composition and an altered ecosystem's response to air pollution, all implemented in revised source-receptor matrices. The benefits will include the ecosystem services, but also the relation to climate change effects where air pollution or changes in the atmosphere-biosphere interaction will play a role.

Delivering central results from ÉCLAIRE, the work will require information from C2, regarding source-receptor matrices, and C3 and C4, for ecosystems effects. At the same time, outputs from the PEGASOS project on effects of climate on health based air chemistry interactions can be integrated.

Deriving economic impacts and valuation of ecosystem services (WP18). Valuation of human health impacts of air pollution has been performed routinely since the mid 1990s and has informed the development of various policies concerning control of air pollutants in Europe and the USA. Research under the NewExt and NEEDS projects sought to estimate the damage to ecosystems (or conversely, benefits through fertilisation effects of N) by considering the use of regulatory revealed preference and repair cost methods, but neither approach is ideal for describing ecosystem protection. Thus, a general structure based on the concept of ecosystem services has now been defined. Four broad categories of ecosystem service may be distinguished (Hettelingh et al., 2008): provisioning services, regulating services, supporting services and cultural services.

Recent work, e.g. led by the CLRTAP Coordination Centre for Effects at RIVM, has had some success in defining impacts in a way that seems more amenable to valuation. However, the relevance of the available valuation literature to the newly defined endpoints is limited. Estimating the overall costs of air pollution to ecosystems needs to establish the functions that ecosystems have for society, and to monetise damage to these functions where possible. Such cost estimates have been applied in a European context previously to obtain estimates of damage to crops in the short-term, but not for other receptors. ÉCLAIRE will draw on the available literature to improve this situation. Whilst the project introduces significant additional challenges to those faced in earlier European policy-related work, for example through the longer timescales involved, it also brings in areas where valuation may be easier. For ÉCLAIRE, areas of particular focus for valuation include the provisioning functions related to timber and possibly meat and milk production, and regulating services such as carbon sequestration and the release of non-CO_2 greenhouse gases from agricultural and other soils. Assessment of supporting and cultural services is likely to be more difficult through a lack of information, though, at the least, guidance will be produced on how the available scientific quantification of associated effects can be linked with valuation.

Separate treatment of agricultural area (crops by crop type; grasslands), forests, and semi-natural ecosystems will need to be performed. Impact functions for different plant-based ecosystems as derived in C3 and C4 will be used to quantify the response of ecosystems to air pollution, and in consequence to estimate damage. The baseline, a situation unaltered with respect to air pollution, will be created from climate change scenarios, in order to accommodate the effects of climate change that have already occurred.

Integrating air pollution effects under climate change (WP19). Work in ÉCLAIRE WP19 will result in an important extension of the GAINS capabilities to generate information on scenario specific risks of adverse effects of air pollution (see Fig. 1.5) by:

- adding novel sustainable thresholds as developed in ÉCLAIRE C3 and C4;
- enabling the assessment of scenario specific impacts outside the code of the GAINS model;
- analyzing the robustness of sustainable thresholds and scenario specific impacts under climate change.

Novel threshold approaches to be applied under WP19 will include the use of dynamic soil, soil-vegetation models, dose-response relationships, assessment of ecosystem services and empirical thresholds from field experiments developed in C3. These modelling tools will be developed and tested together with ÉCLAIRE C4 activities, taking advantage of overall harmonization of future scenarios across ÉCLAIRE (Task 21.1).

The combination of embedded and external analysis of thresholds will lead to scenario-specific estimates of magnitudes and locations of risk due to effects of O_3 and N inputs. The novel thresholds can include exogenous indicators that can be embedded in GAINS, e.g. altered critical loads under climate change or other parameters that can be linearly derived from the meteorological database. Other indicators might require new source-receptor matrices or might even evade linearization – in the latter case evaluation would be limited to external analysis.

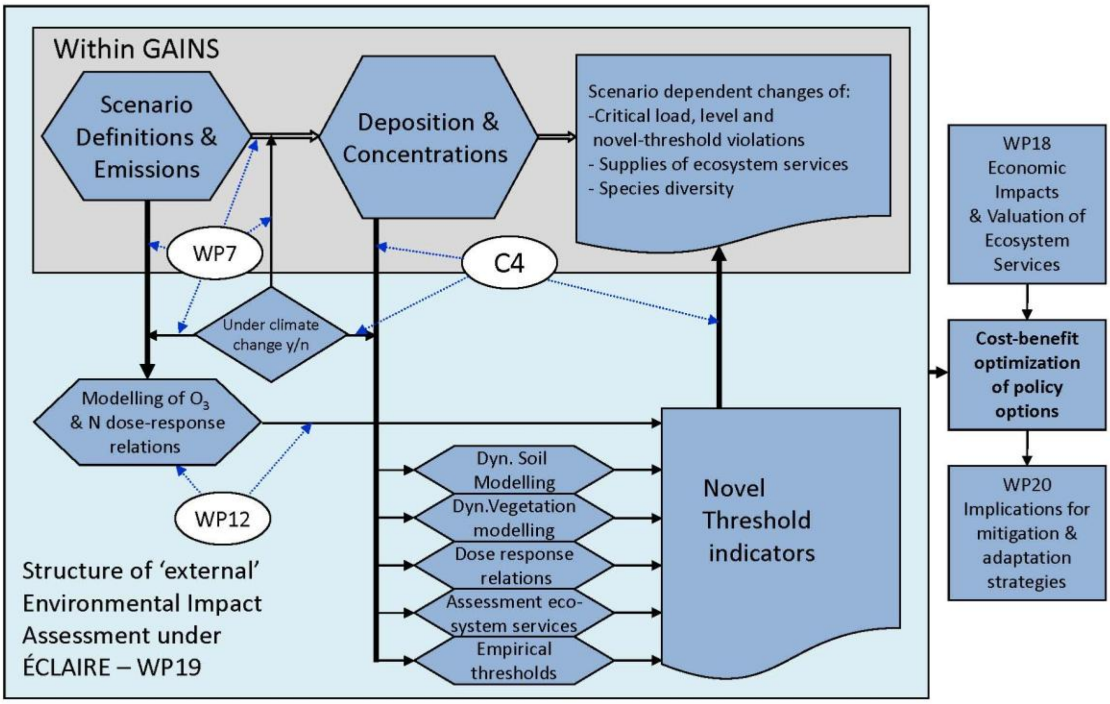

Fig. 1.5. Impact assessment in ÉCLAIRE by means of indicators, sustainable thresholds that can be either embedded in or external to the GAINS model code. Interactions with other components are also presented.

Implications for mitigation & adaptation strategies (WP20)

Policy options presented by ÉCLAIRE will be based on scenario analysis. Once ÉCLAIRE scenarios have been translated into the GAINS model (including the novel indicators and the climate-change related source-receptor matrices mentioned above), we will be able to evaluate to which extent current strategies to reduce climate impacts or air pollution impacts will be consistent with respect to altered climate conditions both in terms of overall effects and cost-efficiency. Consequences to society at large in terms of changed costs of abatement measures will be assessed, as well as from the environmental effects.

While such an analysis is based on standard GAINS procedures, considerable extensions will be needed to accommodate the ÉCLAIRE scenarios. Pollution abatement techniques, their efficiencies and their costs need to be extended along the scenarios, requiring the development of the technology-orientated as well as on the economic module of GAINS. With 2000 as a base year, and scenarios for 2030, 2050 and a beyond-2050 scenario (targeting 2100), the current extrapolation structure of known technologies cannot be maintained. Instead, Representative Concentration Pathway (RCP) emission patterns will need to be analyzed, with back-casting strategies applied to assess for potential abatement technologies and their respective costs. This will extend, further into the future, approaches already scheduled to be developed for the PEGASOS project.

This approach will extend also to adaptation scenarios. Measures under adaptation will focus at reducing climate impacts rather than mitigation of emissions. Adaptation measures may include changes in forestry and agricultural practice and their economic impact, and will also play a role in damage assessment (WP18), so that the cost-benefit analysis will provide combined results from the two work packages. Results from this work package will contribute centrally to the final policy-related outputs of ÉCLAIRE and will be disseminated in close coordination with WP24.

Overall, Component 5 will deliver:

- Description of data for quantifying and valuating ecosystem effects
- Implementation of new effect indicators and critical thresholds in the GAINS modelling system
- Cost optimization of emission abatement and cost-benefit analysis of pollution abatement
- Policy recommendations regarding ecosystem protection under conditions of climate change

B 1.2.7 Performance Indicators

A number of indicators will be used to evaluate the performance of the ÉCLAIRE project, in terms of both scientific output/advances beyond state-of-the-art and interactions with policy/dissemination activities. The outcomes of this evaluation will be reported in the contractual periodic reports (months 18, 36 and 48), under three headings – ‘Policy and Stakeholders’, ‘Science and Research’ and ‘Contractual Deliverables’:

Policy and stakeholders

- A ‘Yearly Progress Report’ which provides current progress or understanding regarding the ‘Key Questions (Q1-7 posed in Section B1.1). It will also detail the progress made in achieving the ‘Overall Objectives’ (O1&2, also listed in Section B1.1). There will also be a section containing key messages for policymakers.
- Dissemination of policy relevant findings to policymakers
- Dialogue with policymakers on policy relevant findings
- Any demonstrable updates/improvements to policy which relate to scientific output of the project and dissemination of its findings

Science and research

- Submission and publication of project related material in peer reviewed journals, special issues, commentaries etc.
- Presentations and posters, given by ECLAIRE scientists, at relevant conferences, in Europe and further afield, as appropriate

Contractual deliverables

- Project deliverables, including information on quality and timing
- Achievement of the ‘Specific Objectives’ (S1-10) stated in section B1.1

B 1.3 S/T Methodology and associated work plan

B 1.3.1 Overall strategy and general description

Based on the European Commission call (ENV.2011.1.1.2-1), it is evident that the project must integrate across several science themes and provide outputs that directly support EU policy on air pollution-climate interaction. This requires that ÉCLAIRE establishes a strategy that: a) links interacting air pollutants (the most important being O_3 and N, including coupling with VOCs, aerosol and S), b) links climate effects on emissions/deposition with those that alter vulnerability of land ecosystems and soils, c) provides new experimental data, including novel interactions, as a basis for the development of models, thresholds and dose-response relationships, d) develops innovative and reliable risk assessment methods for O_3, N and interacting pollutants, and e) integrates the experimental and modelling outcomes as a basis for informing future European air pollution - climate strategies.

The approach of ECLAIRÉ is targeted specifically to meet these needs, so that it can be of maximum use in informing both future scientific assessments and EU policies (e.g. IPCC AR5, long-term CLRTAP strategy, NEC Directive review). To do this, the work plan is structured as five main Science Components (C1-C5; Fig. 1.1) each with a Component Leader (making up membership of the project Executive Steering Group, see Fig. 2.1). Each Science Component consists of a manageable group of 4 or 5 Work Packages (WP), with WP Leaders reporting to the respective Component Leaders, forming the wider management team of the project. The WPs take a logical structure to the work, with measurements, focused on WPs1-2, 9-12 designed to account for ~45% of the overall scientific effort (Section 2.4). Supporting WPs address standards and data management, coordination and overall management, training, networking and dissemination.

The logical flow of data and information across ÉCLAIRE is summarized in the PERT chart (Fig. 1.6a). The experimental studies of WPs 1/.2 and 10/11 provide the starting point, supported by synthesis of existing data (WPs 3,.4, 9). These provide data to support process modelling and threshold development at the plot scale (WPs 3, 4, 12, 13), which, in turn, deliver inputs for upscaling under C2 and C4. The hub of C2 is the development and ensemble intercomparison of European CTMs under WP77, which interacts closely with the parallel development of DGVMs and DSVMs at the European scale under WPs 14/15. Coupled with the assessment of hemispheric background (WP55), local variation (WPs 8, 17) and upscaling of novel thresholds (WP1616), C3 and C4 provide the inputs necessary for the integrated risk assessment (C5). This last step integrates the climate dependence of air pollution fluxes and thresholds, in combination with valuation of ecosystem services (WPs 18-19) to assess the policy implications (WP2020).

B 1.3.2 Timing of work packages and their components

The timing of each of the WPs in ÉCLAIRE is summarized in the GANTT chart (Section 1.3) according to the listing of WPs shown inPart A, Table WT1. The data review and experimental WPs are scheduled to start early in the project, though the exact start dates (linked to field seasons) may be tuned according to the eventual project start date. Most of the modelling and assessment WPs will also start early in the project, in order to ensure a rapid kick-off in development, data assessment and harmonization tasks. Based on the early developments, the models will be updated as the results of the experimental WPs become available. In order to ensure timely delivery, a specific activity on 'Review and Assessment' will be conducted on a three monthly basis by the Executive Steering Group, supported by annual reviews involving the Stakeholder Advisory Board (for further details see Section 2.1.4), in relation to the project deliverables (Part A, Table WT2) and milestones (Part A, Table WT4). The WPs are described in Part A, (Table WT3).

1.3.3. Risks and associated contingency plans

The major scientific risks to the Work Plan of ÉCLAIRE are summarized on the PERT chart (Fig. 1.6a,b), which shows the 'Main Risk Points' as well as four 'Cross-Cutting Risks'. The likelihood and severity of each risk is assessed to show the overall risk, which then forms the basis of risk mitigation actions. Each of the Cross-Cutting Risks have high scores (shown in Fig. 1.6b prior to mitigation), and these risks will therefore be managed by specific tasks under WP21.1 to reduce them. Most critical will be the actions to harmonize scenario use across ÉCLAIRE and to manage data collection, archiving and sharing (Tasks 21.1, 21.4).

Of the Main Risk Points identified in ÉCLAIRE, the highest *a priori* values apply to potential delays in delivery of measurement datasets (risks 1, 3) and handling the consequences of local variability in the Europe-wide assessment (risks 7, 9). The early use of independent datasets and proactive management by Component Leaders (C1, C3) will address the first (risks 1, 3), while the use of several approaches to inform on spatial uncertainty will address the second (risks 7,9). ÉCLAIRE deliberately combines a mix of low and higher risk activities, with the latter especially applying to the novel experiments on new thresholds (WP11, risk 4). By definition, these more exploratory 'special topic' studies have a risk of being too uncertain to quantify new thresholds. This risk is managed by virtue of including 3 contrasting new issues (related to VOCs-O_3, N-form and aerosol), with the fall-backs provided by the meta-analysis and network of O_3, N(wet) interactions with climate and CO_2 (WPs 9, 10).

A further contingency tool in ÉCLAIRE is the use of a specific 'reserved budget' (initially retained by the coordinator) for distribution to partners during the life of the project according to emerging needs (see Section 2.1.7) This is reserved in outline for specific tasks, but will be managed as a whole to balance risk across the project.

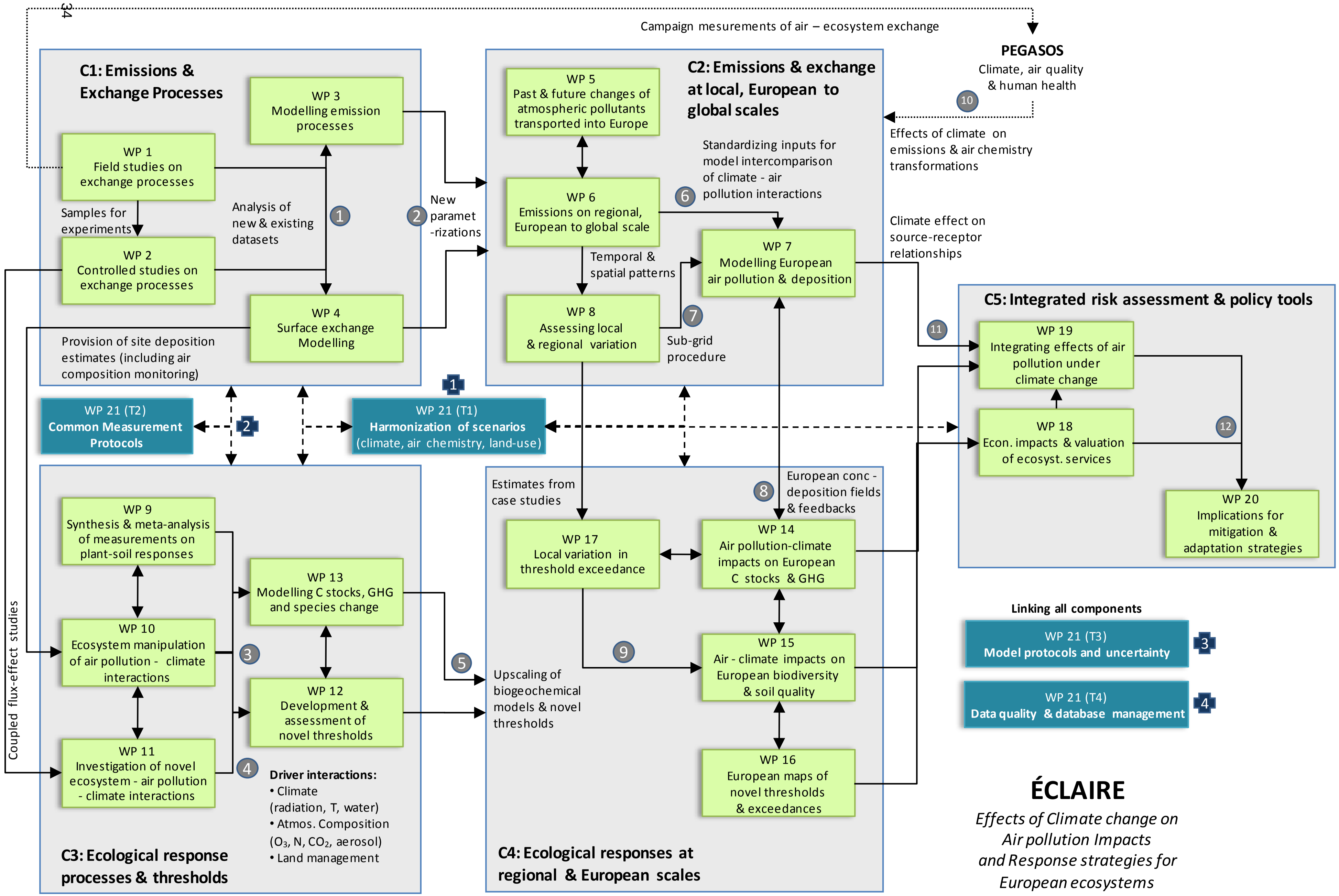

Figure 1.6: PERT chart showing the overview of relationships across ÉCLAIRE. For explanation of risk points (1, 1) see Figure 6b.

Figure 1.6b: Explanation of main risks highlighted in the PERT diagram (Figure 6a), comments and mitigation actions. ÉCLAIRE deliberately contains a mix of more achieveable and higher risk, novel elements, providing a balance to ensure overall project success, while fostering new developments.

Main Risk Point	**Name of Risk**	**Risk from WP**	**Risk to WP**	**Likeli-hood (L)**	**Sever-ity (S)**	**Overall Risk (L*S)**	**Related Deliverables & Milestones**	**Comment and Mitigation Action**
	Slow delivery of verified flux datasets for modelling	1 2	3 4	2	2	4	M1- 5, 6, 7, 8 D11, 1.2, 2.5, 2.6, 2.7	Active monitoring by C1 leader of problems in experimental set up. Start modelling based on existing datasets
	Slow delivery of climate dependence in model parametrizations for upscaling	3	All C2	1	3	3	M13, 16, 17 D3.3, 3.4, 4.1 -2	Assessment will start based on analysis of existing datasets focusing on inter-model characterization.
	Slow delivery of verified effects datasets for modelling and threshold assessment	10 11	12 13	2	2	4	M48, 49, 50 D10.2, 10.3, 11.3	Active monitoring by C3 leader of problems in experimental set up. Start modelling and thresholds work based on existing datasets (incc WP9)
	Novel experiments may remain too uncertain to quantify certain new thresholds including climate dependence	11	12 16	3	2	6	M51, 52 D11.1	Some novel experiments in WP11 are naturally higher risk. Three issues are therefore addressed to spread the risk, while outcomes will anyway inform future threshold development, as influenced by climate change.
	Slow delivery of site-scale C, GHG and species modelling outputs for upscaling	13	14 15	1	3	3	M59, 60 D13.3, 13.4	The site and regional scale modelling will be conducted hand-in-hand with associated models to avoid this risk.
	Slow delivery of regional emission and hemispheric background estimates	5 6	7 8	1	3	3	M23, 27 D5.4, 6.2	Available emissions and hemispheric background will provide a starting point, with improved datasets and modules being implemented later in the project.
	Uncertainty in implementing the sub-grid procedure for all relevant pollutants	8	7 17	2	2	4	M37, 38 D8.2, 8.3	The subgrid procedure is expected to perform more effectively for some pollutants than others. This is not critical as the focus is on uncertainty quantification, while the case studies provide a fall back.
	Challenges in harmonizing different regional modelling perspectives and addressing feedbacks	7 14 15	14 15 7	1	2	2	M62, 63, 66 D14.1, 15.1, 15.2	Bringing together the different modelling communities linking CTMs, DGVMs, DSVMs is a major benefit of ÉCLAIRE in developing the necessary level of integration. Workshops will specifically address complementarity and exchange.
	Implications of local variability for European scale thresholds and effects assessment	17 8	15 14 16	2	2	4	M75, 76 D15.2	This step has the risk to identify significant weaknesses in current European modelling of effects. This is a natural part of advancing the state-of-art, with the risk mitigated by use of the sub-grid procedure and the case studies.
	Slow delivery of outcomes on emissions and air chemistry from PEGASOS	-	All C2	1	1	1	N/A	While PEGASOS will be of benefit to ÉCLAIRE, this is a very low risk as the projects are fully self-standing, while PEGASOS starts already in 1/2011.
	Slow delivery of upscaled estimates of climate dependence on source-receptor relationships	7	19	1	3	3	M29, 30, 31 M32 D7.1	This aspect is critical to the success of ÉCLAIRE, but represents a low risk as the work will focus on improving existing relationships as well as including new ones. Use of successive model versions from an early stage will manage the risk.
	Challenges in including novel elements of climate-dependence and valuation of ecosystem services into GAINS	18 19	20	1	3	3	M78, 79 M86, 90, 92 D18.3	The risk is small as the work will build on foundations developed for health assessment from the EC4MACS and other projects, complemented by direct outcomes from C1-C4 which will also inform development of future strategies.
	Inconsistent application of scenarios	All	All	2	3	6	M99 D21.1	This key risk will be managed by a dedicated activity on scenario harmonization (T21.1) including harmonization of climate, air chemistry and land use scenarios.
	Inconsistent / incomplete measurements	1-2 10-11	C2 C4	2	2	4	N/A	To ensure measurements are harmonized, complete and adequate for modelling, a cross-component task (T21.2) will focus on common measurement protocols.
	Inconsistent model views & uncertainties	All	All	2	2	4	N/A	A special task force (T21.3) on common modelling protocols will ensure compatible approaches and foster best-practice in uncertainty assessment.
	Inaccessible datasets and inadequate quality assurance by individual partners	All	All	2	3	6	N/A	A dedicated Data Management Committee (T21.4) will be established including Component Data Managers to extend established data management tools and work with both data suppliers and data users across and beyond ÉCLAIRE.

Key: Main Risk Point ; Cross-cutting risk: . Risk likelihood: 1, low; 2, medium, 3, high; Risk severity: 1, low, 2, medium, 3, high. The values of Overall Risk are those prior to risk mitigation.

Figure 1.7: GANTT CHART

			Year 1												Year 2											
		Topic / month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Component 1	WP1	Field Studies on exchange Processes																1.5	1.4	1.1						1.2 1.3
Component 1	WP2	Controlled studies on exchange processes													2.5									2.3		2.1 2.2
Component 1	WP3	Modelling emission processes																								
Component 1	WP4	Modelling deposition processes																								
Component 2	WP5	Understanding trends in O3 global background																		5.1						5.4
Component 2	WP6	Upscaling biogenic & non-biogenic emissions								6.1																
Component 2	WP7	Modelling European air pollution & deposition																		7.1						
Component 2	WP8	Assessing local & regional variation												8.1				8.3								
Component 3	WP9	Analysisy of existing measurements on plant & soil responses						9.1						9.2												9.3
Component 3	WP10	Ecosystem manipulation of air pollution - climate interactions												10.1						10.2						10.3
Component 3	WP11	Novel interactions between air pollution and climate																11.3		11.1		11.5				11.2 11.3
Component 3	WP12	Development & assessment of novel tresholds												12.1						12.4						12.2
Component 3	WP13	Modelling C stocks, inc. species change and GHG interactions						13.1												13.2						13.3
Component 4	WP14	Air pollution - climate impacts on European C stocks & GHG						14.1												14.2						14.3
Component 4	WP15	Other air - climate impacts on European ecosystems																								15.1 15.2
Component 4	WP16	European maps of novel thresholds & exceedances												16.1												16.2
Component 4	WP17	Local variation in threshold exceedance												17.1						17.2						
Component 5	WP18	Deriving econ. Impacts & valuation of ecosystem services												18.1												18.2
Component 5	WP19	Integrating air - climate effects into GAINS												19.1												19.2
Component 5	WP20	Implications for mitigation & adaptation strategies									20.1					20.2					20.3			20.4		
	WP21	Standards & data management, Task1						21.1																		
		Standards & data management, Task2								21.3																
		Standards & data management, Task3									21.4															
		Standards & data management, Task4						21.7 21.8		21.9 21.10				21.1												21.11
	WP22	Coordination & management													22.1						22.2					
	WP23	Training						23.1						23.3	23.2									23.4		
	WP24	Networking & dissemination	24.1											24.2 24.3												24.2 24.3

			Year 3												Year 4											
		Topic / month	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Component 1	WP1	Field Studies on exchange Processes						1.6																		
Component 1	WP2	Controlled studies on exchange processes																		2.4			2.6			
Component 1	WP3	Modelling emission processes						3.1 3.2 3.3 3.4																		
Component 1	WP4	Modelling deposition processes												4.1 4.2 4.3 4.4						4.5						
Component 2	WP5	Understanding trends in O3 global background												5.2 5.3												
Component 2	WP6	Upscaling biogenic & non-biogenic emissions						6.2 6.3																		
Component 2	WP7	Modelling European air pollution & deposition												7.5				7.2				7.3				7.4
Component 2	WP8	Assessing local & regional variation						8.2 8.4																		
Component 3	WP9	Analysisy of existing measurements on plant & soil responses																								
Component 3	WP10	Ecosystem manipulation of air pollution - climate interactions																								
Component 3	WP11	Novel interactions between air pollution and climate						11.6				11.4														
Component 3	WP12	Development & assessment of novel tresholds						12.3										12.4 12.5								
Component 3	WP13	Modelling C stocks, inc. species change and GHG interactions												13.4												
Component 4	WP14	Air pollution - climate impacts on European C stocks & GHG						14.4						14.5				14.6		14.7		14.8				
Component 4	WP15	Other air - climate impacts on European ecosystems						15.3												15.4						
Component 4	WP16	European maps of novel thresholds & exceedances										16.3		16.5				16.4								
Component 4	WP17	Local variation in threshold exceedance																				17.3				
Component 5	WP18	Deriving econ. Impacts & valuation of ecosystem services						18.3																		18.4
Component 5	WP19	Integrating air - climate effects into GAINS												19.3								19.4				
Component 5	WP20	Implications for mitigation & adaptation strategies				20.5								20.6								20.7				20.8
	WP21	Standards & data management, Task1																		21.2						
		Standards & data management, Task2																								
		Standards & data management, Task3												21.5												21.6
		Standards & data management, Task4												21.11												21.1
	WP22	Coordination & management	22.1												22.1 22.2											22.1 22.2
	WP23	Training	23.2												23.2											23.2
	WP24	Networking & dissemination												24.2 24.3												24.2 24.3

B 2. IMPLEMENTATION

B 2.1 Management structure and procedures

To facilitate an efficient coordination and execution of ÉCLAIRE, four core management bodies are established to direct and support the Science Components and Work Packages, with their relationships summarized in Fig. 2.1:

1. Coordination team and Project Office
2. General Assembly (GA),
3. Executive Steering Group (ESG),
4. Stakeholder Advisory Board (SAB).

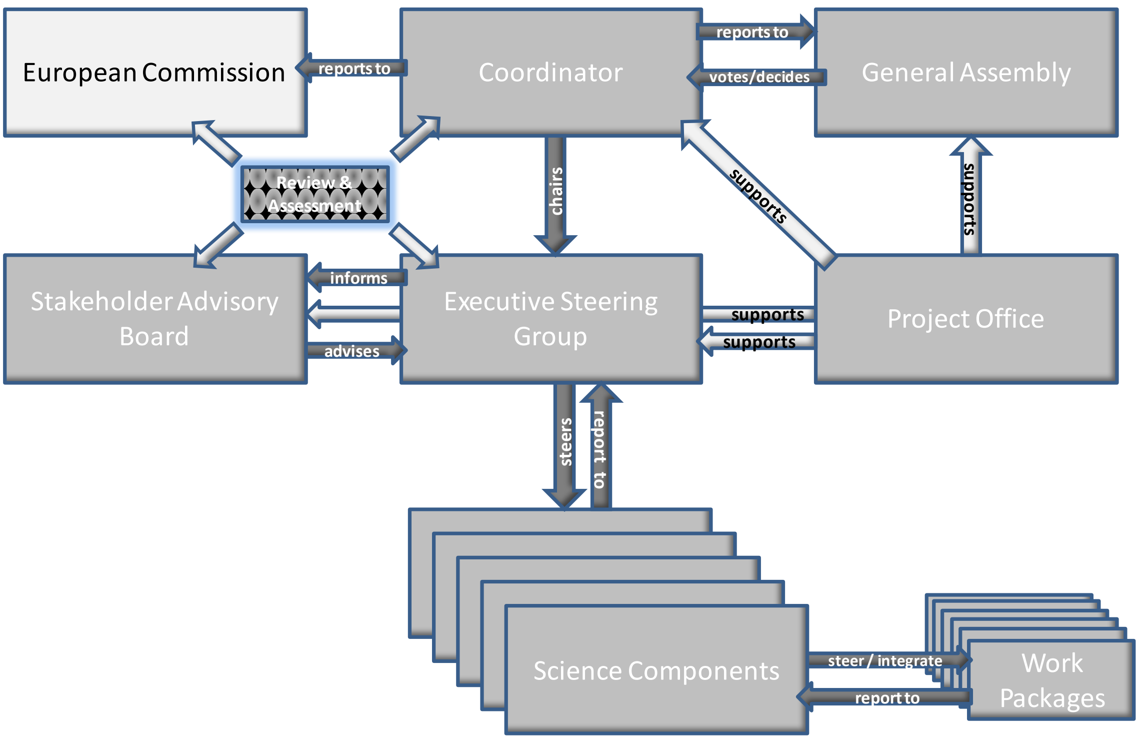

Fig. 2.1. Organizational structure of ÉCLAIRE.

2.1.1 Project Coordination

Partner 1 (NERC) provides the overall *coordination* of ÉCLAIRE, represents the consortium towards the European Commission, and is in charge of the administrative, legal, financial, and scientific management of the project. The Project Coordinator of ÉCLAIRE (Dr. Mark Sutton, NERC) is supported by the Executive Steering Group (ESG) to foster integration of the different components of ÉCLAIRE and to best represent the specific expertise required in the different areas that ÉCLAIRE addresses. The Coordinator institute will host the

ÉCLAIRE *Project Office*, represented by the Scientific Project Manager (Dr Clare Howard) and Project Finance Officer (Mrs Agnieszka Becher), who will assist the Project Coordinator in implementing the management tasks and day-to-day operations.

The management activities of ÉCLAIRE are allocated to WP22, with the tasks of the Scientific Project Manager and Project Office comprising the following responsibilities:

- Acting as a central point of contact for communication between the European Commission and the consortium
- Supervising the fulfillment of duties in accordance with the EC Grant Agreement and the decisions taken by the Consortium,
- Implementing an efficient project management and monitoring procedure in all administrative, legal, financial, and scientific matters,
- Coordinating and preparing the annual reports to the European Commission,
- Chairing and organizing the *General Assembly* and *Executive Steering Group* meetings and drafting the minutes,
- Supporting the work of the *Executive Steering Group* and the *Stakeholder Advisory Board*, providing documents and information to prepare decisions and advice by those project bodies,
- Overseeing the implementation of the cross-cutting activities, including data management, including establishment and management of the ÉCLAIRE database implemented on the ENCORE system (for site based datasets) and in cooperation with the AFOLU database at JRC for spatial datasets.
- Ensuring the dissemination of information and outreach beyond the Consortium with the larger scientific community, international networks, stakeholders, and SMEs, including establishment and implementation of the ÉCLAIRE web portal.

2.1.2 General Assembly

All contractual partners are represented in the *General Assembly*, each with one duly authorized representative per legal entity (i.e., partner institute). The General Assembly is the formal decision-making body in charge of the overall direction of ÉCLAIRE. The General Assembly will meet annually during the plenary science conference of the project and will decide on the following issues:

- The strategic orientation of the project,
- The preparation and approval of the annual implementation plan prior to submission to the European Commission,
- Contractual matters, such as the inclusion of new contract members, associated partners, advisory board members,
- The preparation and amendment of the Consortium Agreement (based on the DESCA model agreement).

The *Project Coordinator* and the *Executive Steering Group* report to and prepare decisions of the *General Assembly* and implement decisions taken by the *General Assembly*.

2.1.3 Executive Steering Group (ESG)

The *Executive Steering Group* of ÉCLAIRE is composed of the Project Coordinator (as chair), the Science Component Leaders, the Scientific Project Manager and the convener of the Scenarios Coordination Task. The chair of the Data Management Committee will attend the ESG discussions as needed.

The *Executive Steering Group* will be responsible for the overall governance and scientific management of the project and will ensure that the decisions decided by the *General*

Assembly are carried out. It will establish and propose to the General Assembly the strategy and project plan, and supervise and report on the progress of the project's activities and make sure that the project is kept on track. The Executive Steering Group will meet at least twice per year, either in person or via teleconference and more frequently as the need arises.

2.1.4 Science Components and Intgegration

Due to the large size of the project, the 24 Work Packages have deliberately been assigned to nine components, five for the core science work (C1-5), one cross cutting component on 'Standards and Data Management' (C6) and cross cutting components on 'Co-ordination and Management' (C7), 'Training' (C8) and 'Networking and Dissemination' (C9), (Figure 1.1). This modular management structure allows for greater integration and increased internal monitoring and reporting of progress from an early stage and during the lifetime of the project. A component based project structure has proven to be successful in the past with large integrating projects, the 6th Framework Project NitroEurope, serving as an example (which included 60+ partners). Each of the Component (and Work Package and cross cutting Task) leaders is experienced and many of them have worked directly with this component structure, through NitroEurope and other projects.

To deliver the integration and syntheisis promised by the project, the Science Component Leaders and the Work Package Leaders within each component form *Scientific Working Groups*. These working groups organise the scientific work within the components and the communication and integration across the science components. An effective horizontal and vertical integration is a key success criterion for ÉCLAIRE and its implementation will be monitored and facilitated by the project coordinators and the *Executive Steering Group*. Horizontal integration will be aided by the establishment of cross-cutting Task Forces under WP21, as highlighted on Figure 1.1.

2.1.5 Stakeholder Advisory Board

The *Stakeholder Advisory Board* (SAB) is an independent panel of leading international experts (international scientific community, policy stakeholders, etc.) established to give advice and assess the progress, performance, and achievements of ÉCLAIRE and to contribute experience, ideas and links related to the project's activities from outside the consortium. Members of the SAB will be invited to participate in the annual project meetings and General Assembly, as well as annual joint meetings with the Executive Steering Group. The members of the Stakeholder Advisory Board will be proposed by the Executive Steering Group to the General Assembly for endorsement. The membership of the SAB may change during the life-time of the project.

2.1.6 Review & Assessment

Review and assessment (R&A) of the scientific progress, the synthesis and integration of results and methodologies across the project and its effective delivery to relevant stakeholders are essential for the successful completion of ÉCLAIRE. R&A is a cross-cutting responsibility of the overall project management, both scientific and administrative. The R&A activity will focus on two stages operating on the same scale as the reporting cycle – i.e. months 19, 37 and 48:

- Review items raised by project partners as a formal part of the annual General Assembly for presentation to the Executive Steering Group. This may also include items raised at any time by project members for discussion at the regular ESG meetings.
- Annual written review from the Stakeholder Advisory Board at the time of each General Assembly, with the preparation of a written response outlining actions to be taken prepared by the Executive Steering Group under the lead of the Coordinator. These reports will be based on a combination of written materials and on outcomes from attendance at the annual General Assembly.

The ESG will take responsibility to implement changes in consultation with the SAB and the Services of the European Commission in order to tune ÉCLAIRE to ensure maximum effectiveness.

The main project risks and risk mitigation actions have been identified in Figure 1.6. An active R&A culture throughout the management structure of ÉCLAIRE will be pursued by the ESG working closely with the Work Package Leaders.

Table 2.1. Membership of the ÉCLAIRE *Executive Steering Group*

Lead	**Role and Expertise**	**Institution**
Mark Sutton (Chair)	• Project coordinator • Expert on the emission, behaviour and fate of reactive nitrogen in the atmosphere and measurement, of biosphere-atmosphere exchange with terrestrial ecosystems and on the integration of pollution mitigation strategies. • Coordinator of NitroEurope IP and the European Nitrogen Assessment (ENA) • Co-chair of the UNECE Task Force on Reactive Nitrogen (TFRN)	NERC (Edinburgh)
Eiko Nemitz	• Leader Component 1: Emissions and exchange processes • Leading the *Reactive Gases and Aerosols* research group at at CEH Edinburgh • Expertise in the measurement and parameterization of surface/atmosphere exchange fluxes of a wide range of trace gases and aerosols, using micrometeorological flux measurement approaches	NERC (Edinburgh)
Almut Arneth	• Leader Component 2: Emissions & exchange at local to global scales • Leads the INES research group on biosphere-atmosphere interactions, initiated by a FP6 Marie Curie Excellence Team grant • Expert on interactions of ecosystem biogeochemical cycles, and trace gas emissions with climate and land use change, including interactions with fire	ULUND
Claus Beier	• Leader Component 3: Ecological responses and thresholds • Head of Ecosystems programme and Coordinator of the ESF Research Network Programme ClimMani, linking European experimental climate change research • Expertise in experimental manipulations and biogeochemical cycling and modelling	DTU
Wim de Vries	• Leader Component 4: Ecological impacts at European and regional scale • Expert in the field of soil chemistry, with special reference to soil acidification, nutrient cycling and green house gas emissions • Project leader at Alterra and responsible for further development of the VSD+ -FORSPACE -EUMOVE model chain at European scale to assess air quality and climate change impacts on carbon sequestration, plant species diversity and soil quality	ALTERRA
Markus Amann	• Leader Component 5: Integrated Risk Assessment & Policy Tools • Leads the *Atmospheric Pollution & economic Development* programme (APD) and co-leader of IIASA's Greenhouse Gas Initiative • Head of the *Centre for Integrated Assessment Modelling* (CIAM) of the European Monitoring and Evaluation Programme (EMEP) under the Convention on Long range Transboundary Air Pollution (CLRTAP).	IIASA

Clare Howard (Secretariat)	• Scientific Project Manager ÉCLAIRE • Leader Work Package 21: Standards and Data Management • Coordinator of the Task Force on Reactive Nitrogen • Technical editor of the European Nitrogen Assessment	UEDIN / NERC(EDI)
Wilfried Winiwarter (Special Representative on Scenarios)	• Leader Task 21.1: Scenario development (cross-cutting task) • Expert in the release of trace constituents into the atmosphere, and their subsequent transformations • Expert on integrated assessment modelling using the GAINS model • Chair of the Expert Panel on Nitrogen Budgets under the UNECE TFRN	IIASA
Francesco Loreto	• Leader Work Package 11: Novel interactions • Expert in plant-pollutant exchanges • Director of Istituto per la Protezione delle Piante (IPP) of Consiglio Nazionale delle Ricerche (CNR)	CNR

Table 2.2. Composition of the ÉCLAIRE *Scientific Working Groups*

Science Activities	Work Package (or Task)	Partner	Lead
Component 1: Emissions and exchange processes	1	NERC	Eiko Nemitz
	2	BOKU	Sophie Zechmeister-Boltenstern
	3	KIT	Klaus Butterbach-Bahl
	4	INRA	Chris Flechard
Component 2: Emissions & exchange at local to global scales	5	JRC	Frank Dentener
	6	ULUND	Almut Arneth
	7	met.no	David Simpson
	8	ECN	Albert Bleeker
Component 3: Ecological responses and thresholds	9	NERC	Gina Mills
	10	DTU	Claus Beier
	11	CNR	Francesco Loreto
	12	SEI-Y, UoY	Lisa Emberson
	13	NERC	Chris Evans

Component 4: Ecological impacts at European and regional scale	14	ALTERRA	Geert Jan Reinds
	15	NERC	Chris Evans
	16	RIVM	Max Posch
	17	UPM	Mark Theobald
Component 5: Integrated Risk Assessment & Policy Tools	18	EMRC	Mike Holland
	19	RIVM	Jean-Paul Hettelingh
	20	IIASA	Wilfried Winiwarter
Work Package 21: Standards and Data Management	21.1	IIASA	Wilfried Winiwarter
	21.2	FDEA-ART	Christof Ammann
	21.3	UEDIN	Clare Howard
	21.4	NERC	Sue Owen

Table 2.3. Leadership of ÉCLAIRE Management & Coordination actions*:*

Management & Coordination Activities	**Work Package**	**Lead**
Coordination & Management	22	Mark Sutton (NERC)
Training	23	Mark Theobald (UPM)
Dissemination & Networking	24	Mark Sutton (NERC)

Table 2.4. ÉCLAIRE *Stakeholder Advisory Board* Members

Expert	**Affiliation**	**Country**
Benjamin Gimeno	Spanish Ministry of the Environment	Spain
Till Spranger	German Federal Ministry of the Environment. Member of the Working Group on Strategies and Review of the CLRTAP	Germany
David Fowler	Centre for Ecology & Hydrology, Chair UK Government Review of Transboundary Air Pollution (RoTAP)	UK
Martin Williams	Kings College, London; Chair of the Executive Body of the CLRTAP.	UK
Christer Ågren	Acid Rain and Climate Secretariat (NGO)	Sweden
Denise Mauzerall	MOZART global ozone modelling, Princeton University	USA
Bruce Hungate	Colorado Plateau Stable Isotope Laboratory, Northern Arizona University	USA

Peringe Grennfelt	IVL, ASTA	Sweden
Barbara Kitzler	Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW), Vienna.	Austria
Spyros Pandis	Scientific Co-ordinator of 7th Framework project 'PEGASOS'. Foundation of Research and Technology-Hellas (FORTH), Greece.	Greece
Luc Maene	Director of the International Fertilizer Industry Association (IFA).	France

2.1.7 Consortium Agreement

The legal framework and the interactions between project partners and the detailed responsibilities of each of the project bodies detailed will be laid out in the **Consortium Agreement**, which will be based upon the DESCA framework (DESCA is a comprehensive, modular consortium agreement for FP7). This will specify the technical contributions and resources to be allocated to each partner, rules for publication, dissemination and use of knowledge, in particular the data policy (see Section 3.2.2). The Consortium Agreement will also cover organization points such as the decision structure, the role and responsibilities of consortium committees / groups and financial provisions, as the well as the legal provisions, such as for the settlement of disputes including any sanctions for no compliance.

2.1.8. Reserve Budget and addition/removal of partners

A reserve budget is retained by the Project Coordinator for later allocation to partners or new contributors to the ÉCLAIRE consortium. While this reserve is unallocated to a particular partner, it is reserved in outline for specific activities according to each Component and Work Package across the four year duration of the project. The reserve budget will help manage project risks, such as emerging data-gaps and outcomes of the Review and Assessment. This budget is specified in Section B2.4 at Table 2.6. Overall, a reserve of €235,000 is retained, representing 3.4% of the contribution of the European Commission to the project. In order to ensure maximum flexibility and minimize risks, this the provisional allocations may agreed by the Coordinator and Executive Steering Group may be exchanged between Work Packages.

Addition of new funded partners. It is not foreseen at this stage that there will be a definite requirement for additional funded partners in ÉCLAIRE. However, flexibility is maintained in case a need requiring a new partner arises (e.g. emerging specific new analysis). Additional emerging technical tasks may also be implemented by new subcontractors including SMEs (e.g. additional data purchase or extraction for later gap-filling if necessary). The involvement of any new partners for these specific tasks will not affect the management structure.

Unfunded associate partners. The science infrastructure of ÉCLAIRE will be open to external scientists and consortia of emerging projects upon request, who will represent

unfunded associate partners. In order to maintain control on the project management structure, the number of associate partners to be accepted will be limited and clear criteria set for acceptance. These will include: a) the collaboration should be of a demonstrable high quality and contribute significantly to the objectives of ÉCLAIRE; b) only institutes (not projects) can become members; c) the applicant institute commits itself to making a clearly described, significant contribution to Work Packages indicated over the duration of ÉCLAIRE, d) the applicant institute commits itself to adhere to the rules set up in the Consortium Agreement, especially to the data policy; e) the applicant institute becomes a member of the consortium of ÉCLAIRE only for the period of time for which it contributes significantly to the work. This means, for instance, if an external institution or consortium asks to use the science infrastructure the flux sites (C1) or experimental manipulation sites (C3), under the auspices of ÉCLAIRE, the data collected on these sites must be delivered to the respective site managers of the site and be made available in the ÉCLAIRE database. In turn, the external institution or consortium can request data taken in the frame of ÉCLAIRE to an extent related to the significance of the external contribution (e.g. from the site, super site or all sites, respectively). This transparent strategy will further mobilize resources to achieve the goals of ÉCLAIRE.

Management of defaulting partners Involvement of a partner in ÉCLAIRE may be terminated following the Review and Assessment if there is an obvious, continued and unresolved failure to deliver committed results. Although this eventuality needs to be considered, the risk is low as all partners have been selected on the basis of their strong track record, while the Coordinator and ESG will work closely with any partner concerned to support them and resolve any difficulties. The Coodinator and ESG will be supported by the Chair and members of the *Data Management Committee* to be established under Task 21.4. This group will include a *Data Manager* for each Science Component, supporting their Component leader, to ensure that the data obtained by partners are a) submitted in a timely fashion, b) complete c) and adequately quality controlled.

B 2.2 Beneficiaries

PARTNER no.:	1
Organization full name:	Natural Environment Research Council: Centre for Ecology & Hydrology *(Edinburgh, Bangor and Wallingford laboratories)*
Organization short name:	*NERC*
URL:	http://www.ceh.ac.uk/

Description of the organization

The **Centre for Ecology & Hydrology** (CEH) is the UK's Centre of Excellence for integrated research in terrestrial and freshwater ecosystems and their interaction with the atmosphere. As part of the UK Natural Environment Research Council (NERC), we provide innovative, independent and interdisciplinary science and long-term environmental monitoring, forming an integral part of NERC's vision and strategy.

CEH has labs at Bangor, Edinburgh, Lancaster and Wallingford (CEH headquarters), with a multidisciplinary approach which is delivered through three interdependent Science Programmes, Biodiversity, Biogeochemistry and Water, supported by an Environmental Information Data Centre. CEH is one of the main UK institutions in charge of model development of JULES, the Joint UK Land Environment Simulator (http://www.jchmr.org/jules/index.html.), which is the land surface model used in the Unified Model of the UK Met Office. Specific model developments applicable to this proposal include: inclusion of effects of ozone on vegetation, inclusion of effects of aerosols on vegetation, coupling of a global Nitrogen cycle to already existing Carbon cycle. CEH is a member of PEER (the Partnership for European Environmental Research). Within ÉCLAIRE, three different laboratories are representing CEH, each with distinct expertise and tasks.

Expertise and experience of your organisation, including previous EU projects

CEH has been and is involved in a wide range of EU funded research, e.g. the FP6 & 7 projects PEGASOS, ACTRIS, LIAISE NoE, CarboExtreme and is the coordinating institute of the large integrated projects NitroEurope (www.nitroeurope.eu, FP6) and NanoFATE. (NMP4-SL-2010-247739). In addition, CEH coordinates initiatives such as ALTER-Net, Life Watch, OpenMI-LIFE, and is involved in Eurolimpacs, SoilTrEC, INCREASE, CLIMOOR, EXPEER and CLIMEX.

Key scientific personnel to be involved in the project – CEH Edinburgh

- Dr. **Mark Sutton,** has conducted substantial work on the emission, behaviour and fate of reactive nitrogen (N_r) in the atmosphere. His work spans a wide range of disciplinary expertise in micrometeorology, atmospheric chemistry and plant ecology. The largest aspect of the work has concerned the measurement, using micrometeorological approaches, of the biosphere-atmosphere exchange of ammonia over a wide range of terrestrial ecosystems. He is coordinator of the NitroEurope IP and has led the work on the European Nitrogen Assessment. *[ÉCLAIRE Project coordinator, contributions across the programme]*
- Dr. **Eiko Nemitz** (Environmental Physicist) leads the Reactive Trace Gas & Aerosols Group at CEH Edinburgh. His work encompasses the measurement and parametrisation of surface/atmosphere exchange fluxes of a wide range of trace gases and aerosols, using micrometeorological flux measurement approaches. This includes fluxes of reactive nitrogen compounds (NH_3, HNO_3, NO, NO_2, HONO), greenhouse gases (CO_2, N_2O, CH_4), volatile organic compounds (VOCs), ozone, sulphur dioxide and aerosols. *[Leading Component 1 and WP 1]*
- Dr. **Ute Skiba**, Ute Skiba is an expert in measurements and understanding the mechanism of trace gas fluxes from soils *[Flux measurements in WP1]*.
- Dr. **Lucy Sheppard**, has interests in plant nutrition and plant stress (frost hardiness, water); since 1986 she has run a range of pollutant effect experiments involving acid rain, ozone and different N forms in open-top chambers and large scale field studies with trees and semi-natural plants. This includes, since 2001, the Whim peatland study distinguishing responses, above and below-ground and gaseous emissions, of peatland community to ammonia, ammonium and nitrate *[Special topic impact studies under WP11]*.
- Dr. **Stefan Reis** (Environmental Modeller), has conducted research on tropospheric ozone abatement strategies for Europe and experience in the integrated assessment modelling of air pollution and climate change *[Upscaling of fluxes W6, 8; policy implications WP20]*.
- Dr. **Sue Owen** has experience in the measurement of BVOCs and has led the data management activities in the NitroEurope project. *[Lead of Task 21.4 and Chair Data Management Committee]*
- Mr. **Bill Bealey** works on ecosystem effects of air pollutant deposition and has experience in research on the EU nature protection policy including the Habitats Directive and the Integrated Pollution Prevention and Control (IPPC) Directive. *[ÉCLAIRE database management Task 6.4]*

Recent relevant publications

Coyle, Mhairi; Nemitz, Eiko; Storeton-West, Robert; Fowler, David; Cape, J. Neil. 2009. Measurements of ozone deposition to a potato canopy. Agricultural and Forest Meteorology, 149 (3-4). 655-666.

Drewer, J., Lohila, A. Aurela, M., Laurila, T., Minkkinen, K., Penttilä, T., Dinsmore, K.J., McKenzie, R., Helfter, C., Flechard, C., Sutton, M.A., Skiba, U.M., Comparison of greenhouse gas fluxes and nitrogen budgets from an ombotrophic bog in Scotland and a pristine mire in Finland. European Journal of Soil Science, in press (2010).

Nemitz, E., Dorsey, J. R., Flynn, M. J., Gallagher, M. W., Hensen, A., Erisman J.-W., Owen, S.M., Dämmgen, U. and Sutton, M.A. (2009) Aerosol fluxes and particle growth above managed grassland. Biogeosciences (GRAMINAE Special Issue), 6, 1627-1645..

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Skiba, U., Drewer, J., Tang, Y.S., van Dijk, N., Helfter, C., Nemitz, E., Famulari, D., Cape, J.N., Jones, S.K., Twigg, M., Pihlatie, M., Vesala, T., Larsen, et al.. Biosphere-atmosphere exchange of reactive nitrogen and greenhouse gases at the NitroEurope core flux measurement sites: Measurement strategy and first data sets. Agriculture, Ecosystems and Environment. Agriculture, Ecosystems and Environment 133 (2009) 139–149

Sutton M.A., Howard C., Erisman J.W., Billen G., Bleeker A., Grenfelt P., van Grinsven H. and Grizzetti B. (2011) The European Nitrogen Assessment (Eds.) Cambridge University Press (in press).

Sutton M.A., Reis S., and Baker S.M.H. (2009) Atmospheric Ammonia: Detecting emission changes and environmental impacts. (Eds). Springer, 464 pp.

Vieno M., Dore A.J., Stevenson D.S., Doherty R., Heal M.R., Reis, S., Hallworth S., Tarrasón L., Wind P., Fowler D., Simpson D. and Sutton M.A. (2010) Modelling surface ozone during the 2003 heat wave in the UK. Atmospheric Chemistry and Physics. **10**, 7963-7978.

Key scientific personnel to be involved in the project – CEH Bangor

- Dr. **Gina Mills** has been Head of the Programme Coordination Centre of the LRTAP Convention's ICP Vegetation since 1992. She has been studying the impacts of ozone on vegetation for over 25 years including studies of the physiological and biochemical responses, predictive modelling of effects on crops and natural vegetation and mapping vegetation at risk and economic impacts, and since 2004 has been responsible for the development of the LRTAP Convention's ozone critical levels for vegetation. *[Leading WP 9, contributor to WPs11, 12]*
- Dr. **Harry Harmens** is chairman of the ICP Vegetation (since 2004) and has more than 20 years experience in studying the impacts of air pollution (ozone, nitrogen, heavy metals) and climate change (elevated carbon dioxide, warming) on vegetation. In recent years he has become more involved in the policy application of effects-based research, in particular during the current revision of the Gothenburg Protocol of the LRTAP Convention *[contributor to WP9, 3.3]*.
- **Felicity Hayes**, MSc, is a plant eco-physiologist specialising in measuring and modelling effects of ozone pollution on vegetation, including interactions with other pollutants and climate change.
- Dr. **Chris Evans** has been involved in dynamic modelling of air pollution impacts on terrestrial and freshwater ecosystems since 1998. He leads the UK Critical Loads and Dynamic Modelling consortium for Defra, and leads or is involved in a range of national and EU-funded projects on air pollutant impacts on carbon cycling and greenhouse gas fluxes, water quality and biodiversity. *[Leading WP 13; contributor to WPs 14, 15, 16]*
- Dr. **Ed Rowe** has worked on the development of integrated dynamic models of agroforestry systems, small African farms, agricultural change at European scale, and (since 2004) of air pollution effects on soils and plant diversity *[contributor to WPs 13, 14]*
- Dr. **Bridget Emmett** is an Honorary Professor at Bangor University and has conducted research on biogeochemical cycles since 1998. Her research is focussed on impacts of drivers of change at the ecosystem level, including soil quality, nitrogen pollution, climate change, land-use change *[contributor to WPs9, 10 and 13]*
- Dr. **David Cooper** is a statistician and mathematical modeller with research areas including JULES and hydrological modelling *[contributor to WPs14 & 15]*

Recent relevant publications

Beier, C., Emmett, B.A., Peñuelas, J., Schmidtd, I.K., Tietema, A., Estiarte, M., Gundersen, P., Llorens, L., Riis-Nielsen, T., Sowerby, A. and Gorissen, A. 2008. Carbon and nitrogen cycles in European ecosystems respond differently to global warming. Science of the Total Environment, 407, 692-697.

Bobbink, R., Hicks, K., Galloway, J., Spranger, T., Alkemade, R., Ashmore, M., Bustamante, M., Cinderby, S., Davidson, E., Dentener, F., Emmett, B., Erisman, J-W., Fenn, M., Gilliam, F., Nordin, A., Pardo, L. amd de Vries, W. 2010. Global assessment of nitrogen deposition effects on terrestrial plant diversity: a synthesis. Ecological Applications, 20(1), 30-59

Harmens, H., Mills, G., Emberson, L.D. and Ashmore, M.R. 2007. Implications of climate change for the stomatal flux of ozone: A case study for winter wheat. Environmental Pollution, 146, 763-770.

Hayes, F., Mills, G., Ashmore, M. 2009. Effects of ozone on biomass partitioning and photosynthetic efficiency and capacity of Lolium perenne and Trifolium repens. Environmental Pollution, 157, 208-214

Luo, Y.Q., Gerten, D., Le Maire, G., Parton, W.J., Weng, E.S., Zhou, X.H., Keough, C., Beier, C., Ciais, P., Cramer, W., Dukes, J.S., Emmett, B., Hanson, P.J., Knapp, A., Linder, S., Nepstad, D. and Rustad, L. 2008. Modeled interactive effects of precipitation, temperature, and [CO2] on ecosystem carbon and water dynamics in different climatic zones. Global Change Biology, 14 (9), 1986-1999.

Mills, G., Hayes, F., Wilkinson, S., and Davies, W. 2009. Chronic exposure to increasing background ozone impairs stomatal functioning in grassland species. Global Change Biology, 15, 1522-1533.

Mills, G., Hayes, F., Simpson, D., Emberson, L., Norris, D., Harmens, H., and Büker, P. 2010. Evidence of widespread effects of ozone on crops and (semi-)natural vegetation in Europe (1990 – 2006) in relation to AOT40 – and flux-based risk maps. Global Change Biology. In press.

Evans, C.D., Cooper, D.M., Monteith, D.T., Helliwell, R.C., Moldan, F., Hall, J., Rowe, E.C., Cosby, B.J. (2010). Linking monitoring and modelling: can long-term datasets be used more effectively as a basis for large-scale prediction? Biogeochemistry (in press)

Prieto, P., Penuelas, J., Niiemets, U., Ogaya, R., Schmidt, I.K., Beier, C., Tietema, A., Sowerby, A., Emmett, B.A., Lang, E.K, Kroel-Dulay, G., Lhotsky, B., Cesaraccio, C., Pellizzaro, G., de Dato, G., Sirca, C. and Estiarte, M. 2009. Changes in the onset of spring growth in shrubland species in response to experimental warming along a north-south gradient in Europe. Global Ecology and Biogeography, 18, 473-484

Rowe, E.C., Moldan, F., Emmett, B.A., Evans, C.D., and Hellsten, S. (2005). Model chains for assessing impacts of nitrogen on soils, waters and biodiversity: a review. Centre for Ecology and Hydrology/ASTA Programme report for the 6th meeting of the Joint Expert Group on Dynamic Modelling under the Working Group on Effects of the Convention on Transboundary Air Pollution. 63 pp.

Sowerby, A., Emmett, B.A., Tietema, A. and Bier, C. 2008. Contrasting effects of repeated summer drought on soil carbon efflux in hydric and mesic heathland soils. Global Change Biology, 14(10), 2388-2404.

Key scientific personnel to be involved in the project – CEH Wallingford

- Dr. **Lina Mercado** is a vegetation modeller at CEH Wallingford since 2004 with field and modelling expertise in ecophysiology. Her recent work has focused on improving descriptions of plant physiological processes within the JULES land surface model in order to improve predictions of present and future land surface – climate interactions.
- A Ph.D. student will be appointed within this project

Recent relevant publications

Mercado L.M., et al. (2007). Improving the representation of radiation interception and photosynthesis for climate model applications. Tellus Series B-Chemical and Physical Meteorology, 59, 553-565.

Mercado L.M, et al. (2008) Modelling the impact of diffuse radiation changes on the terrestrial carbon sink over the 1900-2000 periode. Nature, 458, 1014-1018

Mercado L.M., et al. (2009). Modelling basin-wide variations in Amazon forest productivity I. Model calibration, evaluation and upscaling functions for canopy photosynthesis. Biogeosciences, 6, 1247-1272

PARTNER no.:	2
Organization full name:	Lunds Universitet
Organization short name:	ULUND
URL:	http://www.lunduniversity.lu.se

Description of the organization

Lund University is one of the largest and broadest universities in Scandinavia and is consistently ranked among the world's top 100 universities. Ca. 46000 students study at the University's eight faculties, which have some 6000 employees. With a strong research focus, ULUND has been awarded in recent years more research funding than any other Swedish higher education institution, including strategic funding of € 72 million received in 2009 from the Swedish Government to foster select existing world-leading research, including in the Environmental Sciences.

Expertise and experience of your organisation, including previous EU projects

The Department of Physical Geography & Ecosystems Analysis (INES) was graded as outstanding in the ULUND RQ2008 international research assessment exercise for its internationally recognized research on the interactions between terrestrial ecosystems and the climate system. In 2008, INES was awarded a Linnée Centre of Excellence grant with 10 years funding for studies into Carbon Cycle-Climate Interactions (LUCCI); since 2009 INES hosts the strategic research initiative MERGE (Modeling the Regional and Global Earth system), which brings together a few hundred scientists from six Swedish institutions. INES also hosts a Strong Research Environment funded via the Swedish Research Council Formas to study sustainable use of land resources. Researchers at INES have been actively involved in numerous EU projects over recent years (e.g., CarboEurope, ALARM, CarboAfrica, CarboNorth, RUBICODE, ENSEMBLES). LPJ-GUESS, the biosphere model to be applied in ÉCLAIRE is developed at INES and used throughout the world.

Key scientific personnel to be involved in the project

Prof. **Almut Arneth**, leads the INES research group on biosphere-atmosphere interactions, initiated by a FP6 Marie Curie Excellence Team grant. Her research concentrates on the interactions of ecosystem biogeochemical cycles, and trace gas emissions with climate and land use change, including interactions with fire. Since obtaining her PhD degree in 1998 she has authored and co-authored close to 70 publications in that field, including in Science and Nature Geoscience. She is founding member of the Steering Committee of the IGBP land-atmosphere project iLEAPS. She is workpackage leader in LUCCI and MERGE, and heads the 2.5 Mio € Formas Strong Research Environment "Land use today and tomorrow". She has been active as partner and WP leader in many European projects (ATEAM, Eurosiberian Carbonflux, LBA, CarboAfrica), and is component leader in the FP7 IP PEGASOS (Pan

European Gas and Aerosol Study). *[Leader Component 2 and contributor to WP14]*

Recent relevant publications

Arneth, A., Schurgers, G., Hickler, T., and Miller, P. A. (2008) Effects of species composition, land surface cover, CO_2 concentration and climate on isoprene emissions from European forests, Plant Biol. 10, 150-162, doi:110.1055/s-2007-965247.

Arneth, A., Unger, N., Kulmala, M., and Andreae, M. O. (2009) Clean the air, Heat the climate?, Science 326, 672-673, doi: 610.1126/science.1181568.

Arneth, A., Harrison, S. P., Zaehle, et al. (2010) Terrestrial biogeochemical feedbacks in the climate system, Nature Geosci 3, 525-532, doi:510.1038/ngeo1905.

Arneth, A., Sitch, S., Bondeau, A., et al. (2010) From biota to chemistry and climate: towards a comprehensive description of trace gas exchange between the biosphere and atmosphere, Biogeosciences 7, 121-149.

Schurgers, G., Arneth, A., Holzinger, R., and Goldstein, A. H. (2009) Process-based modelling of biogenic monoterpene emissions: sensitivity to temperature and light, Atmospheric Chemistry and Physics 9, 3409-3423

PARTNER no.:	3
Organization full name:	Technical University of Denmark (DTU), Denmark
–	Risoe National Laboratory for Sustainable Energy (Risoe DTU) Biosystems Division
Organization short name:	DTU
URL:	http://www.dtu.dk/English.aspx

Description of the organization

Risoe DTU, is the national laboratory for sustainable energy research in Denmark, with research groups within the fields of wind energy, solar panels, bio-energy, energy systems, systems analyses and environmental impacts studies. The Biosystems division focuses on research on the use of biomass for energy and biorefinery as well as environmental impacts studies and carbon sequestration related to climate change and air pollution. The department has a staff of 70 scientists and technicians.

Expertise and experience of your organisation, including previous EU projects

The division has many years of experience in experimental studies in terrestrial ecosystems including biogeochemical modelling. The division has coordinated and participated in numerous national and international ecosystem research projects, including EU projects CLIMOOR, VULCAN, EXPEER, CarboExtreme, CarboEurope and NitroEurope, with particular focus on air pollution and climate change impacts in terrestrial ecosystems. The division has strong experience in ecosystem manipulation, soil, gas and water measurements and modelling and is involved in several ongoing international infrastructures and research networks.

Key scientific personnel to be involved in the project

- Head of programme, senior scientist, PhD **Claus Beier**. His interest lies in experimental manipulations and biogeochemical cycling and modelling. Dr Beier is co-ordinator of the ESF Research Network ClimMani, co-ordinated CLIMOOR and VULCAN and acted as Component Leader for NitroEurope *[Coordinator of Component 3 on plot scale experiments and modelling. Climate change experiments in shrubland and agricultural ecosystem, WP10]*
- Senior scientist **Andreas Ibrom**. Biometeorology, carbon sequestration and canopy photosynthesis modelling. *[contributor WP10]*
- Postdoctoral Fellow **Kristian Albert**, Ecophysiological responses to climate and airpollution treatments *[contributor to WP10]*
- Postdoctoral Fellow, **Leon van der Linden**. Ecosystem modelling of experimental results *[contributor to WP13]*
- Technician **Nina Wiese Thomsen**, running experiments, sampling and analyses. *[contributor to WP10]*

Recent relevant publications

Beier, C. (2004) Interactions of elevated CO_2 and temperature on terrestrial ecosystem structure and functioning – the role of whole-ecosystem manipulation experiments. New Phytologist, 162, 243-245.

Hipsey, M., Antenucci, J. Brookes, J.D., Burch, M., Regel, R and Linden, L. 2004. A three-dimensional model for Cryptosporidium oocyst dynamics in lakes and reservoirs. Journal of River Basin Management 2, 180-192.

Luo, Y.; Gerten, D.; Maire, G.L.; Parton, W.J.; Weng, E.; Zhou, X.; Keough, C. Beier, C.; Ciais, P. Cramer, W.; Dukes, J.S.; Emmett, B.; Hanson, P.J.; Knapp, A.; Linder, S.; Nepstad, D. and Rustad, L. (2008) Modelled interactive effects of precipitation, temperature and [CO2] on ecosystem carbon and water dynamics in different climatic zones. Global Change Biology, 14, 1986-1999.

Knapp, A.; Beier, C.; Briske, D.; Classen, A.T.; Luo, Y.; Reichstein, M.; Smith, M.; Smith, S.D.; Bell, J.E.; Heisler, J.L.; Leavitt, S.W.; Sherry, R.S.; Smith, B.; Weltzin, J.; Weng, E. and Yarie, J. (2008) Consequences of altered precipitation regimes for terrestrial ecosystems. BioScience, 58, 1-11.

Ibrom, A., P.G. Jarvis, R.B. Clement, K. Morgenstern, A. Oltchev, B. Medlyn, Y.P. Wang, L. Wingate, J. Moncrieff and G. Gravenhorst 2006. A comparative analysis of simulated and observed photosynthetic CO_2 uptake in two coniferous forest canopies. Tree Physiology. 26:845 - 864.

PARTNER no: 4

Organization full name: Stichting Dienst Landbouwkundig Onderzoek

Organization short name: ALTERRA

URL: http://www.wur.nl/

Description of the organization

Stichting Dienst Landbouwkundig Onderzoek (DLO) is part of Wageningen UR (University and Research centre). Stichting DLO consists of several specialized research institutes. Within ÉCLAIRE, researchers from Alterra will be involved, being one of the specialized research institutes of DLO. Alterra is the main Dutch centre of expertise on rural areas. Its research focus is on four main topics: rural development, biodiversity and ecosystem services, climate change and adaptation, and risk management. Within FP5 and FP6 of the EU, Alterra has been involved, either as coordinator or partner institution, in more than 85 projects.

Expertise and experience of the organisation, including previous EU projects

Alterra has had a key role in various projects related to carbon sequestration, including CarboEurope and NitroEurope IP. Alterra has been the Coordinator of the Intensive Forest Monitoring Programme of the EC and ICP on Forests, focusing on air quality and climate change impacts of forests and is involved in various Forest COST Actions such as "Climate Change and Forest Mitigation and Adaptation in a Polluted Environment" (FP0903). Alterra is a lead institute in the development of methods to assess thresholds for protecting plant ecosystems from atmospheric pollutants and is involved in many biodiversity networks, including Alternet and European biodiversity projects, such as Echochange, EBONE, ESCAPE and EVOLTREE.

Key scientific personnel to be involved in the project

- Prof Dr. **Wim de Vries** is a scientist in the field of soil chemistry, with special reference to soil acidification, nutrient cycling and green house gas emissions, whose research is documented in more than 100 peer-reviewed publications. *[In ÉCLAIRE he will be the leader of Component 4 "Ecological responses at regional & European scales". He is also the project leader at Alterra and responsible for further development of the VSD+ - FORSPACE -EUMOVE model chain at European scale to assess air quality and climate change impacts on carbon sequestration, plant species diversity and soil quality]*
- Dr. **Gert Jan Reinds** is a specialist in modelling nutrient cycling in view of habitat quality for plant species diversity. His research - documented by more than 35 peer-reviewed publications - is focussed on the continental scale application of models on nutrient cycling, soil acidification and plant species diversity. *[In ÉCLAIRE he will be the leader of WP15 "Air - climate impacts on European biodiversity & soil quality" and he is responsible for the application of VSD+ - FORSPACE - EUMOVE.]*
- Dr. **Koen Kramer** is a research scientist in the field of forest productivity and – dynamics based on carbon, water and nutrient cycling. He participated in several European projects regarding forest functioning in relation to climate change and management and was co-

ordinator of the EU DynaBeech project. He is (co)-author of over 25 peer-reviewed publications with a particular research focus on phenology. *[In ÉCLAIRE his main responsibility is further development of FORSPACE in interaction with VSD+ and atmospheric ozone deposition.]*

Recent relevant publications

De Vries, W., S. Solberg, M. Dobbertin, H. Sterba, D. Laubhann, M. van Oijen, C. Evans, P. Gundersen, J. Kros, G.W.W. Wamelink, G.J Reinds and M.A. Sutton, 2009. The impact of nitrogen deposition on carbon sequestration by terrestrial ecosystems. Forest Ecology and Management 258: 1814-1823.

De Vries, W., S. Solberg, M. Dobbertin, H. Sterba, D. Laubhann, G.J. Reinds, G.J. Nabuurs and P. Gundersen, 2008. Ecologically implausible carbon response?. Nature 451: E1 –E3.

De Vries, W., G. J. Reinds and P. Gundersen and H. Sterba, 2006. Impacts of nitrogen deposition on carbon sequestration by forests in Europe. Global Change Biology 12: 1151-1173.

Kramer, K., Degen, B., Buschbom, J., Hickler, T., Thuiller, W., Sykes, M.T., Winter, W.d., 2010. Modelling exploration of the future of European beech (Fagus sylvatica L.) under climate change--Range, abundance, genetic diversity and adaptive response. Forest Ecology and Management 259, 2213-2222.

Reinds, G.J., Posch, M. & Leemans, R., 2009. Modelling recovery from soil acidification in European forests under climate change. Science of the Total Environment 407, 5663–5673.

PARTNER no.:	5
Organization full name:	International Institute for Applied Systems Analysis
Organization short name:	IIASA
URL:	http://www.iiasa.ac.at

Description of the organization

IIASA is a non-governmental, multi-national, independent organization devoted to interdisciplinary, policy-oriented research focusing on selected aspects of environmental, economic, technological and social issues in the context of global change. IIASA's research is organized around fields of policy importance rather than academic disciplines. IIASA investigators perform interdisciplinary research that combines methods and models from the natural and social sciences in addressing areas of concern for all societies.

Expertise and experience of your organisation, including previous EU projects

IIASA's "Atmospheric Pollution and economic Development" (APD) programme has developed a model to explore Greenhouse gas – Air pollution INteractions and Synergies (GAINS) between the control of local and regional air pollution and the mitigation of global greenhouse gas emissions. The GAINS model can be used as a central analytical tool for the integrated assessment of emissions and emission abatement vs. the effects of air pollution and greenhouse gas emissions. It has been applied as a scientific support tool to the development of various European policy processes, such as the National Emissions Ceilings Directive of the European Commission, the Clean Air For Europe (CAFE) and European Climate Change Programme (ECCP). In the 1990s, the predecessor model RAINS was applied in Aisa (RAINS-Asia) to address the scope and cost-effectiveness of SO_2 reductions in 23 Asian countries. The GAINS-Asia project extends this work to greenhouse gases. Within the FP6 ACCENT Network on Excellence, APD coordinated the subproject on "Atmospheric Sustainability", which aimed at aligning European atmospheric research activities to address research questions that are relevant for policies on sustainability. The GAINS model is implemented on the Internet (http://gains.iiasa.ac.at). IIASA has been the coordinator of a number of consortia and demonstrably implemented those projects successfully. Due to its coordinating role in the ongoing LIFE project EC4MACS, IIASA has also experience in managing LIFE projects at all stages. EC4MACS brings together a consortium of institutions to build and maintain a network of well established modelling tools for a comprehensive integrated assessment of the policy effectiveness of emission control strategies for air pollutants and greenhouse gases, and thus provides important input to the current call.

Key scientific personnel to be involved in the project

- Dr. **Markus Amann**: leader of IIASA's APD programme and co-leader of IIASA's Greenhouse Gas Initiative and head of the *Centre for Integrated Assessment Modelling*

(CIAM) of the European Monitoring and Evaluation Programme (EMEP) under the Convention on Long range Transboundary Air Pollution (CLRTAP) *[Coordinator of Component 5]*.

- Dr. **Wilfried Winiwarter**: emissions and integrated assessment modeller and Chair of the Expert Panel on Nitrogen Budgets under the UNECE TFRN; contributor to IPCC *[deputy coordinator of Component 5, coordinator of WP20]*
- **Chris Heyes**: integrated assessment modeller with expertise in ozone assessment *[model development in component 5.2 and 5.3]*
- Dr. **Wolfgang Schöpp**: integrated assessment modeller *[model design and model development in components 5.2 and 5.3]*

Recent relevant publications

Cofala J et al. (2010). Integrated assessment of air pollution and greenhouse gases mitigation in Europe. Arch. Environ. Protect. 36(1):29-39.

Fischer G et al. (2010). Integrated modeling framework for assessment and mitigation of nitrogen pollution from agriculture: Concept and case study for China. Agr., Ecos. & Env., 136(1-2):116-124.

Winiwarter W et al. (2010). Emission mitigation potentials and costs for non-CO_2 greenhouse gases in Annex-I countries according to the GAINS model. J. Integr. Env. Sci. 7 (S1), 235-243.

PARTNER no.:	6
Organization full name:	Norwegian Meteorological Institute
Organization short name:	met.no
URL:	http://www.met.no

Description of the organization

The Norwegian Meteorological Institute (**met.no**) is the national meteorological service in Norway. **met.no** employs around 400 persons, including 70 scientists doing research in numerical weather prediction, ocean modelling, remote sensing, air pollution, product development, instrumentation, climatology and climate research. Air pollution research at **met.no** has a strong operational component where the results of research are turned into products for policy makers, public authorities, or the research community. Through EMEP and its support of the EU Thematic Strategy on air pollution, **met.no** provides support for air pollution strategies and in understanding the couplings between climate/weather variability and air pollution.

Expertise and experience of your organisation, including previous EU projects

met.no represents Norway in ECMWF, EUMETSAT, EUMETNET, WMO and other international fora. **met.no** scientists are active in EU and other international bodies on climate, atmospheric and marine research, and **met.no** (M. Gauss) is currently coordinating the FP6 CityZen project. **met.no** hosts the western center for modelling within the EMEP project (European Monitoring and Evaluation Programme) under the Convention for Long Range Transmission of Air Pollutants under UNECE.

Key scientific personnel to be involved in the project

- Adj. Prof. **David Simpson** has worked with air pollution modelling for 28 years, 20 of these for met.no and EMEP MSC-W. He has worked extensively with biogenic VOC emissions, chemistry, deposition, organic aerosols, and the ozone-effects community. He has participated in many UN-ECE and European Commission working groups, and six EU projects, currently Nitro-Europe and EUCAARI. He is the lead author for the chapter on atmospheric transport and deposition of reactive nitrogen in Europe for the European Nitrogen Assessment (ENA, www.nine-esf.org), and Board member of the *Swedish strategic research area ModElling the Regional and Global Earth system, MERGE*. He has 57 peer-reviewed publications. *[WP 2.3 leader and contribution to WP16 and 5.2]*
- Dr. **Michael Gauss** received his PhD in atmospheric chemistry in 2003 at the University of Oslo, where he worked in the field of atmospheric science from 1998 to 2010. He has been employed at met.no since 2006. He has co-authored 29 peer-reviewed publications and has contributed to two IPCC assessments. He has gained international experience through his participation in more than ten EU-funded projects focusing on atmospheric chemistry and climate change. Since 2008 he has been coordinating the EU FP7 project CityZen. He has assisted in the coordination of the MACC subproject O-POL and is currently acting head of the EMEP centre MSC-W.*[contribution to WP7]*

Recent relevant publications

Jonson, J.; Simpson, D.; Fagerli, H. & Solberg, S. Can we explain the trends in European ozone levels? *Atmos. Chem. and Physics*, **2006**, *6*, 51-66

Mills, G.; Hayes, F.; Simpson, D. et al., Widespread ozone damage to crops and (semi-)natural vegetation in Europe (1990 – 2006) in relation to AOT40 -- and flux-based risk maps Global Change Biology, available online, now due in print 8th Dec. 2010.

Simpson, D.; Butterbach-Bahl, K.; Fagerli, et al., Deposition and Emissions of Reactive Nitrogen over European Forests: A Modelling Study *Atmos. Environ.*, **2006**, *40*, 5712-5726

Simpson, D.; Emberson, L.; Ashmore, M. & Tuovinen, J. A comparison of two different approaches for mapping potential ozone damage to vegetation. A model study *Environ. Poll.*, 2007, 146, 715-725

Tuovinen, J.-P.; Emberson, L. & Simpson, D. Modelling ozone fluxes to forests for risk assessment: status and prospects *Annals of Forest Science*, 2009, 66, 401

PARTNER no.:	7
Organization full name:	Forschungszentrum Juelich GmbH
Organization short name:	Juelich
URL:	http://www.fz-juelich.de/portal/

Description of the organization

Forschungszentrum Jülich GmbH is a member of the Helmholtz Association of German National Research Centres. With 4400 staff members it is the largest interdisciplinary research centre in Germany focusing its research in the fields of health, environment and energy, and information technology. Institute IEK-8: Troposphere is part of the Institute for Energy and Climate Research (IEK) and has over 25 years of experience in the field of Atmospheric Chemistry with a strong focus on the measurements of trace gases and global to regional-scale modelling. It is directed by Prof. Andreas Wahner. About 50 scientists, engineers, technicians and doctoral students are currently working at the institute in the field of atmospheric chemistry.

Expertise and experience of your organisation, including previous EU projects

The Juelich Plant Atmosphere Chamber (JPAC) is operated in cooperation of IEK-8 with the project group Plant-Atmosphere-Interactions at the Institute for Bio- and Geosciences (IBG), Institute Phytosphere, IBG-2. IBG-2: Phytosphere is directed by Prof. Ulrich Schurr and about 100 scientists, engineers, technicians and doctoral students are currently working in the field of plant sciences.

EU projects with participation of the Juelich groups include: HECONOS, CASOMIO, ACCENT, EUCAARI, and PEGASOS and the ESF funded projects INTROP and VOCBAS.

Key scientific personnel to be involved in the project

- PD Dr., **Thomas, Mentel** is head of the Heterogeneous Reaction group at IEK-8. His research areas include heterogeneous atmospheric reactions, physical chemistry and mass spectrometric analysis of aerosols. He has over 40 publications in peer reviewed journals, one in Nature. He coordinated the two European projects HECONOS and CASOMIO. *[Leader of WP2 and contribution to WP7]*
- PD Dr. **Jürgen, Wildt** is head of the Plant-Atmosphere-Interaction group at IBG-2. Since 1990 his work focuses on the mechanisms of trace gas exchange between plants and atmosphere. He has 50 publications in peer-reviewed journals, one in Nature and he participated in 5 national and international projects. *[contribution to WP1WP1, 1.2 and 2.3]*
- PD Dr., **Astrid, Kiendler-Scharr** is leading the young investigators group Stable Isotopes in Aerosols at IEK-8. Her research areas include mass spectrometry in gas- and particle phase. She has published over 40 peer reviewed articles, one in Nature, and coordinates

the experimental activities of PEGASOS. *[contribution to WP2]*

- PD Dr. **Hendrik, Elbern** is head of the Chemical Mechanism and Inverse Modelling group at IEK-8. His special research areas are chemical data assimilation and inverse problems in atmosphere and soils. He has acted as PI in several national, ESA and EC funded projects. He has more than 30 publications in peer-reviewed journals, including some with seminal character in atmospheric chemistry data assimilation. *[contribution to WP7]*

Recent relevant publications

Behnke, K., E. Kleist, R. Uerlings, J. Wildt, H. Rennenberg, J.P. Schnitzler: RNAi-mediated suppression of isoprene biosynthesis in hybrid poplar impacts ozone tolerance. *Tree Physiology* 29, 725-736, 2009.

Elbern, H., A. Strunk, H. Schmidt, and O. Talagrand: Emission rate and chemical state estimation by 4-dimensional variational inversion, *Atmos. Chem. Phys.*, 3749-3769, 2007.

Mentel, Th. F., J. Wildt, A. Kiendler-Scharr, E. Kleist, R. Tillmann, M. Dal Maso, R. Fisseha, Th. Hohaus, H. Spahn, R. Uerlings, R. Wegener, P. Griffiths, E. Dinar, Y. Rudich, A. Wahner: Photochemical production of aerosols from real plant emissions. *Atmos. Chem. Phys.,* 9, 4387-4406, 2009

Kiendler-Scharr, A., J. Wildt, M. DalMaso, Th. Hohaus, E. Kleist, Th. F. Mentel, R. Tillmann, R. Uerlings, U. Schurr, A. Wahner. New Particle formation in forests inhibited by isoprene emissions. *Nature* 461, 381-384, 2009.

Fares, S. F. Loreto, E. Kleist, J. Wildt: Stomatal Uptake and Stomatal Deposition of Ozone in Isoprene and Monoterpene Emitting Plants. *Plant Biology* 10, 44 – 54, 2008.

Lang-Yona, N., Y. Rudich, Th. F. Mentel, A. Buchholz, A. Kiendler-Scharr, E. Kleist, C. Spindler, R. Tillmann, J. Wildt**.** The chemical and microphysical properties of secondary organic aerosols from Holm Oak emissions. *Atmos. Chem. Phys*. 10, 7253-7265, 2010.

PARTNER no.:	8
Organization full name:	Stichting Energieonderzoek Centrum Nederland
Organization short name:	Energy Research Centre of the Netherlands (ECN)
URL:	http://www.ecn.nl

Description of the organization

ECN at Petten is a market-oriented organisation for research, development and knowledge transfer in energy, environment and related fields. ECN develops and markets technologies and products for a safe, efficient and environmentally friendly energy supply. ECN's activities are concentrated in six priority areas: solar energy, wind energy, biomass, clean fossil fuels, energy efficiency and policy studies. The Unit Biomass, Coal & Environmental Research works on the contribution of biomass and coal to a more sustainable use of these energy sources and environmental assessments of the impact of human activities on air and soil quality.

Expertise and experience of your organisation, including previous EU projects

Air Quality and Climate Change unit has a high level of expertise in (development of) analytical equipment for determination of air pollutants; measurement of concentrations and deposition of acidifying air pollutants; aerosol components; and high precision measurement of the most important greenhouse gases CO_2, CH_4 and N_2O. Modelling expertise is available on the local scale, e.g., in parameterisations of deposition fluxes and in derivation of area fluxes of ammonia from manure spreading or methane from landfills by dispersion modelling, as well as on the regional scale, e.g., the derivation of CO_2, CH_4 and N_2O emissions over western Europe by inverse modelling.

Key scientific personnel to be involved in the project

- Prof. **Jan Willem Erisman**'s nitrogen related research focuses primarily on the atmosphere-biosphere interactions and the relation between loads and levels of atmospheric pollutants and the ecosystem effect. He has co-ordinated several national and international projects, including two EC-funded projects. *[Contributor to WPs 8 and 20]*
- MSc. **Albert Bleeker** is involved in leading projects focussing on the application of atmospheric dispersion and deposition models on different scales, linking/integrating models and measurements, with a special emphasis on nitrogen related issues. *[Leader WP 8; Contributor to Component 1, 5]*
- MSc. **Arjan Hensen** works in the field of greenhouse gas emission measurements and local dispersion modelling for emission estimates since 1990. He acts as a project leader and PI in several national and EU projects. *[Contributor to Component 1, 5]*
- MSc. **Arnoud Frumau** has extensive experience in different measurement techniques related to nitrogen and green house gases, as well as modelling their dispersion and deposition at different spatial scales. *[Contributor to Component 1, 2]*

Recent relevant publications

Erisman, J.W., van Grinsven, H., Lei, A., Mosier, A. and Bleeker, A., 2009. Nitrogen and biofuels; an overview of the current state of knowledge. Nutrient Cycling in Agroecosystems,, 2009. DOI 10.1007/s10705-009-9285-4.

Erisman, J.W., Bleeker, A., Hensen, A. and Vermeulen A.(2007) Agricultural air quality in Europe and the future perspectives. Atmospheric Environment, Volume 42, Issue 14, Pages 3209-3217.

Bleeker, A., Draaijers, G., Van Der Veen, D., Erisman, J.W., Mö ls, H., Fonteijn, P., Geusebroek, M. Field intercomparison of throughfall measurements performed within the framework of the Pan European intensive monitoring program of EU/ICP Forest (2003) Environmental Pollution, 125 (2), pp. 123-138.

Denier van der Gon, A. and Bleeker, A. (2005) Indirect N_2O emission due to atmospheric N deposition for the Netherlands. Atmospheric Environment, Volume 39, Issue 32, Pages 5827-5838.

Pieterse, G., Bleeker, A., Vermeulen, A.T., Wu, Y., Erisman, J.W. High resolution modelling of atmosphere-canopy exchange of acidifying and eutrophying components and carbon dioxide for European forests (2007) Tellus, Series B: Chemical and Physical Meteorology, 59 (3), pp. 412-424.

PARTNER no.:	9
Organization full name:	Consiglio Nazionale delle Ricerche
Organization short name:	CNR
URL:	http://www.cnr.it

Description of the organization

The Consiglio Nazionale delle Ricerche (CNR) is the Italian Governmental Research Organisation and one of the European leading research institutions. The Institute for Plant Protection (IPP) focuses on studies about the relationships between biosphere and the atmosphere at different scales, from gene expression to populations and plant communities, aiming to develop better understanding of mechanisms of protection of plants against environmental constraints, pollution, and climate change. The Institute houses more than 40 researchers and an outstanding suite of facilities including those shared with the CNR research areas of Firenze and Roma.

Expertise and experience of your organisation, including previous EU projects

CNR has interdisciplinary, technical and scientific experience about emissions, fluxes, roles and consequences of biogenic volatile organic compounds (BVOC) and about fluxes of greenhouse gases (CO_2, H_2O) and pollutants (O_3, NO_x). CNR has coordinated the mass-spectrometry facility (MASF), a large scale infrastructure of the Network of Excellence on atmospheric chemistry (ACCENT), including mass spectrometers for analysis of stable isotope abundances of C, O, N, H (IR-MS) and proton transfer reaction - mass spectrometers (PTR-MS) for on-line, ultra-sensitive (> ppt) and ultrafast (< 1 s) detection of trace gases in air and for calculation of fluxes of BVOCs exchanges between the biosphere and the atmosphere, or products of fast chemical reactions. CNR is also developing, within the frame of an EC People Industry-Academia project (PTR-TOF), a new highly sensitive PTR instrument with Time of Flight detector. CNR participating people and facilities have been involved in the European Science Foundation (ESF) programmes VOCBAS and SIBAE, contributing to the Integrated Land Ecosystem - Atmosphere Processes Study (iLEAPS) the 10 year land-atmosphere core project of the International Geosphere-Biosphere Programme (IGBP). CNR also participated to the European programmes EUROFACE, CARBOITALY, CARBOEUROPE, NETCARB, ALTERNET, EVOLTREE and FOREST-FOCUS and to the National monitoring programme of the natural area of Castelporziano. CNR-IPP coordinates the recently launched ESF programme on Ecology of Plant Volatiles: from the molecules to the globe (EuroVOL, programme leader Francesco Loreto).

Key scientific personnel to be involved in the project

- Dr **Francesco Loreto**, Institute Director, CNR-IPP. Dr Francesco Loreto is a member of the steering committee of iLEAPS starting 2009 and has coordinated the EC-FP6 Marie Curie Research and training network ISONET (2004-2008) involving 9 countries and 22 young researchers. He will use his expertise and CNR's instrumental capacity in the ÉCLAIRE flux campaign, and to improve understanding of factors controlling the exchange of BVOCs and pollutants, in turn determining sensitivity of plants to pollutants. *[Leader of WP11, contributing to WP2]*
- Dr **Mauro Centritto**, Senior Researcher *[contributing to WP1WP1, 1.2 and 3.3]*
- Dr **Silvano Fares**, Researcher *[contributing to WP1WP1, 1.2 and 3.3]*

Recent relevant publications

Fortunati A., C. Barta, F. Brilli, M. Centritto, I. Zimmer, J-P. Schnitzler, F. Loreto. 2008. Isoprene emission is not temperature-dependent during and after severe drought-stress: a physiological and biochemical analysis. Plant J. 55: 687-697

Fowler D., et al. 2009, Atmospheric composition change: ecosystems - atmosphere interactions. Atmos. Environ. 43: 5193-5267.

Fares S., S. Mereu, G. Scarascia Mugnozza, M. Vitale, F. Manes, M. Frattoni, P. Ciccioli, G. Gerosa, F. Loreto. 2009.The ACCENT-VOCBAS field campaign on biosphere-atmosphere interactions in a Mediterranean ecosystem of Castelporziano (Rome): site characteristics, climatic and meteorological conditions, and eco-physiology of vegetation. Biogeosciences, 6: 1043–1058.

Vickers C.E., J. Gershenzon, M.T. Lerdau, F. Loreto. 2009. A unified mechanism of action for isoprenoids in plant abiotic stress. Nature Chem Biol. 5: 283-291.

Loreto F., J-P Schnitzler. 2010. Abiotic stresses and induced BVOCs. Trends Plant Sci. 15: 154-166.

PARTNER no.: 10

Organization full name: Karlsruhe Institute of Technology, Institute for Meteorology and Climate Research, Atmospheric Environmental Research (IMK-IFU)

Organization short name: KIT

URL: http://imk-ifu.fzk.de/

Description of the organization

Karlsruhe Institute of Technology (KIT) is a higher education and research organisation with about 8000 employees and 18,500 students. KIT was established on 01/10/2009 as merger of *Universität Karlsruhe* (founded in 1825) and the *Forschungszentrum Karlsruhe GmbH* (founded in 1956), member of the Helmholtz Association. Within the KIT the Institute for Meteorology and Climate Research, Atmospheric Environmental Research (IMK-IFU) concentrates on major regional and local environmental problems that are in the center of public interest, i.e., among others, atmospheric pollution and climate change. The work program comprises studies of the complex interactions between biosphere and atmosphere and the associated exchange of environmentally relevant trace substances (CO_2, CH_4, N_2O, NO/NO_2). Information is used for the development of process-oriented models for the simulation of biosphere-atmosphere exchange, the latter being used for the derivation of efficient mitigation and/or adaptation measures.

Expertise and experience of your organisation, including previous EU projects

With this thematic focus IMK-IFU has been involved in several EU projects such as NOFRETETE or NitroEurope.

Key scientific personnel to be involved in the project

- Prof. Dr. **Klaus Butterbach-Bahl** has led the EU Project NOFRETETE and has been Component leader in NitroEurope, focusing on the measurement and ecosystem modeling of trace gas emissions from the plot to the continental scale. In ÉCLAIRE he will conduct eperiments with intact soil cores for improving the parameterization of soil NO and GHG emissions, adaption and further development of biogeochemical models for simulating soil NO emissions on site and regional scales. *[Leading WP 1.3, contributing to Component 1, Component 2, and WP13]*
- Dr. **Ralf Kiese**: Further development of biogeochemical models for simulating soil acidification and changes in soil C:N ratios due to the atmospheric deposition of acidifying compounds*[contributing to WP3 and WP13]*

Recent relevant publications

Butterbach-Bahl, K. et al. 2009, A European wide inventory of soil NO emissions using the biogeochemical models DNDC/ Forest DNDC. Atmospheric Environment, 43, 1392-1402.

De Bruijn, A.M.G., Butterbach-Bahl, K., 2010, Linking carbon and nitrogen mineralization with microbial responses to substrate availability – the DECONIT model. Plant and Soil, 328, 271-290, DOI 10.1007/s11104-009-0108-9.

Dupont, R., Butterbach-Bahl, K., Delon, C., Brüggemann, N., Serca, D., 2008, Neural network treatment of 4 years long NO measurement in temperate spruce and beech forests. Journal of Geophysical Research, 113, G04001, doi:10.1029/2007JG000665

Yao, Z., Wu, X., Wolf, B., Dannenmann, M., Butterbach-Bahl, K., Brüggemann, N., Chen, W., Zheng, X., 2010, Soil-atmosphere exchange potential of NO and N_2O in different land use types of Inner Mongolia as affected by soil temperature, soil moisture, freeze-thaw, and drying-wetting events. Journal of Geophysical Research. 115, D17116, doi:10.1029/2009JD013528.

PARTNER no.:	11
Organization full name:	European Commission Joint Research Centre
Organization short name:	JRC
URL:	http://ec.europa.eu/dgs/jrc/index.cfm

Description of the organization

The Institute for Environment and Sustainability (IES) is one of the seven institutes that constitute the Joint Research Centre (JRC) of the European Commission. The mission of IES is to provide scientific and technical support to EU strategies for the protection of the environment and sustainable development. The IES has an interdisciplinary, integrated philosophy, which combines expertise in experimental sciences, modelling, geomatics and remote sensing. The IES is one of the leading European centres for research on environment and sustainability.

Expertise and experience of your organisation, including previous EU projects

The IES Climate Change Unit provides scientific support for the development and monitoring of European policies in the area of regional and global air pollution and climate change. It has contributed to numerous projects in FP4-FP7; i.e. ACCENT, ADAM, CAPRI, CARBOEUROPE, EUCAARI, GAINS-ASIA, GEMS, MAP, NATAIR, NITROEUROPE AND QUANTIFY. Here, the CCU will use it's capacity on global to regional scale modeling of long-and short lived trace gases and aerosols, evaluating emissions from agricultural and other sectors using highly spatially resolved models of biogeochemical reactions, and performing and analysing measurements of Greenhouse gases and reactive gases fluxes.

Key scientific personnel to be involved in the project

- Dr **Frank Dentener**, Modeler, PI, is a globally renowned atmospheric transport modeler working at the regional, continental and global scale. He is lead author to IPCC AR5. In ÉCLAIRE he will lead the work on understaning hemispheric O_3 trends and their contribution to European ecosystem exposure *[Work Package leader WP 5]*
- Dr. **A Cescatti,** Modeler of large-scale ecosystem air pollution interactions. *[Leading WP 14]*
- Dr. **A. Leip** Modeler *[contributing to Component 4 and 7]*;
- Dr. **C. Gruening,** Group Leader Flux Measurements will co-ordinate the activities at the JRC flux measurement site *[contributing to C1]*

Recent relevant publications

Cescatti, A. (2007). Indirect estimates of canopy gap fraction based on the linear conversion of hemispherical photographs: Methodology and comparison with standard thresholding techniques. Agricultural and Forest Meteorology, 143, 1-12

Kloster, S. F. Dentener, J. Feichter, F. Raes, E. Roeckner, U. Lohmann, E. Roeckner, I. Fischer-Bruns, A GCM study of future climate response to air pollution reductions, Climate Dynamics, 34, 1177-1194, 2010

Mahecha, M.D., Reichstein, M., Carvalhais, N., Lasslop, G., Lange, H., Seneviratne, S.I., Vargas, R., Ammann, C., Arain, M.A., Cescatti, A., Janssens, I.A., Migliavacca, M., Montagnani, L., & Richardson, A.D. (2010). Global Convergence in the Temperature Sensitivity of Respiration at Ecosystem Level. Science, 329, 838-840

Dentener, F., J. Drevet, J.F. Lamarque, and 20 others, Nitrogen and Sulphur Deposition on regional and global scales: a multi-model evaluation, Global Biogeochemical Cycles, 20, GB4003, doi:10.1029/2005GB002672, 2006.

Leip, A., Marchi, G., Koeble, R., Kempen, M. Britz, W., Li, C., Linking an Economic Model for European Agriculture with a Mechanistic Model to Estimate Nitrogen and Carbon Losses from Arable Soils in Europe, Biogeosciences, 73-94, 2008.

PARTNER no.:	12
Organization full name:	University of York
Organization short name:	SEI-Y, UoY
URL:	http://www.york.ac.uk/; http://sei-international.org/

Description of the organization

The Stockholm Environment Institute (SEI) is an independent, international research institute. It has been engaged in environment and development issues at local, national, regional and global policy levels for more than 20 years. It has had a centre at the University of York throughout this time which is based within the Environment Department at the university. SEI's research is gathered into four thematic areas that tackle overarching issues such as climate change, energy systems, vulnerability and governance, as well specific problems such as water resources and air pollution. SEI is an innovator, and has consistently shown the vision to confront issues before they enter the mainstream.

Expertise and experience of your organisation, including previous EU projects

Its researchers have a wide range of experience working throughout the globe for funders including the UN, EU, SIDA, WWF, AdB and Gates Foundation. Previous EU projects include **NeWater** (New approaches to adaptive water management under uncertainty), **ACP Test** (Sustainable transport policies in Africa), **Healthy Futures** (Health, environmental change and adaptive capacity: mapping, examining and anticipating future risks of water-related vector-borne diseases in eastern Africa) and **OPEN EU** (Engaging civil society in research on Sustainable Development Indicators).

Key scientific personnel to be involved in the project

- Dr. **Lisa Emberson**, PI, has been central to the development of the DO_3SE O_3 deposition model to date, and its implementation into the EMEP model, work which she will build on during ÉCLAIRE *[Leading WP 3.4, contributing to Component 1 and 3]*
- Dr. **Patrick Bueker**: Research (DO_3SE model development) *[contributing to WP12 and 3.5]*
- Dr **Kevin Hicks**: Research (N_r impacts on grasslands and ecosystem service analysis); *[contributing to WP18]*
- Prof. **Mike Ashmore**: Research advisor (N_r impacts on grasslands and model development); *[contributing to WP12 and 3.5]*
- Dr. **Andreas Heinemeyer**: Research (C cycling in ecosystems) *[contributing to WP9 and 3.5]*

Recent relevant publications

Tuovinen, J.-P., Emberson, L., and Simpson, D. (2009) Modelling ozone fluxes to forests for risk assessment: status and prospects. Annals of Forest Sciences 66: 401.

Büker, P., Emberson, L.D., Ashmore, M.R., Cambridge, H.M., Jacobs, C.M.J., Massman, W.J., Müller, J., Nikolov, N., Novak, K., Oksanen, E., Schaub, M., de la Torre, D. (2007) Comparison of different stomatal conductance algorithms for ozone flux modelling. Environmental Pollution 146 (3): 726-735

Emberson LD, Buker P, Ashmore MR (2007) Assessing the risk caused by ground level ozone to European forest trees: A case study in pine, beech and oak across different climate regions. Environmental Pollution 147 (3): 454-466

Kutsch W, Bahn M & Heinemeyer A. Soil carbon relations – an overview (2009). In: Soil Carbon Dynamics: An Integrated Methodology. Eds. Kutsch W., Bahn M. Heinemeyer A. Cambridge University Press.

Smart, J.R., Hicks, K., Morrissey, T., Heinemeyer, A., Sutton, M. and Ashmore. M. (2010). Applying the Ecosystem Service Concept to Air Quality Management in the UK: a Case Study for Ammonia. *Environmetrics* (in press)

Bobbink R, Hicks K, Galloway J, Spranger T, Alkemade R, Ashmore M, Bustamante M, Cinderby S, Davidson E, Dentener F, Emmett B, Erisman JW, Fenn M, Gilliam F, Nordin A, Pardo L and de Vries W. (2010). Global Assessment of Nitrogen Deposition Effects on Terrestrial Plant Diversity: a synthesis. *Ecological Applications*, 20(1), 30–59.

PARTNER no. :	13
Organization full name:	Institut National de la Recherche Agronomique
Organization short name:	INRA
URL:	http://www.inra.fr

Description of the organization

INRA is the second largest research institute on agronomy in the world, undertaking research linked with agriculture and environment.

Expertise and experience of your organisation, including previous EU projects

INRA(Gr) is undertaking research on pollutants and greenhouse gases (GHG) exchange between the surface and the atmosphere, and the spatial transfer of these pollutants in the landscape. INRA(Gr) has developed an expertise in (1) flux measurements and emission/deposition process modelling of GHG and pollutants including N_2O, NO_x, O_3, and NH_3 as well as biotic particles (pollens and spores) (2) ecosystem modelling with environmental outputs, and (3) landscape scale modelling of pollutants and GHG exchange. INRA(Gr) has been involved in several EU projects in the past, including GRAMINAE (FP4), CARBOEUROPE (FP5), NITROEUROPE, ACCENT-NoE (FP6).

INRA(Re) is undertaking research on pollutant transfer in agro-hydrosystems, with strong emphases on water and soil quality, and on emissions, deposition and concentrations of atmospheric pollutants and greenhouse gases from agriculture. As part of the EU-FP6 NITROEUROPE project, INRA(Re) has developed an analytical platform for the supply and analysis of atmospheric samples from long-term monitoring sites across Europe, and has provided expertise in the modelling of dry deposition inputs of atmospheric gases and aerosols to terrestrial ecosystems.

Key scientific personnel to be involved in the project

- Dr. **Benjamin Loubet (PI)** is an expert in the measurements and interpretation of biosphere / atmosphere exchange fluxes with micrometeorological techniques and in the dispersion modeling at the local scale *[contributing to WP3 and 1.4]*
- Dr. **Christophe Fléchard's** expertise lies in the measurement of surface / atmosphere exchange fluxes and in the parameterization of exchange processes for application in chemical transport models and to derive deposition fluxes from concentration measurements using inferential modeling techniques *[Leader of WP4]*
- Dr. **Jean-Louis Drouet**: Landscape nitrogen fluxes modelling *[contributing to WP8]*
- Dr. **Sophie Génermont** will bring to the ÉCLAIRE consortium her expertise in process emission modelling, especially of ammonia from agricultural land *[contributing to WP8]*
- Dr. **Raia Massad**: Atmospheric deposition modelling *[contributing to WP8]*

- Dr. **Pierre** Cellier heads the group at INRA Grignon. He has led a Component on integrated N modelling at the landscape scale within NitroEurope and will ensure that the developmenst of this earlier project will fully benefit the landscape level modelling in WP8 *[contributing to WP1WP1, 1.3 and 2.4]*

Recent relevant publications

Cellier P., Bleeker A., Breuer L., Dalgaard T., Dragosits U., Drouet J.L., Durand P., Hutchings N., Kros H., Loubet B., Oenema O., Olesen J., Mérot P., Theobald M., Viaud V., De Vries W. - 2011 - Dispersion and fate of nitrogen in rural landscapes. European Nitrogen Assessment, ENA Report, chap. 11, (in press).

Duretz, S., Drouet, J.-L., Hutchings, N.J., Durand, P. ,Theobald, M.R., Salmon-Monviola, J., Dragosits, U., Maury, O., Sutton, M.A., Cellier, P., 2010. NitroScape: an integrated model of nitrogen fluxes and transformation at the landscape scale. Environmental Pollution *submitted*.

Flechard, C.R., Nemitz, E., Smith, R.I., Fowler, D., Vermeulen, A.T., Bleeker, A., Erisman, J.W., Simpson, D., Zhang, L., Tang, Y.S. and Sutton, M.A, 2010. Dry deposition of reactive nitrogen to European ecosystems: a comparison of inferential models across the NitroEurope network. Atmospheric Chemistry and Physics Discussion (*submitted*).

Loubet, B., Laville, P., Lehuger, S., Larmanou, E., Flechard, C., Mascher, N., Génermont, S., Roche, R., Ferrara, R.M., Stella, P., Personne, E., Durand, B., Decuq, C., Flura, D., Masson, S., Fanucci, O., Rampon, J.-N., Siemens, J., Kindler, R., Schrumpf, M., Gabriele, B. and Cellier, P., 2010. Measurement base carbon, nitrogen and GHG balances of a four years crop rotation. Plant and Soil (*submitted*).

Massad R.-S. , E. Nemitz, and M. A. Sutton, 2010. Review and parameterisation of bi-directional ammonia exchange between vegetation and the atmosphere. Atmos. Chem. Phys., 10, 10359-10386.

Sommer, S.G., Genermont, S., Cellier, P., Hutchings, N.J., Olesen, J.E. and Morvan, T., 2003. Processes controlling ammonia emission from livestock slurry in the field. European Journal of Agronomy, 19(4): 465-486.

PARTNER no.:	14
Organization full name:	National Institute for Public Health and the Environment
Organization short name:	RIVM
URL:	www.rivm.nl (www.rivm.nl/cce)

Description of the organization

RIVM is a governmental research and knowledge institute providing policy support to the Dutch Ministry of Health, Welfare and Sport, the Ministry of Environment and Spatial Planning, the Ministry of Agriculture and Fisheries, the National Food Authority, and several National Inspectorates. The national tasks of the RIVM are laid down by law.

The Coordination Centre for Effects (CCE), located at RIVM, is the Programme Centre of the International Co-operative Programme on Modelling and Mapping of Critical Levels and Loads and Air Pollution Effects, Risks and Trends (ICP Modelling and Mapping, ICP M&M) and supports the work of the Convention on Long-range Transboundary Air Pollution (LRTAP) of the United Nations Economic Commission for Europe (UNECE). The CCE develops methodologies and databases for critical threshold assessments on a European scale, in collaboration with a network of more than 30 National Focal Centres under the LRTAP Convention.

Expertise and experience of your organisation, including previous EU projects

RIVM has a proven track record regarding the execution of EU funded projects. Experts employed by the RIVM have a broad and longs standing experience in international research consortia, including projects funded by the Framework Programme (FP) of DG Research, projects funded by the Public Health Action Programme of DG Sanco and in various projects within the PHARE and CARDS programme of DG Enlargement. Results of the RIVM-Coordination Centre for Effects include the support of the Oslo protocol (1994) and the Gothenburg protocol under the LRTAP Convention, and of the emission ceiling directive (2001) of the European Commission.

Key scientific personnel to be involved in the project

- Dr. **Jean-Paul Hettelingh**: Integrated assessment of air pollution effects (Head, RIVM-CCE) *[contributing to Component 3, 4 and Leading WP19]*
- Dr. **Max Posch**: Modelling of air pollution effects (senior scientist RIVM-CCE) *[Leading WP16, contributing to Component 3, 4, 5]*
- Ing. **Jaap Slootweg**: Management of European critical threshold databases (senior scientist CCE)
  [contributing to Component 3, 4 and 5]
- Drs. **Rob Maas**: cost/benefit analysis in integrated assessment modelling (chairman TF Integrated Assessment Modelling under the Convention LRTAP). *[contributing to*

Component 5]

Recent relevant publications:

Posch M, Aherne J, Hettelingh J-P, 2010. Nitrogen critical loads using biodiversity-related critical limits. *Environmental Pollution (in press*)

De Vries W, Wamelink GWW, Van Dobben H, Kros J, Reinds GJ, Mol-Dijkstra JP, Smart SM, Evans CD, Rowe EC, Belyazid S, Sverdrup HU, Van Hinsberg A, Posch M, Hettelingh J-P, Spranger T, Bobbink R, 2010. Use of dynamic soil-vegetation models to assess impacts of nitrogen deposition on plant species composition: an overview. Ecological Applications 20(1): 60-79; DOI: 10.1890/08-1019.1

Hettelingh J-P, De Vries B, and Hordijk L, 2009. Integrated Assessment, in: Boersema J and Reijnders L (eds.), Principles of Environmental Sciences, Springer, ISBN 978-1-4020-9157-5, pp. 385-417

Hettelingh J-P, Posch M, Slootweg J, Reinds GJ, Spranger T, Tarrason L, 2007. Critical loads and dynamic modelling to assess European areas at risk of acidification and eutrophication. *Water, Air and Soil Pollution: Focus* 7:379-384

PARTNER no.:	15
Organization full name:	Federal Department of Economic Affairs, Agroscope Reckenholz-Taenikon Research Station, Air Pollution/Climate Group
Organization short name:	FDEA-ART
URL:	http://www.agroscope.admin.ch

Description of the organization

FDEA-ART is part of Agroscope, the Swiss network of federal research stations for agricultural research headed by the Federal Office for Agriculture (FOAG). Within FDEA-ART, the Air Pollution/Climate group is responsible for research on the relationship between agricultural ecosystems and the atmospheric environment.

Expertise and experience of your organisation, including previous EU projects

Main areas of expertise include (a) quantification of bi-directional exchanges of reactive trace gases and greenhouse gases, (b) quantification of carbon sequestration in agricultural and alpine soils, (c) assessment of impacts of air pollutants such as ozone and nitrogen, and of climate change, on agricultural ecosystems, and adaptation options, and (d) atmospheric processes related to air pollution. The group is applying most up-to-date facilities for plant, soil, water and air analysis, for micrometeorological flux measurements and chamber-based flux measurements, and for the analysis of trace gas concentration in soil profiles. Experimental work is complemented by statistical and dynamic modelling.
The group participated in the EU projects BIOSTRESS, EXAMINE, GRAMINAE, GREENGRASS, CarboEurope and NitroEurope. Currently the group is involved in the FP7 project ACQWA.

Key scientific personnel to be involved in the project

- Dr. **Albrecht Neftel**, PI *[contributing to Component 1]*
- Dr. **Christof Ammann**, *[Leader cross cutting Task 21.2 (Standards and Data management)]*
- Dr. **Seraina Bassin** *[Component 3 contribution]*

Recent relevant publications:

Spirig, C., Flechard, C.R., Ammann, C., and Neftel, A. (2010) “The annual ammonia budget of fertilised cut grassland - Part 1: Micrometeorological flux measurements and emissions after slurry application.” Biogeosciences, 7, 521–536

Flechard, C.R., Spirig, C., Neftel, A. and Ammann, C. (2010) “The annual ammonia budget of fertilised cut grassland - Part 2: Seasonal variations and compensation point modeling.” Biogeosciences, 7, 537–556

Neftel A., Spirig C., and Ammann C. (2008) “Application and test of a simple tool for operational footprint evaluations”. Environmental Pollution, 152, 644-652

Ammann C., Spirig C., Leifeld J. and Neftel A. (2009) "Assessment of the nitrogen and carbon budget of managed grasslands". Agriculture, Ecosystems and Environment, 2009, 133, 150-162

Tuzson B., Hiller R.V., Zeyer K., Eugster W., Neftel A., Ammann C. and Emmenegger L. (2010) "Field intercomparison of two optical analyzers for CH4 eddy covariance flux measurements". Atmos. Meas. Tech. Discuss., 3, 2961–2993

Sintermann J., Spirig C., Jordan A., Kuhn U., Ammann C., Neftel A. (2010) "Eddy covariance flux measurements of ammonia by electron transfer reaction-mass spectrometry" Atmos. Meas. Tech. Discuss., 3, 1–53, 2010

Volk, M., Bungener, P., Montani, M., Contat, F., Fuhrer, J. (2006) "Grassland yield declined by a quarter in five years of free-air ozone fumigation". Global Change Biol, 12, 74-836

Bassin, S., Werner, R.A., Sörgel, K., Volk, M., Buchmann, N., Fuhrer, J. (2009). "Effects of combined ozone and nitrogen deposition on the in situ properties of eleven key plant species of a subalpine pasture". Oecologia, 158, 747–756

PARTNER no.:	16
Organization full name:	University of Gothenburg
Organization short name:	UGOT
URL:	http://www.gu.se

Description of the organization

With about 37 000 students and a staff of 5 300, the University of Gothenburg is one of the major universities in Europe. Most of its eight faculties are located in central Gothenburg. The University's education and research maintain a breadth and quality that have earned recognition in the form of numerous awards, including a recent Nobel Prize, and a steady stream of applicants at all levels.

Expertise and experience of your organisation, including previous EU projects

At UGOT extensive research related to ozone effects on plants, especially crops and forest trees, including large-scale experimental work, derivation of dose response functions for crops based on stomatal uptake of ozone, gas exchange studies and landscape variation in ozone concentration/exposure. We participated for more than 20 years actively in the work on ozone effects on plants (ICP Vegetation) under the Convention on Long-Range Transboundary Air Pollution and in the methods included in its Mapping Manual. We also participated in the EU projects ESPACE-Wheat (1994-1997, related to effects of carbon dioxide, ozone and climate change on what) and CHIP (1998-2000, related to effects of ozone and carbon dioxide on potato). Recently UGOT received, as part of programmes lead by Lund University, funding for two large strategic research grants (5 years, starting 2010), both with strong links to the present ÉCLAIRE proposal. Together with other already existing research this means that ÉCLAIRE activities will take place in an extensive and expanding research environment at UGOT.

Key scientific personnel to be involved in the project

- Professor, **Håkan Pleijel**: PI, conducts research focussed on air pollutants, mainly related to ground level-ozone – deposition, effects on vegetation and distribution in the landscape near the Earth surface. He has also conducted several investigations of the effect of elevated carbon dioxide on vegetation and, more recently started to work with traffic related air pollutants such as nitrogen oxides and particles as well as the effects of climate and climate change on air pollution. *[contribution to WP4, 3.1, 3.4]*

Recent relevant publications

Pleijel, H., Berglen Eriksen, A., Danielsson, H., Bondesson, N. & Selldén, G. (2006). Differential ozone sensitivity in an old and a modern Swedish wheat cultivar – grain yield and quality, leaf chlorophyll and stomatal conductance. Environmental and Experimental Botany 56, 63-71.

Pleijel, H., Danielsson, H., Emberson, L., Ashmore, M. & Mills, G. (2007). Ozone risk assessment for agricultural crops in Europe: deriving stomatal flux and flux-response relationships for European wheat and potato. Atmospheric Environment 41, 3022-3040.

Mills, G., Buse, A., Gimeno, B., Bermejo, V., Holland, M., Emberson, L. & Pleijel, H. (2007). A synthesis of AOT40-based response functions and critical levels of ozone for agricultural and horticultural crops. Atmospheric Environment 41, 2630-2643.

Piikki, K., DeTemmerman, L., Ojanperä, K., Danielsson, H. & Pleijel, H. (2008). The grain quality of spring wheat (Triticum aestivum) in relation to elevated ozone uptake and carbon dioxide exposure. European Journal of Agronomy 28, 245-254.

Pleijel, H. (Ed) (2009). Air pollution & climate change. Two sides of the same coin? Swedish Environmental Protection Agency, Stockholm. 167 pp.

PARTNER no.:	17
Organization full name:	Forest Research Institute, Hungary
Organization short name:	ERTI-FRI
URL:	http://www.erti.hu

Description of the organization:

The key task of Forest Research Institute is the investigation of the ecological relations, evolution and growth, that is, the internal laws of the forest in order to determine the proper ways of disturbance. The permanent expansion of the many-sided role of the forest, the degradation of forest health condition observed in recent decades, changes of environmental conditions, such as climate change; require gradual extension of basic, biological research. The Forest Research Institute carries on its observations and experiments in so-called "forest laboratories", a country-wide sustainability network comprising hundreds of plots, at its experimental stations, and in the ecological and genetic laboratories operating at these stations. Besides, it has also an outstanding contribution to the maintenance of forest gene collections.

Expertise and experience of your organisation, including previous EU projects

Climate change, potential impacts and appropriate responses: Assessment of the unfavourable impacts of climate change on the environment and on the forest management, elaboration of silvicultural alternatives for their mitigation (improving growing technologies, preparation for their change etc). Analysis of the forest carbon budget, investigation of its relation to forestation and silviculture. Working out adaptation strategies and managing methods, technologies serving the purpose of genetically sustainable high quality timber production. Improvement of drought tolerant varieties that is resistant to emerging biotic pests.

EU project involvement:

- EU-4th “Biosphere-Atmosphere Interactions of ammonia with grasslands across Europe (GRAMINAE)”, ENV4-CT98-0722, 1998-2001
- EU-5th “Sources an sinks of greenhouse gases from managed European grasslands and mitigation strategies (GREENGRASS)”, Global Change. Climate and Biodiversity, EVK2-CT2001-00105, 2002-2004
- EU-5th „Nitrogen oxides emissions from European forest ecosystems (NOFRTETE)”, EVK2-CT2001-00106, 2001-2003
- EU 6th „The nitrogen cycle and its influence on the European greenhouse gas balance (NitroEurope IP)” Energy, Environment and Sustainable Development, Global Change, Climate and Biodiversity, 017841, 2006-2011

Key scientific personnel to be involved in the project

- Prof. **László Horváth**:(PI) will be in charge of the co-ordination of the field flux measurements at the Bugac grassland site within the ÉCLAIRE flux network

[contribution to WP1WP1]

Recent relevant publications

Mészáros, R., *Horváth, L.*, Weidinger, T., Neftel, A., Nemitz, E., Dämmgen, U., Cellier, P. and Loubet, B., 2009: Measurement and modelling ozone fluxes over a cut and fertilised grassland. *Biogeosciences* 6, 1987-1999.

Pogány, A., Mohácsi, Á., Jones, S.K., Nemitz, E., Varga, A., Bozóki, Z., Galbács, Z., Weidinger, T.,

Horváth, L., Szabó, G., 2010: A diode laser based photoacoustic instrument combined with preconcentration sampling for measuring surface-atmosphere exchange of ammonia with the aerodynamic gradient method. Atmospheric Environment 44, 1490-1496.

Machon, A., *Horváth, L.*, Weidinger, T., Grosz, B., Pintér, K., Tuba, Z., Führer, E., 2010: Estimation of net nitrogen flux between the atmosphere and a semi-natural grassland ecosystem in Hungary. European Journal of Soil Science. DOI: 10.1111/j.1365-2389.2010.01264.x.

Czóbel Sz., *Horváth L.*, Szirmai O., Balogh J., Pintér, K., Németh Z., Ürmös, Zs., Grosz B., Tuba Z.: Comparison of N_2O and CH_4 fluxes from Pannonian natural ecosystems. European Journal of Soil Science. DOI: 10.1111/j.1365-2389.2010.01275.x.

Horváth, L., Grosz, B., Machon, A., Tuba, Z., Nagy, Z., Czóbel, Sz., Balogh, J., Péli, E., Fóti, Sz., Weidinger, T., Pintér, K., Führer, E.: Estimation of nitrous oxide emission from Hungarian semi-arid sandy and loess grasslands; effect of soil parameters, grazing, irrigation and application of fertilizer. Agriculture, Ecosystems and Environment and Environment 139, 255-263

PARTNER no.:	18
Organization full name:	Finnish Meteorological Institute
Organization short name:	FMI
URL:	http://www.fmi.fi

Description of the organization

Finnish Meteorological Institute (FMI) is a research and service organization under the Ministry of Transport and Communications of Finland. The main objective of FMI is to provide the Finnish society with meteorological observations, atmospheric monitoring and research and weather forecasting in and around Finland. FMI has about 550 employees of which about 250 in the "Research and Development" sector. Climate change research at FMI covers both measurements and modeling.

Expertise and experience of your organisation, including previous EU projects

FMI has long experience of successful EU coordination. This research will be done in the group 'Greenhouse Gas Research' which has participated in EU-projects CARBOEUROFLUX, CarboEurope-IP, MethMoniteur, NitroEurope-IP, EUROHYDROS, IMECC, GEOMON and GHG-Europe. The group runs a micrometeorological flux site network of eight sites. The research group has long-term co-operation with the EMEP modelling work in METNO.

Key scientific personnel to be involved in the project

- Mr. Juha-Pekka Tuovinen has studied air pollutants over 20 years covering photochemical and inorganic air pollutants. Recently his main foci have been biosphere-atmosphere interactions, turbulent transfer studies, ozone deposition on vegetation and model parameterizations of deposition processes contributing in many related EU-projects and also in, for example, COST action FP903 '**Climate Change and Forest Mitigation and Adaptation in a Polluted Environment'.** ***[Mr. Tuovinen will develop ozone deposition parameterizations as described in WP4, Task 2.]***

- Mr. **Tuomas Laurila** is the head of a research group of 12 persons on Greenhouse gas studies. He will participate in model testing from the observational point of view *[contribution to WP1WP1]*

Recent relevant publications

Tuovinen J.-P., Simpson D., Mikkelsen T.N., Emberson L.D., Ashmore M.R., Aurela M., Cambridge H.M., Hovmand M.F., Jensen N.O., Laurila T., Pilegaard K., and Ro-Poulsen H., 2001. Comparisons of measured and modelled ozone deposition to forests in Northern Europe. Water Air Soil Pollut. Focus 1: 263–274.

Tuovinen J.-P., Ashmore M., Emberson L., and Simpson D., 2004. Testing and improving the EMEP ozone deposition module. Atmos. Environ. 38: 2373–2385.

Tuovinen J.-P., Simpson D., Emberson L., Ashmore M., and Gerosa G., 2007. Robustness of modelled ozone exposures and doses. Environ. Pollut. 146: 578–586.

Tuovinen J.-P. and Simpson D., 2008. An aerodynamic correction for the European ozone risk assessment methodology. Atmos. Environ. 42: 8371–8381.

Tuovinen, J.-P., Emberson, L., Simpson, D., (2009) Modelling ozone fluxes to forests for risk assessment: status and prospects. Ann. For. Sci. 66: 401, 14pp

Laurila, T., Tuovinen, J.-P., Hatakka, J. (2009) Ozone concentration variations observed in northern Finland in relation to photochemical, transport and cloud processes. Boreal Env. Res. 14: 550-558.

PARTNER no.:	19
Organization full name:	University of Helsinki
Organization short name:	UHEL
URL:	http://www.atm.helsinki.fi

Description of the organization

Helsingin Yliopisto, University of Helsinki (UHEL) - The Division of Atmospheric Sciences, Department of Physics in University of Helsinki has over 25 year tradition in atmospheric research. Over one hundred scientists and doctoral students are currently engaged in this area.

Expertise and experience of your organisation, including previous EU projects

Main scientific aim has been to reduce scientific uncertainties concerning global climate change issues, particularly those related to greenhouse gases, aerosols and clouds. UHEL is a world leader in atmospheric aerosol science and one of the founders of "terrestrial ecosystem meteorology" and key countries in developing of ICOS (Integrated Carbon Observation System) for monitoring of concentrations and fluxes of nitrous oxide and methane beside carbon dioxide. The core facilities related to proposed research are the SMEAR II field station located in Hyytiälä, Southern Finland, which is also part of ICOS.

Key scientific personnel to be involved in the project

- Dr, **Janne Rinne**, PI, has 15 years of experience in the measurement of surface exchange fluxes of a range of reactive trace gases, greenhouse gases and aerosols. He will co-ordinate the flux measurements at the Hyytiälä forest site as a contribution to the ÉCLAIRE flux network and contribute VOC flux measurements to the Po Valley intensive campaign. *[contribution to WP1WP1]*
- Dr, **Taina Ruuskanen**, PostDoc *[contribution to WP1WP1]*
- M.Sc, **Pekka Rantala**, Ph.D student *[contribution to WP1WP1]*
- Prof. **Timo Vesala**, Team member *[contribution to WP1WP1]*

Recent relevant publications

Rinne, J., J. Bäck & H. Hakola, 2009: Biogenic volatile organic compound emissions from Eurasian taiga: Current knowledge and future directions. Boreal Environment Research, 14, 807-826.

Rinne, J., R. Taipale, T. Markkanen, T.M. Ruuskanen, H. Hellén, M.K. Kajos, T. Vesala & M. Kulmala, 2007: Hydrocarbon fluxes above a Scots pine forest canopy: measurements and modeling. Atmospheric Chemistry and Physics, 7, 3361-3372.

Ü. Rannik, I. Mammarella, P. Keronen and T. Vesala: Vertical advection and nocturnal deposition of ozone over a boreal pine forest. Atmos. Chem. Phys. 9, 2089-2095, 2009.

Arneth, A., S.P. Harrison, S. Zaehle, K. Tsigaridis, S. Menon, P.J. Bartlein, J. Feichter, A. Korhola, M. Kulmala, D. O'Donnell, G. Schurgers, S. Sorvari and T. Vesala: Terrestrial biogeochemical feedbacks in the climate system. Nature Geoscience 3, 525-532, 2010.

PARTNER no:	20
Organization full name:	Università Cattolica del Sacro Cuore di Brescia
Organization short name:	UNICATT
URL:	http://brescia.unicatt.it/

Description of the organization

The environmental physics, ecophysiology and ecotoxicology lab of the Catholic University of the Sacred Heart (Department of Mathematics and Physics) has been working since ten years on:

1) micrometeorological measurements of gaseous pollutants, water and energy flux exchange between vegetation and atmosphere.

2) manipulation experiments in controlled environment to evaluate the effects of ozone and water limitation on trees and crops (mainly in Open-Top Chambers experiments).

Expertise and experience of your organisation, including previous EU projects

The research group includes expertise in:

- Flux measurements with eddy covariance and gradient techniques (on crops, forests and seminatural vegetation).
- Assessments of ecophysiological effects of ozone and water stress on vegetation: effects on carbon-assimilation, photosystems (chlorophyll fluorescence), growth and yield, foliar visible injuries.
- Stomatal conductance and flux modelling.

Expertise and experience of your organisation, including previous EU projects

This group is currently involved in the MANFRED EU project (“Management strategies to adapt Alpine Space forests to climate change risks”, INTERREG IIIB - www.manfredproject.eu) and took part in the ACCENT network of Excellence. The research group was directly involved only in these EU projects, but it is important to note that our University was involved in other EU projects too.

Key scientific personnel to be involved in the project

- **Giacomo Gerosa**, PhD, scientific coordinator, micrometeorological measurements, statistical analysis. Dr Gerosa will co-ordinate UNICATT’s contribution to ÉCLAIRE and in particular the activities at the arable flux measurement site that contributes to the ÉCLAIRE flux network and the two effects sites operated by UNICATT. He will also host the Po Valley intensive campaign over mixed oak forest *[contribution to WP1WP1, WP10]*

- **Riccardo Marzuoli**, PhD, OTC experiments, chlorophyll fluorescence measurements *[contribution to WP10]*
- **Filippo Bussotti**, Dr, evaluation of ozone effects on plant biomass *[contribution to WP10]*
- **Simone Mereu**, PhD, micrometerological measurements, sap flow measurements *[contribution to WP1]*
- **Lina Fusaro**, Dr, photosynthesis and chlorophyll fluorescence measurements *[contribution to WP1]*
- **Martina Pollastrini**, Dr, gas-exchange measurements, visible injury assessment *[contribution to WP1]*
- **Marco Marzocchi**, Dr, stomatal conductance modelling *[contribution to WP10]*
- **Stefano Pareglio**, Prof, economical assessments of ozone impacts on vegetation*[contribution to WP10]*

Recent relevant publications

Gerosa G., Finco A., Mereu S., Marzuoli R., Ballarin-Denti A. 2009. Interactions among vegetation and ozone, water and nitrogen fluxes in a coastal Mediterranean maquis ecosystem. Biogeosciences 6, pp. 1783-1798.

Gerosa G., Marzuoli R., Desotgiu R., Bussotti F. and Ballarin-Denti A. 2009 Validation of the stomatal flux approach for the assessment of ozone visible injury in young forest trees. Results from the TOP (transboundary ozone pollution) experiment at Curno, Italy. Environmental Pollution 157, pp. 1497-1505.

Gerosa G., Finco A., Mereu S., Vitale M., Manes F., Ballarin-Denti A. 2009. Comparison of seasonal variations of ozone exposure and fluxes in a Mediterranean Holm oak forest between the exceptionally dry 2003 and the following year. Environmental Pollution 157, pp. 1737-1744.

Marzuoli R., Gerosa G., Desotgiu R., Bussotti F., Ballarin-Denti A. 2009. Ozone fluxes and foliar injury development in the ozone-sensitive poplar clone Oxford (Populus maximowiczii x Populus berolinensis): a dose-response analysis. Tree Physiology 29, pp. 67-76.

PARTNER no.:	21
Organization full name:	Odessa National I.I. Mechnikov University
Organization short name:	ONU/
URL:	http://www.onu.edu.ua

Description of the organization

The Odessa National University (ONU) was founded in 1865. ONU has 8 Faculties, 3 Educational Institutes and 72 chairs. ONU prepares bachelors, holders of master and Ph.D. degrees in 30 specialties. There are more as 20.000 students from 25 countries. The University disposes of 17 autonomous scientific laboratories, a scientific library, botanical gardens and palaeontological, zoological, geologicalmineralogical museums, in which more than 1700 collaborators work. Odessa National I.I. Mechnikov University is one of the biggest Universities of Ukraine with scientific Department from 800 scientists, specialists, engineers and administration. The department of University involved within the framework of the project is the Regional Centre for Environmental Monitoring and Ecological Research (RCIEMER). RCIEMER has two field subunits: atmospheric monitoring station “Petrodolindskoye” (arable land area in 35 km near Odessa) and marine research station in the Black Sea (island Zmiiinyi in 35 km near Danube Delta)

Expertise and experience of your organisation, including previous EU projects

The main fields of RCIEMER activities are focused on researches in fields of freshwater and marine ecology; environmental monitoring, atmospheric and marine chemistry; climate and environment and health; environmental sensing, environmental impact assessment. RCIEMER took part in national and international research projects, especially FP7 Envirogrids project (2009-2013), FP7 UpGrade Black Sea Scene project (2009-2011), FP6 Nitroeurope Project: 017841 (GOCE). (2006-2011), FP6 BlackSeaScene project 022868 (RICA). (2005-2008), TACIS CBC Programme. Technical Assistance for Lower Dniester basin water management planning. (2006-2007), INTAS - 04-77-7112. New methods of information treatment for management of water quality in river basins. (2005-2007), ESA-IAF Project “ERUNET” (European-Russian-Ukrainian GMES Network for Monitoring of Oil Spills and Oil & Gas Pipelines) (2004-2005), INTAS-RFRB-97-1435 “Study on nitrogen compounds in the atmosphere over the Former Soviet Union related to acidification and climate change.”(1999-2001), INTAS-97-1860 “To establish the network of scientists for improving NIS data on atmospheric chemistry” (1999-2001)

Key scientific personnel to be involved in the project

- Dr. **Volodymyr Medinets**: team leader – senior researcher. Research focuses on atmospheric chemistry, freshwater and marine ecology. He took part in several international projects and, in ÉCLAIRE, will co-ordinate work at an arable site within the ÉCLAIRE flux network. *[contribution to WP1 and 4.3]*

- Dr. **Yaroslav Bilanchin**, senior researcher – Land cover and soils quality monitoring in southern part of Ukraine. He participated in the NitroEurope project. *[contribution to WP1]*
- **Sergiy Medinets**, researcher – atmospheric chemistry. He will be responsible for CO_2, nitrogen compounds and meteorological measurements and processing of data in atmospheric monitoring station "Petrodolinskoye" building on the successful contribution of this site to the NitroEurope flux network. *[contribution to WP1 and 16]*

Recent relevant publications

Medinets S., Medinets V. Results of investigations of atmospheric pollutants fluxes in Zmeiny island in western part of the Black sea in 2003–2007 years // Journal of Environmental Protection and Ecology 11, No 3, 1030–1036 (2010)

Medinets S., Pitsik V., Medinets V. at al. Results of background atmospheric monitoring pollutants in surface air nearby Odessa in 2007-2008 // In book "Proceedings of International Conference "Ecology of cities and recreational zones". – Odessa: INVAZ. – 2009, P. 103-107

Medinets V., Medinets S., Proschenko V. Atmospheric Chemistry Research. In Book: Island Zmiinyi: Abiotic Characteristics. Exet. Editor V.I. Medinets. Odessa National I.I. Mechnikov Universoty, 2008. p. 115-137.

Medinets S., Medinets V. Investigations of atmospheric fluxes of nitrogen compounds from continent in Zmiinyi island area in 2008-2009. In proceedings of Conference "Ecology of cities and recreational zones". Odessa: INVAZ, 2010, p.234-238.

PARTNER no 22
Organization full name: University of Natural Resources and Applied Life Sciences, Vienna
Organization short name / acronym / web page: BOKU www.boku.ac.at

Description of the organization
BOKU (AT): Founded in 1872, the *University of Natural Resources and Applied Life Sciences, Vienna*, now comprises 14 departments and four service centres in Vienna, as well as a number of experimental entres around Vienna. The university is attended by approx. 6000 students, provides study courses at the bachelor, masters and doctoral levels, has approx. 1.300 permanent staff who are engaged in teaching and research, a broad range of external lecturers, and some 460 persons working in services and administration. Mission: The university sees itself as a teaching and research institution that focuses on renewable resources that are a prerequisite for human existence. The relationships between man, society and the environment form the basis of all activities at BOKU, and its foremost aim is to make decisive contributions to securing the well-being of future generations. In this endeavour, it will seek ways of ensuring a sustainable and environmentally sound management of natural re-sources by allying the competences of the natural, engineering, economic and social sciences.

Expertise and experience of your organisation, including previous EU projects
The new chair of Soil Science/Soil Microbiology investigates the role of soils as sources or sinks for atmospheric trace gases. Microbial processes involved in the production and decomposition of N_2O, CO_2, CH_4 and C_2H_4 have been studied in field trials and laboratory experiments. The laboratory is newly equipped for fully automated measurement of environmental effects on trace gas emissions. Nitrogen cycling is major research topic treated in several projects. The PI Prof. Dr. Sophie Zechmeister-Boltenstern teaches at several national and international Universities and has an excellent scientific record documented by 33 national and international research projects and 56 peer-reviewed publications. The **Institute of Soil Scienc**e is part of the **Department of Forest and Soil Sciences**. The Institute has taken a leading position in multiple EU-Projects e.g. Greenland, Aquaterra, Soil Processes in European Watersheds, Contaminated Soils, COST Action 631, INCO Coal Ashes, Marie Curie Kasachstan

Key scientific personnel to be involved in the project
1. Dr. Sophie Zechmeister-Boltenstern: Principal Investigator, WP2, WP11

2. N.N. PhD: Laboratory Experiments and data evaluation

Recent relevant publications

Inselsbacher E., Wanek W., Ripka K., Hackl E., Sessitsch A., Strauss J., Zechmeister-Boltenstern S. (2010) Greenhouse gas fluxes respond to different N fertilizer types due to altered plant-soil-microbe interactions. Plant and Soil, accepted.

Zechmeister-Boltenstern S., Michel K., Pfeffer M. (2010) Soil Microbial Community Structure in European Forests in Relation to Forest Type and Atmospheric Nitrogen Deposition. Plant and Soil, accepted.

Schindlbacher S., de Gonzalo C., Díaz-Pinés E., Gorría P., Matthews B., Inclán R., Zechmeister-Boltenstern S., Rubio A., Jandl R. (2010) Temperature sensitivity of forest soil organic matter decomposition along two elevation gradients.

Journal of Geophysical Research – Biogeosciences, accepted.

Schaufler, G., Kitzler, B., Skiba, U., Sutton, M.A., Zechmeister-Boltenstern, S. (2010) Greenhouse gas emissions from European soils under different land use: Effects of soil moisture and temperature. European Journal of Soil Science 61, 683–696.

Koranda M., Schnecker J., Kaiser C., Fuchslueger L., Kitzler B., Sessitsch A., Zechmeister-Boltenstern S., Richter A. (2011) Microbial processes and community composition in the rhizosphere of European beech - The influence of plant C exudates. Soil Biology & Biochemistry 43, 551-558.

PARTNER no.:	23
Organization full name:	UNIVERSIDAD POLITECNICA DE MADRID
Organization short name:	UPM
URL:	http://www.upm.es

Description of the organization

Universidad Politécnica de Madrid (UPM) is the oldest and largest Spanish technical university, with more than 4.000 faculty members, around 38.000 undergraduate students and 6.000 postgraduates in 21 Schools of study. As a top quality academic establishment, UPM has a strong commitment to R&D and Innovation. After the first three years of the 7th Framework Programme the UPM has been recognized as the Spanish University with the highest number of projects approved, with more than 114 projects and 30 M€ of funding.

Expertise and experience of your organisation, including previous EU projects

The research group participating in this project has been working on emissions of GHG and Nr, especially in N_2O, NO and NH_3. This is the only Spanish group that has obtained an emission database from Mediterranean agricultural soils. Interesting results have been achieved, in relation to the effect of crop management (irrigation, fertilizing, etc.) on emissions. The group has participated in several national projects and two EU projects (i.e. NitroEurope and N-Toolbox).

In the last two years, the group has started a line of research focused on N deposition. This has been possible due to the incorporation of Mark Theobald to the research team. Mr Theobald is an activity leader in NitroEurope (Landscape verification measurements) and is part of the team that has developed the NitroScape landscape nitrogen model.

Key scientific personnel to be involved in the project

- Prof. **Antonio Vallejo**: Head of research group. Prof. Vallejo will coordinate the activities of the personnel involved in the project.
- Mr. **Mark Theobald** will co-ordinate campaign field measurements of ammonia exchange with Mediterranean vegetation, lead the ÉCLAIRE work on process modelling of ammonia emissions and ÉCLAIRE's training activities *[contribution to Component 1. Leader of WP17 (Local variation in threshold exceedance) and Component 8 (Training)]*.
- Dr **Alberto Sanz Cobena**: Campaign field measurements of ammonia exchange with Mediterranean vegetation and process modelling of ammonia emissions. *[contribution to Component 1 and Component 8 (Training)]*

Recent relevant publications

Theobald MR, Bealey WJ, Tang YS, Vallejo A, Sutton MA. A simple model for screening the local impacts of atmospheric ammonia. Sci.Total Environ. 2009 11/15;407(23):6024-33.

Milford, C., Theobald, M. R., Nemitz, E., Hargreaves, K. J., Horvath, L., Raso, J., Dämmgen, U., Neftel, A., Jones, S. K., Hensen, A., Loubet, B., Cellier, P., and Sutton, M. A. (2009) Ammonia fluxes in relation to cutting and fertilization of an intensively managed grassland derived from an inter-comparison of gradient measurements, Biogeosciences, 6, 819-834.

Sanchez-Martin L., Sanz-Cobena A, Meijide A., Quemada M, Vallejo A. (2010). The importance of the fallow period for N_2O and CH_4 fluxes and nitrate leaching in a Mediterranean irrigated agroecosystem, European Journal of Soil Science, 61, 710–720.

Sanz-Cobena, A., Misselbrook, T.H., Sanz, M.J., Vallejo, A., (2010). “Use of an inverse dispersion technique for estimating ammonia emission from surface applied slurry in Central Spain”. Atmospheric Environment, 44, 999-1002.

PARTNER no.:	24
Organization full name: Tecnológicas Pollution	Centro de Investigaciones Energéticas Medioambientales y (CIEMAT) – Ecotoxicity of Atmospheric Pollution - tmospheric Division.
Organization short name:	CIEMAT
URL:	http://www.ciemat.es/

Description of the organization

The Atmospheric Pollution Division belongs to the Environment Department of CIEMAT (Research Centre on Energy, Environment and Technology). This is a *public body of the Ministry of Science and Innovation, conceived as a Public Research Agency for excellence in energy and environment, as well as in many advanced technologies and in various areas of basic research.* CIEMAT activities are organized around research projects that span the bridge between **R&D and the interests of society.** The CIEMAT team is made up of approximately 1200 people, of whom 47% are university graduates

Expertise and experience of your organisation, including previous EU projects

The Ecotoxicity of Air Pollution Group of the CIEMAT has more than 20 years of experience studying the effects of air pollution on plant ecosystems and agrosystems. The main research interest is the effects induced by the increased deposition of tropospheric ozone and nitrogen compounds on crops, trees and pastures. Air pollutant effects are characterized from cell to ecosystem level, highlighting the effects on plant physiology. All the objectives and activities developed by this research group are within the Convention on Long-Range Transboundary Air Pollution (CLRTAP ONU-CEPE) framework where members of the Group are active participants. The activities of the group are supported by the *Ministry of Environment and the Group is representing the ministry in some of the CLRTAP bodies. Participation in EU financed projects* from the Fifth and Sixth Framework Programmes: MECAPIP, RECAPMA, ECOTREE, BIOSTRESS and HEREPLUS.

Key scientific personnel to be involved in the project

1) Dr. **Rocío Alonso**. Full researcher (FR)- expertise in O_3 flux models to trees and N deposition; 2) Dr. **Victoria Bermejo**. FR- N and O_3 plant effects and critical levels ; 3) Dr. **Ignacio González-Fernández**. FR- modelling O_3 flux and plant development 4) Dr. **Susana Elvira**. FR- plant ecosphysiology 5) **Javier Sanz** FR - O_3 plant effects 6) Dr. **Isaura Rabago**. FR- Critical Loads ; 7) **Hector García**. PhD student; 8) **Hector Calvete**. PhD student *[contribution to WP10]*

Recent relevant publications

Sanz J, Bermejo V, Muntifering R, González-Fernández I, Gimeno BS, Elvira S, Alonso R, 2010. *Environ Pollut* (in press)

González-Fernández I, Bermejo V, Elvira S, Gimeno BS, Alonso R, 2010. *Atmos Environ* 44; 2507-2517.

Avila A, Molowny-Horas R, Gimeno BS, Peñuelas J, 2010. *Water Air Soil Pollut* 207, 123-138**.**

González-Fernández, I, Kaminska A, Dodmani M, Goumenaki E, Quarrie S, Barnes JD. 2010. Establishing ozone flux-response relationships for winter wheat: Analysis of uncertainties based on data for UK and Polish genotypes. *Atmospheric Environment* 44, 621-630

Lassaletta L, García-Gómez H, Gimeno BS., Rovira JV., 2009. *Sci Total Environ* 407, 6034–6043

Alonso R, Elvira S, Sanz MJ., Gerosa G, Emberson L, Bermejo V, Gimeno BS, 2008. *Env. Pollut* 155: 473-480.

Fenn ME, Jovan S, Yuan F, Geiser L, Meixner T, Gimeno BS, 2008. *Environ Pollut* 155: 492-511.

González-Fernández I, Bass D, Muntifering R, Mills G, Barnes J. 2008. *Atmos Environ* 42, 8755- 8769.

Breiner J., Gimeno BS, Fenn M, 2007. *The Scientific World* 7(S1):198-205.

Karlsson PE, Braun S, Broadmedow M, Elvira S, Emberson L, Gimeno BS, Le Thiec D, Novak K, Oksanen E, Schaub M, Uddling J, Wilkinson M, 2007. *Environ Pollut* 146: 608-816.

Sanz J, Bermejo V, Gimeno BS, Elvira S, Alonso R, 2007. *Atmos Environ* 41: 8952–8962.

Alonso R, Bermejo V, Sanz J, Valls B, Elvira S, Gimeno BS, 2007. *Environl Pollut* 146: 692-698.

Mills G, Buse A, Gimeno BS, Bermejo V, Holland M, Emberson L, Pleijel H, 2007. *Atmos Env.* 41: 2630-2643.

Elvira S, Alonso R, Gimeno BS, 2007. *Environ Pollut* 146:608-816.

Phoenix GK, Hicks WG, Cinderby S, Kuylenstierna JCI, Stock W, Dentener F, Giller KE, Austin AT, Lefroy RDB, Gimeno BS, Ashmore MR, Ineson P, 2006. *Global Change Biology* 12: 470-476.

PARTNER no.:	25
Organization full name:	Centre National de la Recherche Scientifique – Laboratoire des Sciences du Climat et de l'Environnement
Organization short name:	CNRS
URL:	http://www.lsce.ipsl.fr

Description of the organization

LSCE is a joint research unit with personnel and facility funded by *Centre National de la Recherche Scientifique* (CNRS) and *Commissariat à l'Energie Atomique*. Only CNRS personnel will be involved in ECLAIRE and CNRS will be the main institutional partner for this project. LSCE employs currently 160 permanent staff in the fields of biogeochemical cycles modelling and observation and of past and future climate studies. LSCE is in particular active in the areas of the carbon cycle, atmospheric chemistry and aerosols global and regional scale modelling including inverse modelling, and in observations of reactive gases and aerosols. Over the past 10 years LSCE has developed an interactive chemistry-aerosol-climate model LMDz-INCA and the terrestrial biosphere and carbon cycle model ORCHIDEE.

Expertise and experience of your organisation, including previous EU projects

LSCE has a confirmed experience in large-scale EU projects participation (e.g., NITROEUROPE, QUANTIFY, EUCARII) as well as coordination and management (GEOMON, IMECC, GREENCYCLES, NICE, and the preparatory phase of the ICOS research infrastructure).

Key scientific personnel to be involved in the project

- Dr **Didier Hauglustaine** is *Directeur de Recherche* at CNRS and has 20 years research experience in atmospheric sciences. He entered CNRS in 1993 and spent 4 years as a post-doctoral fellow at the National Center for Atmospheric Research (NCAR) (1994-1998). He has coordinated the development of the interactive chemistry model (INCA) coupled to a general circulation model (LMDz) in order to investigate the coupling between atmospheric chemistry, aerosols, climate and the biosphere. He has been co-I in 10 EU projects and coordinator of the EUROCORES programmes on climate at the European Science Foundation (ESF) from 04/2007 to 08/2009. He has also been lead author for the IPCC TAR and AR4. *[D. Hauglustaine will contribute to Component 2 and run the global climate-chemistry-biosphere model LMDz-INCA-ORCHIDEE in order to investigate the role of large scale air pollution and impact on European air quality and ecosystems.]*
- Dr **Juliette Lathière** is *Chargée de Recherche* at CNRS since 2008. She's specialized in biosphere-atmosphere interactions and has 6 years of experience in biogenic emissions. After a PhD focusing on VOC and NO emissions from plants, and their impact on atmospheric chemistry, she worked as a postdoctorate researcher from 2006 to 2008 for the QUEST project in the UK. She is now developing her research activity at the LSCE,

linking vegetation (ORCHIDEE model) and atmospheric chemistry (LMDz-INCA model). *[J. Lathière will contribute to Component 2 and use the ORCHIDEE model to calculate the past and future emissions from soil and vegetation.]*

Recent relevant publications

Lathière, J., D. A. Hauglustaine, N. De Noblet-Ducoudré, G. Krinner, et G. A. Folberth, Past and future changes in biogenic volatile organic compound emissions simulated with a global dynamic vegetation model, *Geophys. Res. Lett*., 32, L20818, doi:10.1029/2005GL024164, 2005.

Lathière, J., D. A. Hauglustaine, A. Friend, N. De Noblet-Ducoudré, N. Viovy, et G. Folberth, Impact of climate variability and land use changes on global biogenic volatile organic compound emissions, *Atmos. Chem. Phys.*, 6, 2129–2146, 2006.

Hauglustaine, D. A., J. Lathière, S. Szopa, et G. A. Folberth, Future tropospheric ozone simulated with a climate-chemistry-biosphere model, *Geophys. Res. Lett*., 32, L24807, doi:10.1029/2005GL024031, 2005.

Szopa, S., D. A. Hauglustaine, R. Vautard, et L. Menut, Future global tropospheric composition and impact on european air quality, *Geophys. Res. Lett.*, 33, L14805, doi:10.1029/2006GL025860, 2006.

PARTNER no.:	26
Organization full name:	Swedish Meteorological and Hydrological Institute
Organization short name:	SMHI
URL:	http://www.smhi.se

Description of the organization

SMHI, the Swedish Meteorological and Hydrological Institute, is a government agency under the Ministry of the Environment. SMHI manages and develops information on weather, water and climate that provides knowledge and advanced decision-making information for public services, the private sector and the general public. SMHI's national and international co-operation is extensive.

Expertise and experience of your organisation, including previous EU projects

SMHI conducts extensive research. The aim is to improve forecasts for weather and water conditions, and to develop methods for analysing climate change and environmental problems linked to the atmosphere, oceans, lakes and watercourses. Strengths of SMHI research are mainly in the field of dynamic modelling and data analysis. SMHI co-ordinates SUDPLAN (www.smhi.se/sudplan) dealing with climate change and air quality. Participation in recent FP projects of relevance for this proposal include ENSEMBLES (climate), GEMS and MACC (atmospheric chemistry, air quality).

Key scientific personnel to be involved in the project

- Dr. **Magnuz Engardt**: Researcher. Modeller of Air Quality *[contribution to WP6]*
- Dr. **Camilla Andersson**: Researcher. Modeller of Air Quality *[contribution to WP6]*
- Dr. **Joakim Langner**: Researcher. Modeller of Air Quality *[contribution to WP6]*

Recent relevant publications

Andersson, C. and Engardt, M. 2010. European ozone in a future climate: Importance of changes in dry deposition and isoprene emissions. J. Geophys. Res., 115, D02303. doi:10.1029/2008JD011690

Klingberg J., Engardt M., Uddling J., Karlsson P.E. and Pleijel H. 2010. Ozone risk for vegetation in the future climate of Europe based on stomatal ozone uptake calculations. Tellus, DOI: 10.1111/j.1600-0870.2010.00465.x

Andersson, C, Bergström, R. and Johansson, C. 2009. Population exposure and mortality due to regional background PM in Europe – Long-term simulations of source region and shipping contributions. Atmos. Environ. 43, 3614-3620. doi:10.1016/j.atmosenv.2009.03.040

Engardt, M., Bergström, R. and Andersson, C. 2009. Climate and emission changes contributing to changes in near-surface ozone in Europe over the coming decades: Results from model studies. Ambio 38, 452–458. DOI: 10.1579/0044-7447-38.8.452

Langner, J., Andersson, C. and Engardt, M. 2009. Atmospheric input of nitrogen to the Baltic Sea basin: present situation, variability due to meteorology and impact of climate change. Boreal Environ. Res. 14, 226-237.

Hole, L. and Engardt, M. 2008. Climate change impact on atmospheric nitrogen deposition in Northwestern Europe: A model study. Ambio 37, 9-17.

Andersson, C., Langner, J. and Bergström, R. 2007. Interannual variation and trends in air pollution over Europe due to climate variability during 1958-2001 simulated with a regional CTM coupled to the ERA40 reanalysis. Tellus 59B, 77-98. doi: 10.1111/j.1600-0889.2006.00196.x

Langner, J., Bergström, R. and Foltescu, V. 2005. Impact of climate change on surface ozone and deposition of sulphur and nitrogen in Europe. Atmos. Environ. 39, 1129-1141.

PARTNER no.:	27
Organization full name:	DRZAVNI HIDROMETEOROLOSKI ZAVOD
Organization short name:	DHMZ
URL:	http://meteo.hr/

Description of the organization

Drzavni Hidrometeroloski Zavod (DHMZ)is governmental institute responsible for research and operational activities at national level in the field of meteorology, hydrology and air quality. The main objective of DHMZ is to provide the best possible information about the air quality, to ensure public safety in relation atmospheric and airborne hazards and research activities supporting development and use of specialized meteorological and environmentally relevant products. DHMZ is responsible for operation of national air quality network in urban, industrial and rural areas, national parks, parks of nature, protected areas. Within its responsibility is to conduct work related to international cooperation in the field of air quality measurements and modelling. DHMZ is also contributing to the EMEP programme of CLRTAP; provides data, assessments and advice to the government in all matters related to transboundary fluxes of air pollutants and their deposition. Analytical work is performed at the Chemical laboratory of DHMZ. DHMZ has the infrastructure capacity to manage functioning of up to 50 observational sites (automatic and sampling) with daily measurement protocols and supportive research activities..

Expertise and experience of your organisation, including previous EU projects

DHMZ has a modelling capacity for running atmospheric and air quality models on local, national and regional scales. The capability was developed in connection with "The Cooperation Programme in Higher Education and Research between Norway and the Western Balkans" in 2006-2009 which supported the project "High Resolution Environmental Modelling and Evaluation Programme for Croatia (EMEP4HR)". DHMZ participated in the FP6 NitroEurope IP (2006-2011) operating an inferential network of 11 sites across Europe and perform laboratory analyses of measurements.

Key scientific personnel to be involved in the project

- **Sonja Vidič, PI,** is Head of Air quality research and applications unit at DHMZ and has a long experience in monitoring network design and operation, as well as in the data analysis, interpretation and modelling. In ÉCLAIRE she will apply here expertise to provide high-quality measurements of reactive nitrogen compounds, ozone and wet deposition at the core ÉCLAIRE effects sites for estimation of atmospheric deposition inputs *[contribution to WP4]*
- **Vesna Đuričić** is Head of Chemical Laboratory of DHMZ and has a long experience in air quality monitoring operation, as well as in the data analysis, data management and interpretation. *[contribution to WP4]*

- **Jadranka Škerin-Sović** is chemist in Chemical Laboratory of DHMZ and has a long experience in analytical work, sample analysis and QA/QC, as well as in supervising air quality monitoring operation, development of analytical methods and data analysis. *[contribution to WP4]*

Recent relevant publications

Y.S. Tang, I. Simmons, N. van Dijk, C. Di Marco, E. Nemitz, U. Dämmgen, K. Gilke, **V. Djuricic, S. Vidic**, Z. Gliha, D. Borovecki, M. Mitosinkova, J.E. Hanssen, T.H. Uggerud, M.J. Sanz, P. Sanz, J.V. Chorda, C.R. Flechard, Y. Fauvel, M. Ferm, C. Perrino and M.A. Sutton (2009). *European scale application of atmospheric reactive nitrogen measurements in a low-cost approach to infer dry deposition fluxes*, ***Agriculture, Ecosystems and Environment*** 133 (2009), pp. 183-195.

J.W. Erisman, A. Beeker, A. Neftel, V. Aneja, N. Hutchings, L. Kinsella, Y.S: Tang, J. Web, M. Sponar, C. Raes, M. Mitosinkova, **S. Vidic**, H. V. Andersen, Z. Klimont, R. Pinder, S. Baker, B. Reidy, C. Flechard, L. Horvath, A. Lewandowska, C. Gillespie, M. Wallash, R. Gehrig, T. Ellerman (2009). *Detecting Change in Atmospheric Ammonia Following Emission Changes*, **Atmospheric Ammonia**, Chapter 23. editors: Mark A: Sutton, Stefan Reis, Samantha M.H. Baker, Springer, 2009. pp.393-390.

Špoler Čanić K, **S. Vidič** and Z. Bencetić Klaić: (2009) *Precipitation chemistry in Croatia during the period 1981-2006*, ***J. Environ. Monit.***, 2009, **11**, p. 839 – 851.

Škevin Sović,Jadranka et all (2009). *Organization of Proficiency Testing for Dairy Laboratories in Croatia, Bosnia and Herzegovina and Macedonia in Order to Improve Quality Assurance*. ***Mljekarstvo.*** 59 (2009) , 2; 141-147.

PARTNER no:	28
Organization full name:	University of Edinburgh
Organization short name:	UEDIN
URL:	http://www.ed.ac.uk

Description of the organization

The University of Edinburgh is one of the largest and most successful universities in the UK with an international reputation as a centre of academic excellence. The University is the leading research university in Scotland and is amongst the top ten in the United Kingdom. The University of Edinburgh is Scotland's major university for research in the GeoSciences. The School of GeoSciences has over 370 academic and research staff and around 160 PhD students.

Expertise and experience of your organisation, including previous EU projects

At the European level, traditionally the University has been very successful in participating in European Framework Programmes. During FP6 the University collaborated in some 180 projects: total award value of ~€45M. To date, the University has been involved in over 130 FP7 projects.

Key scientific personnel to be involved in the project

- **Dr Dave Reay (PI)** is Senior Lecturer in Carbon Management at the School of GeoSciences and is heavily involved in knowledge transfer and outreach. *[Contributing to WP 21-23 as Manager for Dr Howard]*
- **Dr Clare M Howard** has a science background in modelling environmental systems, including a PhD in longterm climate feedbacks and quantifying uncertainty in Earth System Models. She is project officer for the European Nitrogen Assessment (a 700 page state of the science/policy document on Nitrogen in Europe) and has been involved in several science communication projects, in the formal and informal sector *[Contributing to WP 21-23]*.
- **Dr Ruth Doherty** is a Lecturer in Atmospheric Sciences with research interests in climate and air quality and climate-chemistry interactions. She is a member of the UN Task Force on Hemispheric Transport of Air Pollution (UN-TFHTAP) and a contributing author on its 2007 interim report and forthcoming 2010 report. She has published over 30 peer reviewed papers. She has recently led a UK research council (NERC)-funded project to investigate the joint and interactive effects of heat and ozone on human health, and a follow-on wider project will examine the spatial variations in health outcomes related to mixtures of air pollutants and weather in the UK, and the relationship to socio-economic inequalities. Both projects have utilised/will utilise Dr Vieno's expertise with WRF and EMEP4UK models. *[Contributing to WP 6 & 8 as Manager for Dr Vieno]*
- **Dr Massimo Vieno** Dr Vieno has a background in physics, meteorology and atmospheric chemistry. He has more than 8 years experience in regional scale modelling of transport, deposition and interactions of various pollutants including ozone, ammonia, oxides of nitrogen and oxides of sulphur. He is the main developer of the EMEP4UK model, a

regional and higher resolution application of the EMEP unified model. *[Contributing to WP 6 & 8]*

Recent relevant publications

Doherty, R., M. Heal, P. Wilkinson, S. Pattenden, M. Vieno, B. Armstrong, R. Atkinson, Z. Chalabi, S. Kovats, A. Milojevic, D.S. Stevenson, Impacts of Future Environmental Change on Climate and Air Pollution Mediated Human Health, *Environmental Health*, 8(Suppl 1):S8 doi:10.1186/1476-069X-8-S1-S8, 2009

Reay, D.S., Howard, C.M., Bleeker, A., et al. (2011). Societal choice and communicating the European nitrogen challenge. In: *The European Nitrogen Assessment* ed. M.A. Sutton, C.M. Howard, J.W. Erisman, et al., Cambridge University Press.

Vieno, M., Dore, A. J., Stevenson, D. S., Doherty, R., Heal, M. R., Reis, S., Hallsworth, S., Tarrason, L., Wind, P., Fowler, D., Simpson, D., and Sutton, M. A.: Modelling surface ozone during the 2003 heat-wave in the UK, *Atmos. Chem. Phys.*, 10, 7963-7978, 10.5194/acp-10-7963-2010, 2010.

PARTNER no:	29
Organization full name:	University of Bonn, Institute of Crop Science and Resource Conservation
Organization short name:	UBO
URL:	http://www.ipe.uni-bonn.de

Description of the organization

The University of Bonn (UBO) is considered to be one of Germany's and Europe's most important institutes of higher education. It is home of learning to over 27,000 students. The Institute of Crop Science and Resource Conservation at UBO conducts research and university education on the sustainable use of rural areas, focusing on ways to highly efficient plant production by simultaneously minimizing negative effects to adjoining ecosystems.

Expertise and experience of your organisation, including previous EU projects

The institute and the PI have been involved in numerous research projects on air pollution effects to ecosystems at the national and international level. There is special expertise in the interaction of deposited aerosols with plants, plant ecophysiology, and crop modelling. Contributions to EU projects include participation in the GRAMINAE and ACCENT programs.

Key scientific personnel to be involved in the project

- Dr. **Jürgen Burkhardt** (PI) has led pioneering investigations into the effect of aerosol on stomatal function, by studing the ‘wick effect’ of deposited aerosol and its influence on increasing water loss from vegetation. In ÉCLAIRE he will take this work forward and feed its results into the overall assessment of climate change / air pollution impacts on ecosystem effects. He will design and supervise the experiments and laboratory analyses, maintain links with the international consortium and publish the results. *[contributing to WP11]*
- N.N. *(to be determined)* A Ph.D. student will prepare, run and analyse a suite of greenhouse experiments.

Recent relevant publications

Burkhardt (2010): Hygroscopic particles on leaves: nutrients or desiccants? Ecological Monographs, 80, 369-399.

Burkhardt, J., Flechard, C. R., Gresens, F., Mattsson, M., Jongejan, P. A. C., Erisman, J. W., Weidinger, T., Meszaros, R., Nemitz, E., Sutton, M. A. (2009): Modelling the dynamic chemical interactions of atmospheric ammonia with leaf surface wetness in a managed grassland canopy. Biogeosciences, 6, 67-83.

Sutton, M.A. , Nemitz, E., Milford, C., Campbell, C., Erisman, J. W., Hensen, A., Cellier, P., David, M., Loubet, B., Personne, E., Schjoerring, J. K., Mattsson, M., Dorsey, J. R., Gallagher, M.W., Horvath, L. Weidinger, T. Meszaros, R., Dämmgen, U., Neftel, A., Herrmann, B., Lehman, B. E., Flechard, C., Burkhardt, J. (2009): Dynamics of ammonia exchange with cut grassland: synthesis of results and conclusions of the GRAMINAE Integrated Experiment. Biogeosciences, 6, 2907-2934

Fowler, D., …, Burkhardt J., et al. (57 authors) (2009): Atmospheric composition change: Ecosystems-Atmosphere interactions. Atmospheric Environment, 43, 5193-5267.

Burkhardt, J., Hunsche, M., Pariyar, S. (2009) Progressive wetting of initially hydrophobic plant surfaces by salts – a prerequisite for hydraulic activation of stomata? Proc. Int. Plant Nutrition Colloq. XVI, Department of Plant Sciences, UC Davis, www.escholarship.org/uc/item/2m09483m

Burkhardt, J., Kaiser H., Kappen L., Goldbach, H.E. (2001): The possible role of aerosols on stomatal conductivity for water vapour. Basic and Applied Ecology, 2, 351-364.

Burkhardt, J., Kaiser H., Goldbach, H.E., Kappen L. (1999): Measurements of electrical leaf surface conductance reveal recondensation of transpired water vapour on leaf surfaces. Plant Cell and Environment, 22, 189-196

PARTNER no.:	30
Organization full name:	Federal Research Institute for Forest, Snow and Landscape WSL
Organization short name:	WSL
URL:	http://www.wsl.ch/index_EN

Description of the organization

The Swiss Federal Institute for Forest, Snow and Landscape Research WSL belongs to the ETH Domain. The aims of WSL's research are to find ways to sustainably manage landscapes and forests to benefit people's quality of life, and to handle the natural hazards that typically occur in mountainous countries in the best possible ways for maximum protection at affordable costs. In cooperation with partners in industry, science and society at large, WSL develops strategies to solve problems that are relevant to society. The interdisciplinary and transdisciplinary approach to a research that is problem-oriented with a view to practical solutions is a particular strength of WSL.

Expertise and experience of your organisation, including previous EU projects

The WSL has taken part in many previous and currently running EU projects. To just name a few relative recent EU-Projects with related topics: Evoltree, Sensor, Motive.

Key scientific personnel to be involved in the project

- Dr. **Matthias Dobbertin**, PI, is a specialist on environmental effects on forest growth and condition and add this expertise to the ÉCLAIRE consortium. *[contributing to WP9]*

Recent relevant publications

Dobbertin M., Eilmann B., Bleuler P., Giuggiola A., Graf Pannatier E., Landolt W., Schleppi P., Rigling A. (2010) Effect of irrigation on needle morphology, shoot and stem growth in a drought exposed Pinus sylvestris L. forest. Tree Physiology 30: 346-360.

Thimonier A., Graf Pannatier E., Schmitt M., Waldner P., Walthert L., Schleppi P., Dobbertin M., Kräuchi N., (2010) Does exceeding the critical loads for nitrogen alter nitrate leaching, the nutrient status of trees and their crown condition at Swiss Long-term Forest Ecosystem Research (LWF) sites? Eur. J. For. Res. DOI 10.1007/s10342-009-0328-9.

Vries W. de, Solberg S., Dobbertin M., Sterba H., Laubhann D., van Oijen M., Evans C., Gundersen P., Kros, J., Wamelink G.W.W., Reinds G.J., Sutton M.A. (2009). The impact of nitrogen deposition on carbon sequestration by European forests and heathlands. For. Ecol. Manage. 258: 1735-1750, doi:10.1016/j.foreco.2009.02.034.

Solberg, S., Dobbertin, M., Reinds, G.J., Lange, H., Andreassen, K., Garcia Fernandez, P., Hildingsson, A., de Vries, W. (2009). Analyses of the impact of changes in atmospheric deposition and climate on forest growth in European monitoring plots: A stand growth approach. For. Ecol. Manage. 258: 1735-1750, doi:10.1016/j.foreco.2008.09.057.

de Vries W., Solberg S., Dobbertin M., Sterba H., Laubhahn D., Reinds G.J., Nabuurs G.-J., Gundersen P. (2008) Ecologically implausible carbon response. Nature, 451, E1-E3.

Dobbertin M. (2005) Tree growth as indicator of tree vitality and of tree reaction to environmental stress: A review. Eur. J. For. Sci., 124: 319-333.

PARTNER no.:	31
Organization full name:	IVL SVENSKA MILJOEINSTITUTET AB
Organization short name:	IVL
URL:	http://www.ivl.se

Description of the organization

IVL Swedish Environmental Research Institute is an independent, non-profit organisation, owned by a foundation jointly established by the Swedish Government and Swedish industry. IVL was established in 1966 and has since then been involved in the development of solutions to environmental problems, both at national and international level. The institute comprises Sweden's largest group of environmental experts and employs around 180 people, which makes IVL a leading institute for applied environmental research and consultancy services.

IVL undertakes both research projects and contract assignments in the entire environmental field. The activities include for example climate issues, environmental technology, indoor environment, waste management, working environment, environmental measurements, and environmental quality evaluation. IVL also performs studies of the environmental effects in air, water, and soil, and the institute has its own accredited laboratories for analysis.

Expertise and experience of your organisation, including previous EU projects

IVL has a long experience in participating and coordinating EU projects. Currently, IVL is coordinating the following EU projects:

- Advance ETV – European Environmental Technology Verification system, 2009-2012.
- ArcRisk - Impacts on health in the Arctic and Europe owing to climate-induced changes in contaminant cycling, 2009-2013.
- CADASTER - The project aims at providing the practical guidance to integrated risk assessment by carrying out a full hazard and risk assessment for chemicals, 2009-2012.
- COHIBA – Control Of Hazardous substances In the Baltic sea region, 2009-2012.

Key scientific personnel to be involved in the project

- Associate Prof. **Per Erik Karlsson**: Expert on ozone impacts on forests *[contributing to WP9 and 12]*
- M.Sc. **Stefan Åström**: Environmental economist, Integrated Assessment Modelling *[contributing to WP18]*

Recent relevant publications

Klingberg J., Engardt M., Uddling J., Karlsson P.E. and Pleijel H. Ozone risk for vegetation in Europe under different climate change scenarios based on ozone uptake calculations. Accepted Tellus A, April 2010.

Karlsson, P.E., Braun, S., Broadmeadow, M., Elvira, S., Emberson, L., Gimeno, B.S., Le Thiec, D., Novak, K., Oksanen, E., Schaub, M., Uddling, J. Wilkinson, M. 2007. Risk assessments for forest trees - the performance of the ozone flux versus the AOT concepts. Environmental Pollution 146, 608-616.

Karlsson, P.E., Örlander, G., Langvall, O., Uddling, J., Hjorth, U., Wiklander, K., Areskoug, B., Grennfelt, P. 2006. Negative impact of ozone on the stem basal area increment of mature Norway spruce in south Sweden. Forest Ecology and Management 232, 146-151.

Apsimon H., Amann M., Åström S., Oxley T., 2009, Synergies in addressing air quality and climate change, Climate Policy, v.9, iss.4, 2009

Åström et al. 2010, Potential impacts on air pollution following Nordic low greenhouse gas emission initiatives, Scenario analysis performed with the GAINS model, TemaNord 10:18

PARTNER no.:	32
Organization full name:	Max Planck Gesellschaft zur Förderung der Wissenschaften e.V.
Organization short name:	MPG
URL:	http://www.bgc-jena.mpg.de/

Description of the organization

The Max-Planck-Institute for Biogeochemistry (MPI-BGC) is a research institute of the German Max-Planck Society for the advancement of the sciences. Its research mission is the investigation of the global biogeochemical cycles and their interaction with the climate system. The institute combines strong observational and process-based studies (soil carbon, plant community structure, nutrition

and growth, vegetation-atmosphere fluxes, convective boundary layer) with global scale modeling (e.g. vegetation dynamics, global carbon cycle, aerosol modeling). The institute also disposes over extensive, modern technical facilities for biogeochemical measurements: stable isotope and gas analytics, chemical analytics, 14C analytics by AMS, field instrumentation support, and computing.

Expertise and experience of your organisation, including previous EU projects

MPI-BGC is one of the Partner votal European biogeochemical cycle research institutions, and as such is co-ordinating the EU-funded CARBOEUROPE-IP project, and within the project the “Continental Integration” component (M. Heimann) and the “Soils” activity (E.-D. Schulze). Moreover the Institute is strongly involved in the recently EU-funded NITROEUROPE project. The institute was involved in 12 of the 15 previous CarboEurope projects, and co-ordinated three of them.

Key scientific personnel to be involved in the project

- **Dr. Sönke Zaehle** is the PI of the MPG and an expert in terrestrial biosphere modelling, specifically the modelling the couplings of the carbon and nitrogen cycles, and the effect of N deposition on carbon sequestration. *[contributing to WP14]*

Recent relevant publications

Zaehle, S., Friend, A. D., Friedlingstein, P., Dentener, F., Peylin, P., Schulz M. (2010): Carbon and nitrogen cycle dynamics in the O-CN land surface model: 2. The role of the nitrogen cycle in the historical terrestrial C balance, Global Biogeochemical Cycles, 24, GB 1006, doi:10.1029/2009GB003522.

Zaehle, S., Friend, A. D. (2010): Carbon and nitrogen cycle dynamics in the O-CN land surface model: 1. Model description, site-level evaluation and sensitivity to parameter estimates, Global Biogeochemical Cycles, 24, GB 1005, doi:10.1029/2009GB003521.

Zaehle, S., Friedlingstein, P., Friend A. D. (2010): Terrestrial nitrogen feedbacks may accelerate future climate change, Geophysical Research Letters, 37, L01401, doi:10.1029/2009GL041345.

Ciais, P. Schelhaas, M.J, Zaehle., S., Piao, S.L, Cescatti, A., Liski, J., Luyssaert, S., Le-Maire, G., Schulze, E.-D., Bouriaud, O., Freibauer, A., Valentini, R., Nabuurs, G.J. (2008): Carbon accumulation in European forests, Nature – Geosciences, 1, 425 - 429.

PARTNER no.:	33
Organization full name:	Institute of Physico-chemical and Biological Problems in Soil Science
Organization short name:	IPBPSS
URL:	http://www.issp.psn.ru/

Description of the organization

The IPCBPS was established in 1970 yr in Biological Centre of Academy of Sciences of USSR located in Pushchino, Moscow region. Presently, it is one from the leading institution in Russia for researches in soil and environmental sciences. It consists of seven laboratories and two research groups. The institute has focused on studying the basic role of soils in various biosphere processes. Current lines of researches are concerned with investigating physicochemical and biological problems of soil formation and transformation of compounds in soils and ecosystems; influence of soil properties and state on biogeochemical cycling the elements; significance of cryogenic zones for global cycle of substance and energy as well as for temporary closing-down genetic resources; space-time organization of the soils and soil functioning in biosphere as a basis for sustainable development.

Expertise and experience of your organisation, including previous EU projects

IPCBPS is participating in the following Programs of Basic Research of Russian Academy of Science: 'Fundamentals of Biodiversity Conservation in Russia', "Environmental and climatic changes: natural disasters" and in more than 30 grants of Russian Foundation for Basic Researches, in 5 grants of EU-INTAS and in EU FP6 Program projects NitroEurope, OMRISK.

Key scientific personnel to be involved in the project

- Prof., Dr. Biolog. Sci., Ph.D. **Alexander Komarov**; development and comparison of mathematical models of soil/vegetation dynamics at different levels of nitrogen deposition, coordination of team work in frame of the project. *[contributing to WP14 and 4.3]*
- PhD. **Irina Priputina**; she has an experience in critical loads concept, work with VSD+ and other models, administration of necessary databases. *[contributing to WP14 and 4.3]*
- Researcher **Vladimir Shanin**; a specialist in programming and models administrator. He is also developing expert rules and scenarios for model runs. His role is to compile climate and fires scenarios, programming and run models for selected case-studies. *[contributing to WP14 and 4.3]*
- Researcher **Yulia Khoraskina**; a specialist in soil chemistry, she develops models of soil organic matter dynamic in relation to dynamics of basic cations. Her role is to compile scenarios in relation carbon and elements of soil nutrition, and run models. *[contributing to WP14 and 16]*

Recent relevant publications

Yurova A.A., Volodin E.M., Ågren G., Chertov O.G., Komarov A.S. Effects of variations in simulated changes in soil carbon contents and dynamics on future climate projections. Global Change Biology. 2010. 16, 823–835.

Bobrovsky, M., Komarov, A., Mikhailov, A., Khanina, L. Modelling dynamics of soil organic matter under different historical land-use management techniques in European Russia. Ecological Modelling, 2010. 221(6), pp. 953-959.

Priputina I., Averkieva I. Use of biogeochemical models of matter migration for evaluation of forest ecosystem stability in relation to air pollutants. Bull of Samara Sci Center of RAS 2009;1(7): 1522-1527 (in Russian with English summary).

Khoraskina Yu.S., Komarov A.S., Bezrukova M.G., Zhiyanski M. Modeling of calcium dynamics in soil organic layers. Computer Research and Modeling, 2010, vol. 2, no. 1, pp. 103–110 (In Russian).

Shanin V.N., Komarov A.S., Mikhailov A.V. The effect of forest management regime and climate change on nutrients balance in forest ecosystems: a model approach. Bull of Samara Sci Center of RAS 2009;1(7): 1601-1609 (in Russian with English summary).

PARTNER no.:	34
Organization full name:	Dr Michael Holland
Organization short name:	EMRC

Description of the organization

EMRC (Ecometrics, research and consulting) is a UK-based micro-consultancy, led by Mike Holland, who typically works in collaboration with other freelance consultants as well as larger organisations. By combining 'research and consulting', EMRC's aim is to provide the latest science in a policy-relevant format, particularly in the fields of air quality, climate and waste management.

Expertise and experience of your organisation, including previous EU projects

Mike Holland has worked on the effects of pollution on health the environment and the economy for the last 25 years, for the last 8 of which he has operated freelance, trading as EMRC. During these 25 years Mike has performed a large amount of research and consultancy for the European Union, including the following projects:

- ExternE, Externalities of Energy (1991-2005). Lead for development of the project methodology, which has now been adopted across Europe and beyond. http://www.externe.info/.
- Cost-benefit analysis of transboundary air pollution policies (1997 to present). Analysis for EC DG Environment covering the National Emission Ceilings Directive and its revision, the Ozone Directive, and the UNECE CLRTAP Gothenburg Protocol and its revision. In the course of this work we highlighted the importance of the health impacts of air pollution, raising their policy profile considerably.
- Cost benefit analysis of various Daughter Directives to the Framework Directive on Ambient Air Quality (Daughter Directives 2 (CO and benzene), 3 (ozone) and 4 (PAHs and heavy metals: for EC DG Environment.
- CBA under the Clean Air For Europe (CAFE) Programme, again for EC DG Environment, assisting in the developing of the Thematic Strategy on Air Pollution.
- Assessment of the co-benefits of climate policies for EC DG Environment..
- In addition to this work for the European Commission and its institutions, EMRC's client base includes UK Government at national and local levels, the Welsh Assembly, the OECD, WHO, Environmental NGOs such as the European Environment Bureau and the Health and Environmental Alliance, and private enterprises.

Key scientific personnel to be involved in the project

- Dr **Mike Holland**, Lead researcher. *[Leading WP18]*

Recent relevant publications

Mills, G., Buse, A., Gimeno, B., Bermejo, V., Holland, M., Emberson, L. and Pleijel, H. (2006) A synthesis of AOT40-based response functions and critical levels of ozone for agricultural and horticultural crops. Atmospheric Environment.

Coenen, P., Holland, M., Wagner, A., and Palmer, T. (2009) Cost Benefit Analysis to Support the Impact Assessment accompanying the revision of Directive 1999/32/EC on the Sulphur Content of certain Liquid Fuels for EC DG Environment.

Entec (2010) Assessment of the Possible Development of an EU-wide NOx and SO2 Trading Scheme for IPPC Installations (draft, February 2010, contributing author).

Menne, B. and Matthies, F. (Eds.) (2010) The health effects of climate change in the European Union: evidence for action. Technical background document for WHO Europe, CEHAPIS Project. [Contributing author].

Brink, C., van Grinsven, H., Jacobsen, B.H., Rabl, A., Gren, I.M, Holland, M., Klimont, Z., Hicks, K., Brouwer, R., Dickens, R., Willems, J.,Termansen, M., Velthof, G., Alkemade, R., van Oorschot, M. and Webb, J. (2011) Costs and benefits of nitrogen in the environment. European Nitrogen Assessment, Chapter 22.

Holland, M and Spadaro, J. (2009) Costs, Benefits and Trade-Offs: Volatile Organic Compounds. Contract report for Defra. http://wwwb.vito.be/reach_sea_datasources/vdocuments/files/CBA_VOC_EMRC.pdf

Barrett, M. and Holland, M. (2008) The Costs and Health Benefits of Reducing Emissions from Power Stations in Europe. For the Air Pollution and Climate Secretariat. http://www.airclim.org/reports/APC20_final.pdf

Pye, S., Holland, M, van Regemorter, D., Wagner, A and Watkiss, P. (2008) Analysis of the Costs and Benefits of Proposed Revisions to the National Emission Ceilings Directive NEC CBA Report 3. National Emission Ceilings for 2020 based on the 2008 Climate & Energy Package. For European Commission DG Environment. http://www.cafe-cba.org/assets/necdcba3.pdf

PARTNER no.:	35 *(Department 1)*
Organization full name:	Aarhus University
Organization short :	AU
URL:	http://www.au.dk

Description of the organization

AU covers nine main academic areas. Combined, they span the entire research spectrum - fundamental research, applied research, strategic research and research-based advice to governments and decision makers at national and international level. In 2009 the university had 30,414 students, of whom 15,000 were Master's degree students, about 1,500 PhD students and close to 550 postdoctoral scholars. In the latest THE-QS rankings, Aarhus University is ranked 84th in the world, which is the second highest Scandinavian ranking.

In this project AU will be represented by the National Environmental Research Institute (NERI) and the Faculty of Agricultural Sciences. Three departments will contribute. Due to the considerable differences in expertise, two partner descriptions are provided (this is for department 1).

Expertise and experience of your organisation, including previous EU projects

NERI provides research and policy advice for ministries and other national and international parties regarding terrestrial and aquatic ecosystems, air and climate, the arctic environment and in environmental economics and planning. The Department of Policy Analysis focuses on interdisciplinary and integrated analysis of environment and society. The department works with environmental economics, sociology, and environmental geography to produce integrated analyses of environment and society, and integrated assessments of the impact of policies to regulate the use of chemicals. NERI Departments have participated in numerous EU research projects, including the on-going PASHMINA, POINT and LIAISE.

Key scientific personnel to be involved in the project

- Senior Researcher: **Jim Smart**, is an environmental economist with expertise in valuation methods, ecosystem health and ecosystem goods and services. He has extensive experience in interdisciplinary environmental analysis and will contribute to the valuation of ecosystem services in this project *[contributing to WP18]*

Recent relevant publications

Wiegand, J, Raffaelli, D., Smart, J.C.R. & White, P.C.L. (2010), Assessment of ecosystem health using an holistic indicator: a case study of the River Ythan catchment in the UK, Journal of Environmental

Management, 91, 1446-1455.

Smart, J.C.R., Büker, P. & Ashmore, M. (2009), A framework for the economic valuation of long-term benefits from the control of metal emissions based on scenario analyses, Report for Defra Contract AQ0813 'Assessing the benefits of reductions in metal emissions to the atmosphere'(Report for the UK government)

Hicks, K, Morrissey, T, Ashmore, M, Raffaelli, D, Utton, M, Smart, J.C.R. , Ramwell, C, Bealey, B and Heinemeyer A. (2008). Towards an Ecosystems Approach for Ammonia: Embedding an Ecosystem Services Framework into Air Quality Policy for Agricultural Ammonia Emissions. Defra Report NR0120 (Report for the UK government)

PARTNER no.:	35 *(Departments2 and 3)*
Organization full name:	Aarhus University
Organization short name:	AU
URL:	http://www.au.dk

Description of the organization

AU covers nine main academic areas. In this project AU will be represented by the National Environmental Research Institute (NERI) and Faculty of Agricultural Sciences. Three departments will contribute. Due to the considerable differences in expertise, two partner descriptions are provided (this is for department 2 and 3).

Expertise and experience of your organisation, including previous EU projects

The Department of Atmospheric Environment (ATMI) in NERI, AU is the national focal point regarding air quality research in Denmark. ATMI has long experience in field

experiments, as well as in developing and applying chemistry-transport models (CTM) from hemispheric scale down to urban and street scale including dynamical modelling of emissions.

The Department of Agroecology and Environment focuses its research on the interaction between soils, crop production and environment. The department has developed a range of models to analyse flows of carbon and nitrogen at field, farm and landscape scales, with particular emphasis on nitrate leaching and greenhouse gas emissions.

Both departments have participated in numerous EU research projects, including the on-going NitroEurope IP. Other relevant EU projects are AEROBACTICS and CarboEurope IP,

Key scientific personnel to be involved in the project

- Post Doc. **Carsten Ambelas Skjøth**: Will be in charge of the further developments of an existing dynamic emission model for agricultural areas in order to provide emission patterns for model experiments on European scale. *[contributing to WP6 and 8]*
- Senior Scientist, **Camilla Geels**: Will based on experience in development and application of atmospheric models including the surface exchange of e.g. dust, CO2 and nitrogen, contribute to the developments of the coupling between the dynamic emission model and the atmospheric models. *[contributing to WP6 and 8]*
- Principal scientist, **Ole Hertel**: Will take part in the further development and application of the high resolution dynamic emission model for agricultural sources for describing emission pattern in the chemistry-transport modelling for Europe. *[contributing to WP6 and 8]*
- Senior Scientist, **Nicholas John Hutchings**: To advise on the modelling of landscape scale ammonia emissions from agricultural sources using the Nitroscape modelling framework.

[contributing to WP6 and 8]

Recent relevant publications

Hertel, O., Skjøth, C. A., Løfstrøm, P., Geels, C., Frohn, L., Ellermann, T., and Madsen, P. V., (2006) Modelling nitrogen deposition on local scale – a review of current state-of-the-art. Env. Chem. 3(5).

Ambelas Skjøth, C., O. Hertel, S. Gyldenkærne and T. Ellermann, (2004), Implementing a dynamical ammonia emission parameterization in the large-scale air pollution model ACDEP, JGR.109 (D6).

Geels, C., Gloor, M., Ciais, P et al. (2007) Comparing atmospheric transport models for future regional inversions over Europe. Part 1: Mapping the CO_2 atmospheric signals. Atm. Chem. Phys. 7, 13.

Ambelas Skjøth, C., S. Gyldenkærne, T. Ellermann, O. Hertel and M. Hjort Mikkelsen. (2008) Footprints on ammonia concentrations from environmental regulations. J. Air Waste Manag., 58

Happe, K., Hutchings, N.J., Dalgaard, T, Kellermann, K. (2010) Modelling the interactions between regional farming structure, nitrogen losses and environmental regulation. Agricultural Systems (in press).

PARTNER no.:	36
Organization full name:	Wageningen University and Research Centre
Organization short name:	WUR
URL:	http://www.wur.nl

Description of the organization

Wageningen University forms together with a number of research institutes a cluster of internationally-leading knowledge institutions offering applied and scientific research to promote the sustainable use of our environment. Research focuses on land use, water management and environment in rural and semi-urban areas and is implemented in close collaboration with stakeholders and private and public research partners. WUR has a longstanding record of successfully conducting and coordinating large European projects within the current and past EU Frameworks. The Earth System Science – Climate Change (ESS-CC) group of the department of Environmental Science of WUR participates in ÉCLAIRE.

Expertise and experience of your organisation, including previous EU projects

The ESS-CC group has expertise on interactions between biogeo- and atmospheric chemistry, land use change and climate change. The group has developed detailed stand alone land-surface models (LSM) based on long-term flux monitoring projects and uses the same LSMs in coupled regional and global model systems to study interactions between land use change, biogeo- and atmospheric chemistry, hydrology and climate. The ESS-CC group has been and is currently involved in a number of EU projects including the EU-FP7 projects "COMBINE" on new components in Earth system and climate models and "PEGAGOS", on the link and interactions between air quality and climate change.

Key scientific personnel to be involved in the project

Dr. **Laurens Ganzeveld**, PI, Assistant professor in the chair group Earth System Sciences - Climate Change of the department of Environmental Sciences at Wageningen University, Netherlands ESS-CC. Main research interest is the role of surface reactive trace gas and aerosol exchanges in atmospheric chemistry and climate. This includes dry deposition processes, biogenic emissions, in-canopy interactions, role of micrometeorology and hydrology in atmospheric chemistry, cryosphere-atmosphere and ocean-atmosphere exchanges, impact of land cover and land use changes in atmospheric chemistry and climate and xtensive evaluation of surface exchanges using field observations and 1-D and 3-D models *[contribution to WP4 and 7]*

Recent relevant publications

Ganzeveld, L., et al., The impact of Future Land Use and Land Cover Changes on Atmospheric Chemistry-Climate Interactions, J. Geophys. Res, in press

Ganzeveld, L., et al., Surface and Boundary Layer Exchanges of Volatile Organic Compounds, Nitrogen Oxides and Ozone during the GABRIEL Campaign, Atmos. Chem. Phys., 8, 6223–6243, 2008.

Lelieveld, J., et al., Tropical forest sustains atmospheric oxidation capacity, Nature, doi:10.1038/nature06870, 2008.

Ganzeveld, L., Valverde-Canossa, J., Moortgat, G., Steinbrecher, R., Evaluation of Peroxide Exchanges over a Coniferous Forest in a Single-Column Chemistry-Climate Model, Atmos. Environ., 40, S68-S80, 2006.

Ganzeveld, L., and J. Lelieveld, Impact of Amazonian deforestation on atmospheric chemistry, Geophys. Res. Lett., 31, L06105, doi:10.1029/2003GL019205, 2004.

Ganzeveld, L., J. Lelieveld, F. J. Dentener, M. C. Krol, A. F. Bouwman, and G.-J. Roelofs, The influence of soil-biogenic NOx emissions on the global distribution of reactive trace gases: the role of canopy processes, J. Geophys. Res., 107, 2002.

Ganzeveld, L., J. Lelieveld, F. J. Dentener, M. C. Krol, and G.-J. Roelofs, Atmosphere-biosphere trace gas exchanges simulated with a single-column model, J. Geophys. Res., 107, 2002.

Ganzeveld, L., and J. Lelieveld, Dry deposition parameterization in a chemistry general circulation model and its influence on the distribution of reactive trace gases, J. Geophys. Res., 100, 20,999-21,012,1995.

PARTNER no.:	37
Organization full name:	Université Libre de Bruxelles
Organization short name:	ULB
URL:	http://www.ulb.ac.be/

Description of the organization

The ULB has seven faculties and a series of additional schools and institutes which together provide a full range of academic tuition in all disciplines and at all levels. The Atmospheric Spectroscopy Group at ULB is part of the "Service de Chimie Quantique et Photophysique", belonging to the Faculty of Sciences. It currently has 10 members, with activities centred on the remote-sensing of composition, from satellites or from the ground. The researchers contribute to space missions for the sounding of the low Earth's Atmosphere, among which IASI, and to the preparation of future programs.

Expertise and experience of your organisation, including previous EU projects

The Atmospheric Spectroscopy Group at ULB has acquired a leading position for the atmospheric radiative transfer modeling in the thermal infrared and also for the development of atmospheric trace gases retrieval methods. It owns and maintains sophisticated algorithms, for research and operational applications in atmospheric chemistry and physics. Current research themes in the group are principally related to the IASI/Metop satellite mission: IASI calibrated level1C are routinely processed at ULB to provide concentration distributions of climate (e.g. H_2O, CH_4) and chemistry trace gases (e.g. O_3, CO, HNO_3, NH_3, SO_2, VOCs) on the global scale and in near-real-time.

The group has been partner in ACCENT (Atmospheric Composition Change: The European Network of Excellence), with PI contribution in AT2, from 2004 to 2010. It is currently involved in the European Volcano Observatory Space Services (EVOSS, FP7-Space-2009-1), running through to 2012.

Key scientific personnel to be involved in the project

- Dr. **Pierre Coheur**, Group leader, Satellite remote sensing – Atmospheric chemistry. *[contribution to WP1 and 8]*
- Dr. **Lieven Clarisse**, Atmospheric radiative transfer and chemistry *[contribution to WP1 and 8]*
- Dr. **Daniel Hurtmans**, Atmospheric radiative transfer expert – Data and software manager *[contribution to WP1 and 8]*
- Dr. **Cathy Clerbaux**, Satellite remote sensing – Atmospheric chemistry *[contribution to WP1 and 8]*
- Ir. **Yasmine Ngadi**, IASI data handling – Atmospheric chemistry *[contribution to WP1 and 8]*
- Ir. **Martin Van Damme** (PhD), Satellite remote sensing of ammonia – C-N cycle – climate *[contribution to WP1 and 8]*

Recent relevant publications

Clarisse, L., C. Clerbaux, F. Dentener, D. Hurtmans, P.-F. Coheur, Global ammonia distribution derived from infrared satellite observations, 2009, Nature Geoscience, 2, 479-483

Clarisse, L., Shephard M., Dentener F., Hurtmans D., Cady-Pereira K., Karagulian F., Van Damme M., Clerbaux C., Coheur P.F.: Satellite monitoring of ammonia: A case study of the San Joaquin Valley, 2010a, Journal of Geophysical Research, 115, D13302

Clerbaux, C., Boynard, A., Clarisse, L., George, M., Hadji-Lazaro, J., Herbin, H., Hurtmans, D., Pommier, M., Razavi, A., Turquety, S., Wespes, C., and Coheur, P. F.: Monitoring of atmospheric composition using the thermal infrared IASI/MetOp sounder, Atmos. Chem. Phys., 2009, 9, 6041-6054.

George, M., Clerbaux, C., Hurtmans, D., Turquety, S., Coheur, P. F., Pommier, M., Hadji-Lazaro, J., Edwards, D. P., Worden, H., Luo, M., Rinsland, C., and McMillan, W.: Carbon monoxide distributions from the IASI/METOP mission: evaluation with other space-borne remote sensors, 2009, Atmos. Chem. Phys., 9, 8317-8330

Fortems-Cheiney, A., Chevallier, F., Pison, I., Bousquet, P., Carouge, C., Clerbaux, C., Coheur, P. F., George, M., Hurtmans, D., Szopa, S.: On the capability of IASI measurements to inform about CO surface emissions, 2009, Atmos. Chem. Phys., 9, 8735-8743

PARTNER no.:	38
Organization full name:	Bulgarian Academy of Sciences – Institute of Plant Physiology and Genetics
Organization short name:	BAS – IFRG
URL:	http://www.bio21.bas.bg/ipp

Description of the organization

Bulgarian Academy of Sciences (BAS) has 15 Institutes and research units in the field of life sciences. Institute of Plant Physiology and Genetics (IFRG) was recently created (July 2010) by merging of two former Institutes – Institute of Plant Physiology and Institute of Genetics. Both former institutes are one of the oldest biological institutes of the BAS. Researchers from the IPFG target scientific questions, which are highly relevant in terms of scientific and socio-economic impact, and are included in priorities of BAS and Framework Programmes of EU. The scientific work of IFRG is organized into nine departments: Photosynthesis, Plant mineral nutrition and water relations, Plant stress molecular biology, Regulation of plant growth and development, Experimental algology, Molecular Genetics, Cytogenetics, Plant Biotechnology, and Applied Genetics. IFRG's research directs important questions of plant physiology and genetics, which are at the forefront of the current international research (e.g. role of volatile compounds, mechanisms of plant stress tolerance, role of reactive oxygen species, improvement of stress tolerance and productivity of agronomically important plants, breeding programs of cultivated plants, elucidation of genetic bases of resistance to diseases, utilization of large scale alga cultures). The research performed at IFRG has important innovation potential as regards improvement of agronomically important crop plants. The Institute has been exploiting this potential by obtaining five patents for tomato varieties, with an additional four patent applications filed. Large FAO/IAEA project, which is coordinated by the Institute, aims to evaluate genetic diversity in cereals in South Eastern and Central Europe. The IFRG has good synergies with other BAS Institutes and Bulgarian Universities, as well as with foreign institutions.

An important socio-economic aspect of the Institute's activities is the education of graduate students and the training of highly qualified scientists

Key scientific personnel to be involved in the project

- Dr. **Violeta Velikova** : measurements of leaf gas exchange, fluxes of BVOC, NO emission from leaves in the field and under controlled conditions. *[contribution to WP2]*

Recent relevant publications

Velikova V, Tsonev T, Barta C, Centritto M, Koleva D, Stefanova M, Busheva M, Loreto F – BVOC emissions, photosynthetic characteristics and changes in chloroplast ultra-structure of *Platanus orientalis* L. exposed to elevated CO_2 and high temperature. Environ Pollut 157: 2629-2637, 2009

Velikova V, Fares S, Loreto F – Isoprene and nitric oxide reduce damages in leaves exposed to oxidative stress. Plant Cell Environ 31: 1882-1894, 2008

Velikova V, Loreto F, Tsonev T, Brilli F, Edreva A – Isoprene prevents the negative consequences of high temperature stress in *Platanus orientalis* leaves. Functional Plant Biol 33: 931-940, 2006

Velikova V, Tsonev T, Pinelli P, Alessio GA, Loreto F - Localized O_3-fumigation for field-studies of the impact of different ozone levels on photosynthesis, respiration, electron transport rate and isoprene emission in Mediterranean oak species. Tree Physiol 25: 1523-1532, 2005

Velikova V, Pinelli P, Pasqualini S, Reale L, Ferranti F, Loreto F – Isoprene decreases the concentration of nitric oxide in leaves exposed to elevated ozone. New Phytol 166: 419-426, 2005

Velikova V, Loreto F - On the relationship between isoprene emission and thermotolerance in *Phragmites australis* leaves exposed to high temperatures and during the recovery from a heat stress. Plant Cell Environ 28, 318-327, 2005

Loreto F, Velikova V - Isoprene produced by leaves protects the photosynthetic apparatus against ozone damage, quenches ozone products, and reduces lipid peroxidation of cellular membranes. Plant Physiol 127: 1781-1787, 2001

PARTNER no.:	39
Organization full name:	Netherlands Organisation for Applied Scientific Research
Organization short name:	TNO
URL:	http://www.tno.nl

Description of the organization

TNO, the Netherlands Organisation for Applied Scientific Research, is one of Europe's leading independent research and development organisations. TNO is the largest fully independent Research, Development organization in the Netherlands, with a staff of over 5,000 and a total annual turnover of close to 600 million Euros. TNO's primary tasks are to assist and support trade and industry, including SME's, governments and others in technological innovation and solving problems by rendering services and transferring knowledge and expertise.

Expertise and experience of your organisation, including previous EU projects

TNO Built Environment and Geosciences, more specifically the unit Environment, Health and Safety, investigates the processing of anthropogenic pollutants in the atmosphere and their influence on the environment and climate change. Its facilities include an accredited chemical laboratory and air quality monitoring equipment. TNO develops integrated monitoring techniques on an operational basis using modeling, (in situ) observations and remote sensing data. TNO has considerable experience in modeling large-scale and urban air pollution, generating bottom-up emission inventories, and performing measurements for validation of models and satellite observations. TNO successfully developed, tested and used the modeling system that we intend to use in this research, LOTOS-EUROS. Monitoring air pollution levels and changes in air pollutant emissions is one of the key focal points of the air quality group at TNO. The unit is and has been involved in numerous EU projects: NEU, EUCAARI, MEGAPOLI, GEOMON, MACC I & II, PASODOBLE, INTARESE, TRANSPHORM, ENERGEO, CARE4HEALTH, URGENCHE.

Key scientific personnel to be involved in the project

- Dr. **Martijn Schaap**: modelling concentration distributions and deposition fluxes over Europe
  [contribution to WP 7]
- Dr. **Roy Wichink Kruit**: modelling concentration distributions and deposition fluxes over Europe
  [contribution to WP7]

Recent relevant publications

Schaap, M., Otjes, R.P., Weijers, E.P. (2010), Illustrating the benefit of using hourly monitoring data on secondary inorganic aerosol and its precursors for model evaluation, Atmos. Chem. Phys. Discuss., 10, 12341-12370, 2010

Schaap, M., et al., (2004): Secondary inorganic aerosol simulations for Europe with special attention to nitrate, Atmos. Phys. Chem., 4, 857-874

Stern, R., Builtjes, P., Schaap, M., Timmermans R., Vautard, R.; Hodzic, A., Memmesheimer, M., Feldmann, H.; Renner, E., Wolke, R., Kerschbaumer, A. (2008): A model inter-comparison study focussing on episodes with elevated PM_{10} concentrations, *Atmos. Environ, 42, 4567-4588*

van Loon, M et al. (2007), Evaluation of long-term ozone simulations from seven regional air quality models and their ensemble average, Atmospheric Environment, 41 (10), 2083-2097

Wichink Kruit R.J., Van Pul W.A.J., Sauter F.J., Van den Broek M., Nemitz E., Sutton M.A., Krol M., Holtslag A.A.M., 2010. Modeling the surface-atmosphere exchange of ammonia. Atmospheric Environment 44, 945-957

Wichink Kruit R.J., Van Pul W.A.J., Otjes R.P., Hofschreuder P., Jacobs A.F.G., Holtslag A.A.M., 2007. Ammonia fluxes and derived canopy compensation points over non-fertilized agricultural grassland in the Netherlands using the new gradient ammonia-high accuracy-monitor (GRAHAM). Atmospheric Environment 41, 1275-1287.

B 2.3 Consortium as a whole

2.3.1. Structure of the Partnership

The ÉCLAIRE consortium consists of 39 Partners from 18 countries, including 13 EU member states, three countries associated to FP7 (Norway, Switzerland and Croatia) and two International Cooperation Partner countries (ICPC) (Russia, Ukraine). As shown by Fig. 2.2 the consortium covers the main geographical and socioeconomic areas of Europe.

As a large consortium, it is important that ÉCLAIRE clearly distinguishes the diverse roles of the different partners in the project according to the scale of their contribution and responsibilities. The complementary partnership is thus grouped as follows:

Steering Partners: These institutes represent the leading partners of ÉCLAIRE. They are involved in leading the major Science Components and Work Packages, as well as cross-cutting Tasks (WP21). To ensure the effective "conveyance of ideas/understanding", across the project these partners have key responsibilities in multiple Work Packages. The Principal Investigators (PIs) of these partner institutes form the ÉCLAIRE Executive Steering Group (Section B2.1) (Partners 1-5).

Core Partners: These institutes play a key supporting role in the leadership, management and delivery of ÉCLAIRE. Staff from each of these groups is involved in leading a Work Package or cross-cutting Task, or make a major contribution to several Work Packages, supporing the linking of ÉCLAIRE components (Partners 6-14).

Other Partners: Together with the Steering and Core partners, these institutes provide the additional contributions to research within ÉCLAIRE. These partners are responsible for substantial or smaller, more targeted research tasks, mainly focused on one or two of the ÉCLAIRE components (Partners 15-39).

In addition, to the funded consortium (the contractors), ÉCLAIRE will be open to applications to be considered as unfunded **Associate Partners** (Section B2.1.7). The inclusion of the groups accepted will allow a close engagement with other leading international research partners, as well as a further enhancement of the ERA.

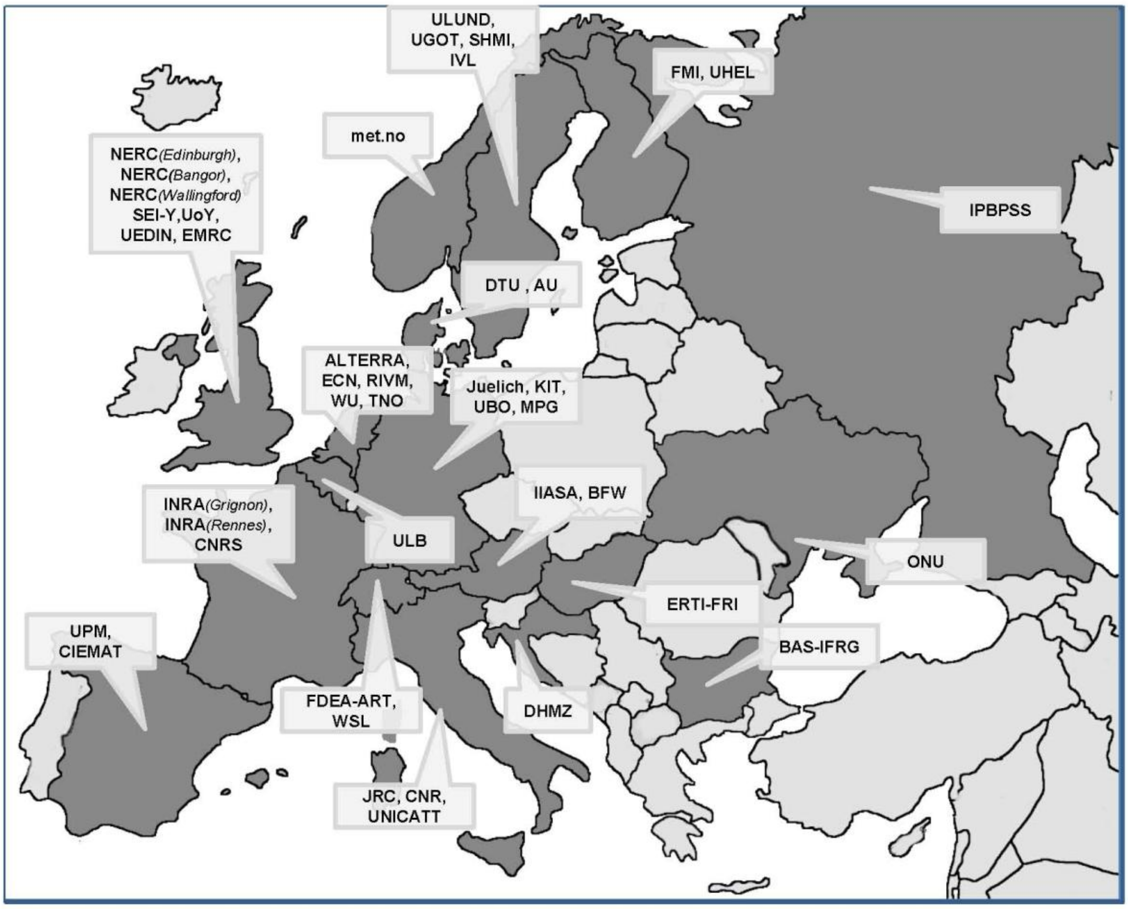

Fig. 2.2. Overview of ÉCLAIRE consortium partners and their geographic distribution.

The comparatively large number of partners reflects the expertise that is required to undertake the work programme and the benefits of including partners with complementary roles. Such a balanced consortium structure according the principles outlined above is essential to assemble all the knowledge, research facilities, models and experiences to do the research, as a basis to meet the expected impacts of the call (Section B3).

2.3.2. Complementarity of the partnership

Table 2.5 summarizes the contribution profiles of the different partners to ÉCLAIRE. These profiles demonstrate how the consortium collectively constitutes the leading European expertise in air pollution exchange and its impacts on land ecosystems and soils. The complementarity roles within the partnership reflects the respective contributions to the different Science Components and other WPs.

All organizations included in ÉCLAIRE are highly regarded internationally in their respective field. Collectively and uniquely, ÉCLAIRE integrates teams and scientists from a very broad range of research fields:

Soil science, microbiology, plant physiology, micrometeorology and environmental physics, atmospheric chemistry, atmospheric composition monitoring, earth observation, agricultural management, forest management, conservation management, global change dynamics, large scale ecosystem manipulation experiments, process-level ecological modelling, uncertainty analysis, atmospheric deposition modelling, landscape inventories, coupling of multi-component models, hydrological measurement and modelling, atmospheric dispersion modelling at local, regional and continental scales, analysis of landscape structure and buffering capacity, natural sources of air pollution, , scenario development and analysis, environmental and agricultural economics, emission inventory methodologies, QA/QC methodologies, integrated assessment modelling, economic valuation, cost-benefit analysis, data management including web-enabled databases, project management, advanced education and training and policy analysis of climate change and transboundary air pollution.

Together the consortium is therefore extremely well placed to implement the necessary multi-disciplinary approach to achieve the objectives of ÉCLAIRE.

2.3.3. Role of International Cooperation Partner Countries

The following International Cooperation Partner Countries (ICPC) countries Partners are included in ÉCLAIRE. In addition to the immediate scientific benefits, these partners add significantly to developing cooperation across the European Research Area (ERA):

Partner 21 (ONU): Odessa National University.

Role: to conduct biosphere atmosphere measurements of O_3 and other N and C trace gases over arable vegetation under extreme east European continental climatic conditions (WP1).

Benefit to ÉCLAIRE: these measurements substantially extend the climate space examined under the flux measurement network, allowing the contrast of croplands with NW France and the Po Valley of Italy. The partner ONU was specifically selected based on a successful contribution to the NitroEurope project, allowing ÉCLAIRE to further exploit and extend the investment already made in the Petrodolinskaya experimental field site. The ONU team will also have the benefit to ÉCLAIRE of accessing landcover/land management and other datasets for Ukraine to improve the overall Europe-wide upscaling.

Partner 33 (IPBPSS) Institute of Physico-chemical and Biological Problems in Soil Science

Role: to contribute to European scale modelling of ecosystem carbon dynamics in relation to atmospheric pollution under climate change (WP14).

Benefit to ÉCLAIRE: the modelling efforts of this team bring specific advantages with expertise in soil turnover processes related to carbon and trace gas exchange. The team will also bring access to landuse/land cover datasets for Russian conditions improving the ability fo ÉCLAIRE to provide the widest possible European upscaling.

2.3.4. Role of a Small / Medium sized Enterprise (SME)

Partner 34 (EMRC) is classed as an SME. They have been involved specifically for their unique expertise on valuation of air quality and ecosystem services, based on experience of conducting extensive work under the EU Clean Air For Europe (CAFÉ) programme and under the EC4MACS project of the LIFE programme. EMRC will play a key role in ÉCLAIRE leading WP18 on economic impacts and valuation of ecosystem services.

Table 2.5. ÉCLAIRE partners, country of origin and principal investigator (PI). Under Component and Work Package, **bold** indicates Component leader; ***Italics*** indicates WP leader. M/F: Male/Female ratio of team membership contributing to ÉCLAIRE.

		Partner acronym	**Partner full name**		**PI**	**Component & WPs**	**Complementary expertise for the ÉCLAIRE consortium**	**M/F of team**
Steering Parners	**1a**	NERC (Edinburg)	Natural Environment Research Council	UK	Mark Sutton	All including **C1**, ***WP21, WP22, WP24***	Land-atmosphere exchange, modelling, effects, policy analysis	4/3
	1b	NERC (Bangor)	Natural Environment Research Council	UK	Gina Mills	***C3***, C4, C5,	Air pollution effects, experiments, models	3/2
	1c	NERC (Walling)	Natural Environment Research Council	UK	Lina Mecardo	C4	Global modelling of ecosystem-atmos effects	0/1
	2	ULUND	Lunds Universitet	SE	Almut Arneth	C1, **C2**, C3, C4, WP21, WP24	Land-atmos exchange, BVOCs, models	0/1
	3	DTU	Danmarks Tekniske Universitet	DK	Claus Beier	**C3**, WP21, WP24	Ecosystem manipulation experiments	4/1
	4	ALTERRA	Stichting Dienst Landbouwkundig Onderzoek	NL	Wim de Vries	C2, C3, **C4**, C5, WP21, WP24	Process modelling and European upscaling with soil-vegn modelling	3/0
	5	IIASA	Internationales Institut Fuer Angewandte Systemanalyse	AT	Wilfried Winiwarter	C4, **C5**, WP21, WP24	Integrated assessment models, policy analysis	4/0
Core Partners	**6**	met.no	Meteorologisk Institutt	NO	David Simpson	***C2***, C4, C5	Atmospheric chemistry transport modelling	2/0
	7	Juelich	Forschungszentrum Juelich GmbH	DE	Thomas Mentel	***C1***, C2	Land-atmos exchange controlled facility	3/1
	8	ECN	Stichting Energieonderzoek Centrum Nederland	NL	Albert Bleeker	C1, ***C2***, C5	Land-atmos exchange, local models, policy	4/0
	9	CNR	Consiglio Nazionale Delle Ricerche	IT	Francesco Loreto	C1, ***C3***	Controlled plant-atmos exchange, VOCs	2/0
	10	KIT	Karlsruhe Institute of Technology, Inst. for Meteo. and Climate Research	DE	Klaus Butterbach-Bahl	***C1***, C2, C3	Biogeochemical emissions modelling soil NO_x, N_2O	2/0
	11	JRC	JRC - Joint Research Centre - European Commission	IT	Frank Dentener	C1, ***C2***, ***C4***, WP21	Land-atmos exchange, hemispheric O_3, atmos & ecosystem modelling	4/0
	12	SEI-Y, UoY	University of York	UK	Patrick Bueker	C1, ***C3***, C5, WP23	O_3 modelling, thresholds, ecosystem services	4/1
	13a	INRA (Gringnon)	Institut National de la Recherche Agronomique	FR	Benjamin Loubet	C1, C2	Land atmos fluxes, O_3, emission modelling	2/1

		Partner acronym	Partner full name		PI	Component & WPs	Complementary expertise for the ÉCLAIRE consortium	M/F of team
	13b	INRA (Rennes	Institut National de la Recherche Agronomique	FR	Chris Fléchard	***C1***	Deposition modelling, air chemistry monitoring	2/1
	14	RIVM	National Institute for Public Health and the Environment	NL	Jean-Paul Hettelingh	C3, C4, ***C5***	Critical loads and levels mapping, thresholds development	4/0
Other Partners	**15**	FDEA-ART	Eidgenoessisches Volkswirtschaftsdepartment	CH	Juerg Fuhrer	C1, C3, WP21	Ecosystem responses to O_3 and N fluxes	2/1
	16	UGOT	Goeteborgs Universitet	SE	Ludde Edgren	C1, C3	O_3 exchange modelling	1/0
	17	ERTI - FRI	Erdészeti Tudományos Intézet	HU	Laszlo Horvath	C1	Land-atmos exchange measurment (Puszta)	1/0
	18	FMI	Ilmatieteen Laitos	FI	Tuomas Laurila	C1	Land-atmos exchange measurement (Boreal)	2/0
	19	UHEL	Helsigin Yliopisto	FI	Janne Rinne	C1	Land-atmos exchange measurement (Boreal)	2/0
	20	UNICATT	Universita Cattolica Del Sacro Cuore	IT	Giacomo Gerosa	C1, C3	Ecosystem responses to O_3 and N fluxes	3/1
	21	ONU	Odessa National I.I. Mechnikov University	UKR	Vladimir Medinets	C1, C4	Land-atmos exchange measnt (continental)	3/0
	22	BOKU	University of Natural Resources and Applied Life Sciences, Vienn	AT	Sophie Zechmeister-Boltenstern	C1, C3, WP23	Soil and microbial processes leading to trace gas emissions, controlled facility	0/1
	23	UPM	Universidad Politecnica de Madrid	ES	Antonio Vallejo	C1, C2, ***C4***, ***WP23***	Emissions measurment & modelling, science communication	3/0
	24	CIEMAT	Centro de Investigactiones Energeticas, Medioambientales y Tecnologicas – CIEMAT	ES	Victoria Bermejo	C3	Ecosystem responses to O_3 and N fluxes	4/4
Other Partners	**25**	CNRS	Centre National de l Recherche Scientifique	FR	Didier Hauglustaine	C2	Global scale atmospheric chemistry modelling	1/1
	26	SMHI	Svergies Meteorologiska Och Hydrologiska Institut	SE	Magnuz Engardt	C2, WP21	Air Pollution Climate interactions modelling	2/1
	27	DHMZ	Drzavni Hidrometeroloski Zavod	HR	Sonja Vidic	C1	Air chem. monitoring, policy analysis	0/3
	28	UEDIN	The University of Edinburgh	UK	David Reay	C2, WP21, WP22, WP23	Regional atmospheric chemistry modelling, high resolution zooming	2/2

		Partner acronym	**Partner full name**		**PI**	**Component & WPs**	**Complementary expertise for the ÉCLAIRE consortium**	**M/F of team**
	29	UBO	Rheinische Friedrich-Wilhems -Universitaet Bonn	DE	Juergen Burkhardt	C3	Plant physiology, aerosol – drought interactions	1/0
	30	WSL	Eidgenoessische Forschungsanstalt WSL	CH	Matthias Dobbertin	C3	ICP Forests Level 2 database and analysis	1/0
	31	IVL	IVL Svenska Miljoeinstitutet AB	SE	Per_Erik Karlsson	C3, C5	Ozone flux modelling and forest services	2/0
	32	MPG	Max Planck Gesellschaft zur Foerderung der Wissenschaften E.V	DE	Sönke Zaehle	C4	Dynamic global biogeochemical modelling	1/0
	33	IPBPSS	Institute of Physico-chemical and Biological Problems in Soil Science	RU	Aleksander Komarow	C4	Soil processes and dynamic modelling; access to Russian data	2/2
	34	EMRC	Dr Michael Holland	UK	Michael Holland	***C5***	Economic valuation; ecosystem services	1/0
	35	AU	Aarhus Universitet	DK	Camilla Geels	C2, C5	Modelling climate dependence of emissions; valuation of ecosystems	4/1
	36	WU	Wageningen Universiteit	NL	Laurens Ganzeveld	C1, C2	Biosphere-atmosphere exchange modelling	1/0
	37	ULB	Universite Libre de Bruxelles	BE	Pierre-Francois Coheur	C1, C2	Earth Observation from satellites for NH_3, O_3, NO_2.	3/3
	38	BAS - IFRG	Bulgarian Academy of Sciences - Institute of Plant Physiology and Genetics	BU	Violeta Velikova	C1	VOC and O_3 plant exchange processes	1/0
	39	TNO	Nederlandse Organisatie Voor Toegepast Natuurwetenschappelijk Onderzoek	NL	Martijn Schaap	C2	Atmospheric chemistry and transport modelling at European scale	2/0

2.3.5. Third Parties

One partner (UNICATT) is working with a ‘Third Party’ (in this case FLA (Lombardy Foundation for the Environment) to deliver the project – in this case, only resources are being provided from FLA.

Open Top Chamber (OTC) Facilities

The use the OTC facility of Curno (CRINES) for manipulation experiments is required to deliver ÉCLAIRE results. CRINES is an infrastructure owned by a consortium headed by FLA (Lombardy Foundation for the Environment). FLA guarantees the technical management of the experimental site under all the points of view except the scientific research work which is done by the UNICATT personnel.

The budget for the use of the OTC facility is 10k€ per experimental season (total 20k€). This covers rental of equipment - 16 OTC with motors and filters, O_3 gas analysers, portable analytic instrumentation (e.g. porometers, fluorimeters etc.) datalogger, agrometerological probes etc. It also covers costs incurred through water and electrical consumption.UNICATT has multi-year experience of collaboration with FLA, with the services provided being cost-effective and fit for purpose. The specific costs of rental and utilities to the site, and the terms of the third party agreement between the beneficiary and the third party, will be documented and signed by the legal representatives at UNICATT. FLA is a non-profit research institution and does not apply any additional charge in excess of the running costs.

No other service providers are currently known who could provide a similar service in the case of either the tall tower facility, or the OTC site.

2.3.5. Other countries

No other countries apart from Associated Countries and International Partner Countries are applying for EC funds as part of ÉCLAIRE.

2.3.6. Additional partners:

At this stage of the proposal, the inclusion of additional funded partners is not foreseen, as the consortium covers all relevant expertise required to deliver the planned work. However, an unallocated budget (see B2.4) has been set aside to address contingencies emerging during the project runtime. Advice from the Stakeholder Advisory Board (SAB) on the direction of research and potential gaps in expertise will be sought throughout the project and the evolving results from the work conducted critically assessed in close collaboration with the EC Project Officer. This will ensure that, should the need arise to include additional partners, this will be addressed efficiently so that their integration into the consortium can be swiftly addressed.

B 2.4 Resources to be committed

2.4.1. Strategy for resource allocation

The overall resource allocation for ÉCLAIRE is summarized for C1-C5 and WPs21-24 in Table 2.6. At the highest level, an apportionment is made between measurement and modelling activities. Although the required modelling activities are more diverse (across C1-C5), substantial resources are needed for the measurements. C1 and C3 are therefore the largest components, amounting for 49% of the total budget (in which measurement tasks account for 45% of the EC budget to science components). In order to ensure effective coordination, cross-cutting integration and harmonization, significant resources are dedicated to WP21 (4%) and WP22 (7% as EC contribution). The resources to WP23 (training) and WP24 (networking and dissemination) are deliberately much smaller, as these represent 'seeding' activities to work in partnership with the use of other training, networking and dissemination instruments/activities (i.e., Marie Curie, COST, European Science Foundation, UNECE Task Forces, IPCC AR5 etc). The unallocated budget is a key tool for risk management and planning by the coordinator (see Section B2.4.3).

Table 2.6. Overall budget summary of ÉCLAIRE.

	EC Contrib. (k€)	Share of EC contrib. (%)	Total budget (k€)	Share of total (%)
C1 [WP1-4]	1,845	*26.37%*	*2,975*	*27.72%*
C2 [WP5-8]	975	*13.93%*	*1,574*	*14.67%*
C3 [WP9-13]	1,605	*22.94%*	*2,603*	*24.26%*
C4 [WP14-17]	875	*12.51%*	*1,313*	*12.24%*
C5 [WP18-20]	595	*8.50%*	*840*	*7.83%*
WP21	285	*4.07%*	*454*	*4.23%*
WP22	482	*6.89%*	*482*	*4.49%*
WP23	50	*0.0071459*	*50*	*0.47%*
WP24	50	*0.71%*	*50*	*0.47%*
Unalloc'd	**235**	*3.36%*	***390**	*3.63%*
Totals	**6,997**		**10,731**	

*based on 50% EC budget contribution for RTD and 100% contributon for other activities.

The resources allocated across ÉCLAIRE are matched to the tasks to be carried out by each partner in the WPs. Consistent with the structured approach to the partnership (Steering Partners, Core Partners Other Partners, Section B2.3.1), the partner budgets vary according to the number and size of the tasks to which they are committed. Hence Steering Partners are deliberately linked to multiple WPs, with the required resources to ensure conveyance of information effectively across the whole project. Conversely, the resources to Other Partners are focused on the specific tasks to which they contribute. The EC contribution to each partner is allocated according to the principle of 'fair rate for the task', taking into account the special situation of ICPC partners.

Detailed breakdowns of resource allocation are shown by WP in Table 2.7 and by cost category in Table 2.8. Table 2.7 highlights that the largest costs in both C1 and C3 are for field and controlled measurements (WPs 1, 2, 10, 11), while the largest resources for upscaling go to the comparitive application of different models for atmospheric transport and biogeochemical cycling to understand the climate interactions (WPs 7, 15). C5 is targeted on fewer activities, with one integrated assessment model (GAINS), and is therefore the smallest science component.

2.4.2. Multi-laboratory legal entities and local partnerships.

In considering the budget according to partner, it is important to recognize that some legal entities represent several institute partners, while some contributions are provided by different legal entities working in local partnership.

Two national organizations are included in ÉCLAIRE that represent legal entities including multiple laboratories, NERC and INRA (Partners 1, 13). To demonstrate the justification of resources, it is therefore essential to show the contributing laboratories

(NERC: Edinburgh, Bangor, Wallingford; INRA: Grignon, Rennes) separately in Tables 2.7 and 2.8.

Four local partnerships are included in ÉCLAIRE. IN the case of UNICATT (Partner 20) a ‘Third Party’ is used as this concerns technical inputs. By contrast, for Finland (Helsinki) and Spain (Madrid), the local partnerships will allow the research effort to be shared between laboratories, especially for shared use of field sites. This applies to partners 18 & 19 (FMI, UHEL) and 23 & 24 (UPM, CIEMAT). Although there is no legal connection between these institutes the local partnership will ensure that they can combine resources effectively.

2.4.3. Mobilization of the resources, including national co-funding, equipment and reserve budget

A subsantial effort has been placed in designing ÉCLAIRE to maximize benefits across the European Research Area (Section B3.1.2). In doing so, the Coodinator of ÉCLAIRE has successfully negotiated for 12 of the ÉCLAIRE partners to voluntarily contribute a larger amount of resources for RTD activities than the FP7 minimum. By applying the principles of ‘common programming’ to ÉCLAIRE, several of these partners have agreed to co-fund the RTD by 50% rather than 25% (see bottom of Table 2.7). In this way, an additional €1.6 million has been in drawn into support the common endeavor of ÉCLAIRE compared with full use of the standard 75% model. The lead taken in this regard by NERC is especially important to ensure strong coordination across the project. As shown in Table 2.9 ÉCLAIRE also mobilizes substantial durable equipment resources, amounting to €6.4 million.

A modest but important reserve budget is included in ÉCLAIRE to support effective management of the project. The indicative tasks are shown in Table 2.10, while managing the reserve as a whole will minimize risks.

2.4.4. Use of flat-rate costing, in the case of SME’s consisting of one person and where a salary is not being drawn.

EMRC (beneficiary 34), is an SME which employs only one person (Dr M Holland), Dr Holland does not draw a salary and is therefore required to use a flat-rate hourly costing, which depends upon his experience, the year of the project call and the country in which he is working. The hourly rate for Dr Holland is €67.39. The costs for Dr Holland on the project are therefore:

Flat-rate per hour €67.39
Total No. Hours 1,261
Total Person Months 8.3
Total Personnel Costs (i.e. direct costs only) €85,002

Table 2.7: Allocation of the ÉCLAIRE budget by Partner according to Work Package. The detailed values are shown as EC contribution, with the total budgets and national funding contributions shown at the bottom.

		Particpant number	1a	1b	1c	2	3	4	5	6	7	8	9	10	11	12	13a	13b	14	15
Component	Work Package	Topic	NERC (CEH Edinburgh)	NERC (CEH Bangor)	NERC (CEH Wallinford)	ULUND	DTU	ALTERRA	IIASA	met.no	Juelich	ECN	CNR	KIT	JRC	SEI-Y, UoY	INRA (Grignon)	INRA (Rennes)	RIVM	FDEA-ART
Component 1	WP1	Field Studies on exchange Processes	150								10	125	5	5	100		120			120
	WP2	Controlled studies on exchange processes	5								110		70	5						
	WP3	Modelling emission processes	10			40								50			5	30		
	WP4	Surface exchange modelling	25							10				0		40		85		
Component 2	WP5	Past & future changes of atmospheric pollutants transported into Europe				5				10				0	60					
	WP6	Emissions on regional, European to global scale	10			55		20						20						
	WP7	Modelling European air pollution & deposition				70				140	30			0	30					
	WP8	Assessing local & regional variation	10							10		80		10			45			
Component 3	WP9	Synthesis & meta-analysis of measur'nts on plant-soil responses	10	30			20	20								25				
	WP10	Ecosystem manipulation of air pollution - climate interactions		80			245													60
	WP11	Investigation of novel ecosystem - air pollution - climate interactions	95	25									95							
	WP12	Development & assessment of novel tresholds	20	20			10									80			10	
	WP13	Modelling C stocks, GHG and species change		80		25		55						40		60			10	
Component 4	WP14	Air pollution - climate impacts on European C stocks & GHG		30	80	80		90	10						60				30	
	WP15	Air - climate impacts on European biodiversity & soil quality		35				70											40	
	WP16	European maps of novel thresholds & exceedances						50	10	20									60	
	WP17	Local variation in threshold exceedance	20	15				40												
Component 5	WP18	Deriving econ. Impacts & valuation of ecosystem services		10					20							20			40	
	WP19	Integrating effects of air pollution under climate change						20	60	20									50	
	WP20	Implications for mitigation & adaptation strategies	20					10	150			40							10	
	WP21	Standards & data management	110			30	30	30	25						30					10
	WP22	Coordination & management	237					2												
	WP23	Training	32													2				
	WP24	Networking & dissemination	30			5	5	5	5											
		Total EC Contribution by Participant	***784***	***325***	***80***	***310***	***310***	***412***	***280***	***210***	***150***	***245***	***170***	***130***	***280***	***227***	***170***	***115***	***250***	***190***
		of which RTD	*485*	*325*	*80*	*305*	*305*	*405*	*275*	*210*	*150*	*245*	*170*	*130*	*280*	*225*	*170*	*115*	*250*	*190*
		of which MGT	*237*	*0*	*0*	*0*	*0*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		of which OTH	*62*	*0*	*0*	*5*	*5*	*5*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*2*	*0*	*0*	*0*	*0*
		Total Budget (EC plus National Co-funding)	***1,269***	***650***	***160***	***412***	***412***	***547***	***372***	***420***	***200***	***327***	***340***	***260***	***373***	***302***	***340***	***230***	***333***	***253***
		of which RTD	*970*	*650*	*160*	*407*	*407*	*540*	*367*	*420*	*200*	*327*	*340*	*260*	*373*	*300*	*340*	*230*	*333*	*253*
		of which MGT	*237*	*0*	*0*	*0*	*0*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		of which OTH	*62*	*0*	*0*	*5*	*5*	*5*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*2*	*0*	*0*	*0*	*0*
		National Contribution to RTD activities (kEuro)	*485*	*325*	*80*	*102*	*102*	*135*	*92*	*210*	*50*	*82*	*170*	*130*	*93*	*75*	*170*	*115*	*83*	*63*
		% national contribution to RTD activies	50%	50%	50%	25%	25%	25%	25%	50%	25%	25%	50%	50%	25%	25%	50%	50%	25%	25%

		Particpant number	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39		
Component	Work Package	Topic	UGOT	ERTI - FRI	FMI	UHEL	UNICATT	ONU	BOKU	UPM	CIEMAT	CNRS	SMHI	DHMZ	UEDIN	UBO	WSL	IVL	MPG	IPBPSS	EMRC	AU	WU	ULB	BAS - IFRG	TNO	Unallocated budget	**Total for all Partners**
Component 1	WP1	Field Studies on exchange Processes		80	40	90	80	50		30														10			55	**1,070**
	WP2	Controlled studies on exchange processes							100																40			**330**
	WP3	Modelling emission processes								25																		**160**
	WP4	Surface exchange modelling	30		50									50									50					**340**
Component 2	WP5	Past & future changes of atmospheric pollutants transported into Europe										60																**135**
	WP6	Emissions on regional, European to global scale										20			20							30						**175**
	WP7	Modelling European air pollution & deposition										30	50										20			40	20	**430**
	WP8	Assessing local & regional variation								10					50							10		30				**255**
Component 3	WP9	Synthesis & meta-analysis of measur'nts on plant-soil responses	25														45	20										**195**
	WP10	Ecosystem manipulation of air pollution - climate interactions					120				120																30	**655**
	WP11	Investigation of novel ecosystem - air pollution - climate interactions							30							70												**315**
	WP12	Development & assessment of novel tresholds	50															10										**200**
	WP13	Modelling C stocks, GHG and species change																										**270**
Component 4	WP14	Air pollution - climate impacts on European C stocks & GHG																	50	20							10	**450**
	WP15	Air - climate impacts on European biodiversity & soil quality																										**145**
	WP16	European maps of novel thresholds & exceedances						5												20								**165**
	WP17	Local variation in threshold exceedance								40																		**115**
Component 5	WP18	Deriving econ. Impacts & valuation of ecosystem services																25			80	20						**215**
	WP19	Integrating effects of air pollution under climate change																										**150**
	WP20	Implications for mitigation & adaptation strategies																									20	**230**
	WP21	Standards & data management											10		10												20	**305**
	WP22	Coordination & management													243												20	**482**
	WP23	Training							2	10					4												30	**50**
	WP24	Networking & dissemination																									30	**50**
		Total EC Contribution by Participant	***105***	***80***	***90***	***90***	***200***	***55***	***132***	***115***	***120***	***110***	***60***	***50***	***327***	***70***	***45***	***55***	***50***	***40***	***80***	***60***	***70***	***40***	***40***	***40***	***235***	**6,997**
		of which RTD	*105*	*80*	*90*	*90*	*200*	*55*	*130*	*105*	*120*	*110*	*60*	*50*	*80*	*70*	*45*	*55*	*50*	*40*	*80*	*60*	*70*	*40*	*40*	*40*	*155*	**6,335**
		of which MGT	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*243*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*20*	**502**
		of which OTH	*0*	*0*	*0*	*0*	*0*	*0*	*2*	*10*	*0*	*0*	*0*	*0*	*4*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*60*	**160**
		Total Budget (EC plus National Co-funding)	***186***	***107***	***120***	***120***	***267***	***73***	***262***	***185***	***240***	***220***	***81***	***100***	***354***	***93***	***60***	***73***	***67***	***53***	***107***	***120***	***93***	***53***	***53***	***53***	***390***	**10,731**
		of which RTD	*186*	*107*	*120*	*120*	*267*	*73*	*260*	*175*	*240*	*220*	*81*	*100*	*107*	*93*	*60*	*73*	*67*	*53*	*107*	*120*	*93*	*53*	*53*	*53*	*310*	**10,069**
		of which MGT	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*243*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*20*	**502**
		of which OTH	*0*	*0*	*0*	*0*	*0*	*0*	*2*	*10*	*0*	*0*	*0*	*0*	*4*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*60*	**160**
		National Contribution to RTD activities (kEuro)	*81*	*27*	*30*	*30*	*67*	*18*	*130*	*70*	*120*	*110*	*21*	*50*	*27*	*23*	*15*	*18*	*17*	*13*	*27*	*60*	*23*	*13*	*13*	*13*	***155***	**3,734**
		% national contribution to RTD activies	44%	25%	25%	25%	25%	25%	50%	40%	50%	50%	26%	50%	25%	25%	25%	25%	25%	25%	25%	50%	25%	25%	25%	25%	50%	37%

Table 2.8: Allocation of the ÉCLAIRE budget according to EC contribution by participant and cost type. Funding for RTD activities is requested at 50-75% and for Management and other activites at 100% .

		Staff Costs (personnel costs)	Subcontract	Travel and subsistance	Equipment	Durable Equipment	Overheads	Staff Costs (personnel costs)	Subcontract	Travel and subsistance	Other (audit)	Equipment	Durable Equipment	Overheads	Staff Costs (personnel costs)	Subcontract	Travel and subsistance	Equipment	Durable Equipment	Overheads	
1a	**NERC** *(CEH Edinburgh)*	198		27	27		233	85		46	5			101	16		28			18	**784**
1b	**NERC** *(CEH Bangor)*	137		26			162														**325**
1c	**NERC** *(CEH Wallingford)*	33		7			39														**80**
2	**ULUND**	180		8	3		114										3			2	**310**
3	**DTU**	151		15	25		114														**310**
4	**ALTERRA**	231		19			155				2				3					2	**412**
5	**IIASA**	170		7			98								3					2	**280**
6	**met.no**	98		15			98														**210**
7	**Juelich**	64		25			61														**150**
8	**ECN**	127		16	8		95														**245**
9	**CNR**	93		4			73														**170**
10	**KIT**	77		4			49														**130**
11	**JRC**	164		11			105														**280**
12	**SEI-Y, UoY**	127		11	3		84								1					1	**227**
13a	**INRA (***Grignon*	90			16		64														**170**
13b	**INRA** *(Rennes)*	72					43														**115**
14	**RIVM**	127		3			120														**250**
15	**FDEA-ART**	109		10			71														**190**
16	**UGOT**	56		9	1		39														**105**
17	**ERTI - FRI**	28		9	15	15	13														**80**
18	**FMI**	44		8			39														**90**
19	**UHEL**	34		18	4		34														**90**
20	**UNICATT**	83		7	35		75														**200**
21	**ONU**	28		4	2		21														**55**
22	**BOKU**	68		3	10		49								0.6		0.5			0.5	**132**
23	**UPM**	51		5	5		44								5					5	**115**
24	**CIEMAT**	38		7	26	7	42														**120**
25	**CNRS**	61		6	2		41														**110**
26	**SMHI**	26		8			26														**60**
27	**DHMZ**	16		9	6		19														**50**
28	**UEDIN**	41					39	126						117	2					2	**327**
29	**UBO**	34		3	7		26														**70**
30	**WSL**	25		3			17														**45**
31	**IVL**	25		6			24														**55**
32	**MPG**	20		2			28														**50**
33	**IPBPSS**	13		20			7														**40**
34	**EMRC**	64		3			13														**80**
35	**AU**	28		10			23														**60**
36	**WU**	38		4			29														**70**
37	**ULB**	15		5	5		15														**40**
38	**BAS - IFRG**	10		4	19		8														**40**
39	**TNO**	13		4			23														**40**
Unallocated budget																					**235**
Total EC Contribution																					**6,997**

Table 2.9. Value of existing and requested durable equipment used for the project.

	Total Value [€]			
Item description	**Count**	**Provided**	**Count**	**Requested**[b]
Field equipment				
CO_2/H_2O Eddy-covariance flux systems and micromet eqt.	9	207,000		
Fast response eddy-covariance O_3 systems	8	160,000	1	15,000[c]
NO soil flux systems based on auto chambers	6	210,000		
Chemical Ionisation MS (PTR-MS / eTR-MS) for VOCs / NH_3	6	1,080,000		
Continuous analysers for HNO_3 acid gases and aerosols - (GRAEGOR, Aerosol Mass Spectrometer)	6	674,000		
Continuous NH_3 analysers (e.g. AMANDA, GRAHAM)	4	240,000		
Gas analysers for NO, NO_2, O_3 (incl. gradient & EC)	9	270,000		
Flux tower installations with meteorological sensors	9	270,000		
Laboratory equipment & facilities				
GC systems for lab analysis of VOCs/CH_4/N_2O	5	42,000		
Soil exchange system at BOKU & KIT	2	210,000		
Phytotron / smog chamber installations at Juelich and CNR	2	760,000		
Continuous analysis systems for NH_3/NH_4^+ (e.g. AMFIA)	1	20,000		
Equipment for process and bio-assay analysis - (inc. isotope gas exchange)	5	190,000		
Large-scale facilities				
Super computers (% usage)	8	320,000		
Manipulation site installations	6	1,720,000	1	14,000[d]
Total		**6,373,000**		**29,000**

[a] Items provided for use in the project for which funds are NOT requested from the European Commission. The estimated values are reduced pro-rata where items are only used a small % of the time on ÉCLAIRE. Only items with unit costs exceeding €10,000 are included.

[b] Items for which funding is requested from the European Commission through ÉCLAIRE, where the partner funding request for durable equipment to the Commission exceeds €10,000.

[c] Fast response O_3 eddy covariance system for Bugac field site, HU.

[d] Additional instrumentation for the open top chamber experimental facility, CIEMAT, ES.

Table 2.10: Provisional allocation of the project reserve budget. This budget is initially retained by the project coordinator for dissemination to partners and or external organizations during the life of the project.

Component and WPs	**Activity description**	**Funds for allocation in k€ EC contribution**	**Provisional allocation of the reserve budget**
C1 (WPs14)	Emissions & exchange processes	55	Contingency for field experiments, including external involvement in joint Po Valley campaign with PEGASOS
C2 (WPs 5-8)	Emissions & exchange at local, EU to global scales	20	Contingency on policy led scenarios (depending on scenario complexity following stakeholder requests from the CLRTAP , e.g. EMEP Steering Body, WGSR).
C3 (WPs 9-13)	Ecological response processes & thresholds	30	Contingency on controlled field experiments, including supporting additional plant soil measurements to meet emerging needs.
C4 (WPs 14-17)	Ecological responses at regional & European scales	10	Contingency on additional emerging datasets (e.g. to increase European representativeness in non-EU countries) and to handle policy led scenarios.
C5 (WPs 18-20)	Integrated risk analysis & policy tools	20	Contingency on additional policy led scenarios (e.g. following stakeholder request from CLRTAP).
WP21	Standards & Data Management	20	Overall data management, including option to prepare additional database interrogation/visualization features
WP22	Coordination & Management	20	Reserve budget for supporting SAB members to attend annual General Assemblies and Science Conferences
WP23	Training	30	Reserve budget for junior scientists among ÉCLAIRE partners to attend trainging and science communication workshops.
WP24	Networking & Dissemination	30	Reserve budget for additional dissemination activities including response to emerging stakeholder requests
Total		**235**	

B 3. POTENTIAL IMPACT

B 3.1 Strategic impact

ÉCLAIRE is highly relevant to at least three of the societal 'grand challenges' identified by the European Commission, for which the following overall impacts can be expected:

- ***Climate change:*** ÉCLAIRE will provide a first Europe-wide quantification of how climate change is altering the threat of air pollution on ecosystems and soils, and how, in return, pollutant impacts on ecosystems affect terrestrial C stocks, including the potential for feedbacks, providing direct support for the next generation of more integrated air pollution – climate policies.
- ***Food Security:*** ÉCLAIRE will provide an improved quantification of how air pollutants affect crop yields, especially considering the way in which climate change may alter the extent of crop loss across Europe due to tropospheric O_3. At the same time, it will show how agricultural NH_3 emissions can expect to alter under climate change, exacerbating this major loss of fertilizer nitrogen.
- ***Energy Security:*** ÉCLAIRE will provide information on how climate change will alter the net effect of air pollutants on forest carbon sequestration, with implications for wood and bioenergy production. It will integrate, among others, the roles of N fertilization from atmospheric deposition (from NH_3 and NO_x), the phytotoxic growth inhibition effect of O_3 (from NO_x and VOCs) and the diffuse radiation stimulatory effect of atmospheric aerosol (from NO_x, NH_3, VOCs and SO_2).

In addition, although not directly a focus of this call, a close interaction can be expected with the fourth grand challenge of *human health*, via the respiratory effects of the same air pollutants. For this, the outcomes of ÉCLAIRE, which are focused on land ecosystems and soils, will be linked with health issues through the integrated assessment modelling (WP19) and implications for mitigation and adaptation strategies (WP20) based on links to EC4MACs, PEGASOS and other projects. Given the scale of these challenges, and their close interlinkages, it is evident that a major Europe-wide approach is needed to tackle the issue and provide robust advice to support EU policies.

B 3.1 Expected impacts listed in the work programme

ÉCLAIRE addresses all three impact areas highlighted in the work programme including: a) *knowledge generation*, b) institutional development *strengthening the European Research Area*, and, c) the integration of information for the development of *future European policies*.

B 3.1.1 Impacts through knowledge generation

The main knowledge-based impact expected from this call (ENV.2011.1.1.2.1) is "*quantification of the impact of atmospheric pollution under changing climate conditions on European land ecosystems*". Although the role of tropospheric O_3 is particularly highlighted in the call text, it is evident that, to achieve this wider impact, each of the main pollutants affecting land ecosystems must be considered, including their wet and dry deposition and other effects such as light scattering by secondary aerosol.

The question of how air pollution effects will be altered under a changing climate implies a main focus on *present to future conditions* including a central role for future scenarios. At the same time, since SO_2 concentrations have substantially decreased over past decades, the future perspective for European air pollution impacts on ecosystems clearly focuses on O_3 and its precursors (especially due to the increasing hemispheric background) and reactive N, including both NO_x and NH_3 emissions (which have only seen modest net reductions in Europe, especially NH_3).

To achieve the necessary impact, a full analysis of the emissions of each of the pollutantsemissions affecting O_3 and N is therefore needed, focusing on NO_x, VOCs and NH_3, while including SO_2 where necessary for completeness. Among these pollutants, NH_3 most typically rather neglected in regional air pollution analyses. However, *the need to generate knowledge on the emissions and fate of NH_3 emissions is absolutely essential* to ensure the desired project impact since:

- Reduced nitrogen (NH_x) is already the dominant form of N deposition input to semi-natural and forest habitats: This is because it is emitted from agricultural land, therefore preferentially concentrates its deposition to semi-natural and forest land (Sutton et al., 2009b)
- Expected reductions in NO_x emissions over the next century (Representative Concentration Pathway (RCP) scenarios) suggest that NH_3 will become the dominant form of European N_r emission, with its contribution increasing from ~50% to ~75% between 2000 and 2050 (Winiwarter et al. 2011)
- Emissions of NH_3 are strongly climate sensitive (theoretical emission potentials double every 5 ºC, Flechard et al. 2010), so that NH_3 emissions may increase further than the RCP estimates, which do not account for temperature effect.

In addition, although the effects of aerosol are most usually considered in relation to human health impacts, atmospheric visibility and global dimming (which are beyond the scope of this call), the light scattering effect of aerosol increasing in diffuse radiation can increase photosynthesis (Mecardo et al. 2009) making it essential to include this effect in the overall assessment of ÉCLAIRE.

The scope of impacts to be considered under this call particularly highlights the role of air pollutants on carbon balances (biomass including soil organic matter). Nevertheless, it is evident that, to achieve the expected impact, each of the major interactions with greenhouse gases and species composition should be integrated, in order to see the net effect on global warming potential of future scenarios and policy options. Consideration of plant community composition change is essential, both because the effects of air pollutants in altering plant communities interact with net carbon stocks, and because of the need to assess the overall consequences on ecosystem services. Only by combining these issues does it become possible to address the overall economic implications of the future risks.

Altogether, the above arguments require that the following pollutants and issues are included in the work programme of ÉCLAIRE in order to ensure that it has the required scientific and policy impact:

1. Effects of NO_x and VOC emissions on formation of *tropospheric O_3*, as affected by climate, and its impacts on crop yields and carbon balance (including soil carbon stocks) for agricultrual, semi-natural and forest ecosystems;
2. Effects of NO_x and NH_3 emissions, as affected by climate, on *N_r concentrations and deposition*, and the vulnerability of semi-natural ecosystems and forests, on community composition and above/below ground carbon stocks.
3. Effects of NO_x, NH_3 and VOC emissions, as affected by climate, on aerosol formation and the consequence of *light-scattering effects on diffuse radiation*, photosynthesis rates and carbon stocks.
4. The major interactions of each of the above with other greenhouse gases (especially N_2O, but also CH_4 in the case of wetlands) in order to consider the overall effect on global warming potential, which is necessary for correct policy underpinning.

5. The context of the above effects in a future Europe where further declines in SO_2 emissions are projected according to planned revision of the Gothenburg Protocol and NEC Directive.

By addressing each of these issues in an interlinked way, including assessment of the interactions with enhanced CO_2 concentrations, ÉCLAIRE will be uniquely able to meet the expected impact of the call.

To do this represents a major challenge that can only be addressed by a broad consortium of European researchers, including a large number of teams especially to support a) different science process contributions, b) different measurement and modelling approaches and c) wide integration over a broad range of European climate–space. It will also require that ÉCLAIRE draws strongly on available information from previous EU projects and other programmes. For example, while the main interactions with greenhouse gases must be included to provide the net effect on global warming potential, many of the greenhouse gas interactions have already been the subject of intensive research by the NitroEurope IP and GHG Europe projects. This will allow ÉCLAIRE to draw on these results and focus more effectively on the key new measurements.

The research call also targets the expected impact: *"Support to EU policies through reliable and innovative ozone and other air pollutant risk assessment methodologies.*" While the link to EU policies is considered under Section B3.1.3, this aspect of knowledge generation highlights substantial challenges to be addressed by ÉCLAIRE. As outlined in the progress beyond state-of-the-art (Section B1.2), several air pollutant risk assessment methodologies have been developed for widespread use over the last two decades, including the application of critical levels for O_3, NH_3 and NO_x and critical loads for the nutrient and acidifying effects of N deposition. However, the present state-of-the-art takes insufficient account of the potential sensitivity of thresholds or dose-responses to future climate change and pollutant interactions.

In order to ensure maximum impact, a range of approaches will be deployed in ÉCLAIRE to advance these risk assessment methods. Novel approaches will include the use of both empirical outcomes from experimental studies including the effects of pollutant mixtures (WPs 9, 11) and the development of dynamic models including climate, pollution and plant/soil interactions. For example in the case of O_3, the work will advance the DO_3SE modelling approach to include a more process-based photosynthesis model able to handle future climatic conditions. However, to reach the expected impact, the novel approaches in ÉCLAIRE must go beyond threshold setting, and also seek to deliver improved dose-response relationships, underpinned by both the experimental studies and the dynamic models.

In regard of *innovative risk assessment methodologies* for the other pollutants, several further challenges are identified by ÉCLAIRE in order to meet the intended impact. The first is to note that climate change is likely to alter the apportionment between wet and dry N deposition in many locations, as well as the relative contributions of oxidized and reduced N deposition. For this purpose, a unique long-term experiment of NERC (EDI) is included. This will build on existing measurement of plant species changes to consider the effects of wet/dry NH_x/NO_y deposition on carbon storage, feedbacks to trace gas fluxes and the role of N in altering O_3 sensitivity (WP11). Further novel issues are the extent to which hygroscopic aersosol deposition (which will alter under climate change) may itself affect plant drought stress, which will be tested for the first time, and the effects of BVOCs (which may increase under climate change) in inducing plant self protection to O_3 damage.

Together, the results of these three Special Topic experiments in WP11 will complement the 8-site experimental effects network focusing on O_3 and N (and in some cases CO_2) interactions (WP10) to extend the impact of ÉCLAIRE in considering novel mechanisms, including thresholds, by which climate may alter air pollution threats. While the Special Topic experiments advance fundamental understanding with long-term impact (especially for FP8 and beyond), the multi-site effects network will ensure robustness of the improved risk assessment methodologies by allowing comparison over four ecosystem types for each of two climate regimes. Such an approach requires that ÉCLAIRE builds on existing infrastructures across Europe. This strategy is essential to ensure the expected impact of achieving *reliable risk assessment*, since experiments focused on single sites will always be at risk of not being representative across the wide range of European conditions. Thus, the combination of a core multi-site network, supported by single-site Special Topics and process level modelling provides a strong approach to combine robustness and novelty in the overall outcomes. This approach also balances the risks of ÉCLAIRE (Section B1.3), including a combination of low and high risk activities to maximize the overall project impact.While the expected impact of the call text and the above paragraphs emphasizes the final targets on pollution effects and risk assessment methodologies, it is equally clear that climate change will alter air pollution impacts both through modifying ecosystem vulnerability and by altering the overall magnitude of emissions, atmospheric residence times and deposition. For this reason, *it is absolutely essential for ÉCLAIRE to meet its intended impact, that the work integrates both the climate sensitivity to emissions/transport/deposition and the climate sensitivity to ecosystem vulnerability (thresholds, dose-response)*. Were the project to focus on either of these aspects, a misleading overall picture could emerge, either over- or under-estimating the net effect of climate change on air pollution impacts.

Considering each of these interactions, Figure 3.1 summarizes the pathway of knowledge use and knowledge generation within ÉCLAIRE, highlighting the steps needed to achieve the expected impact.

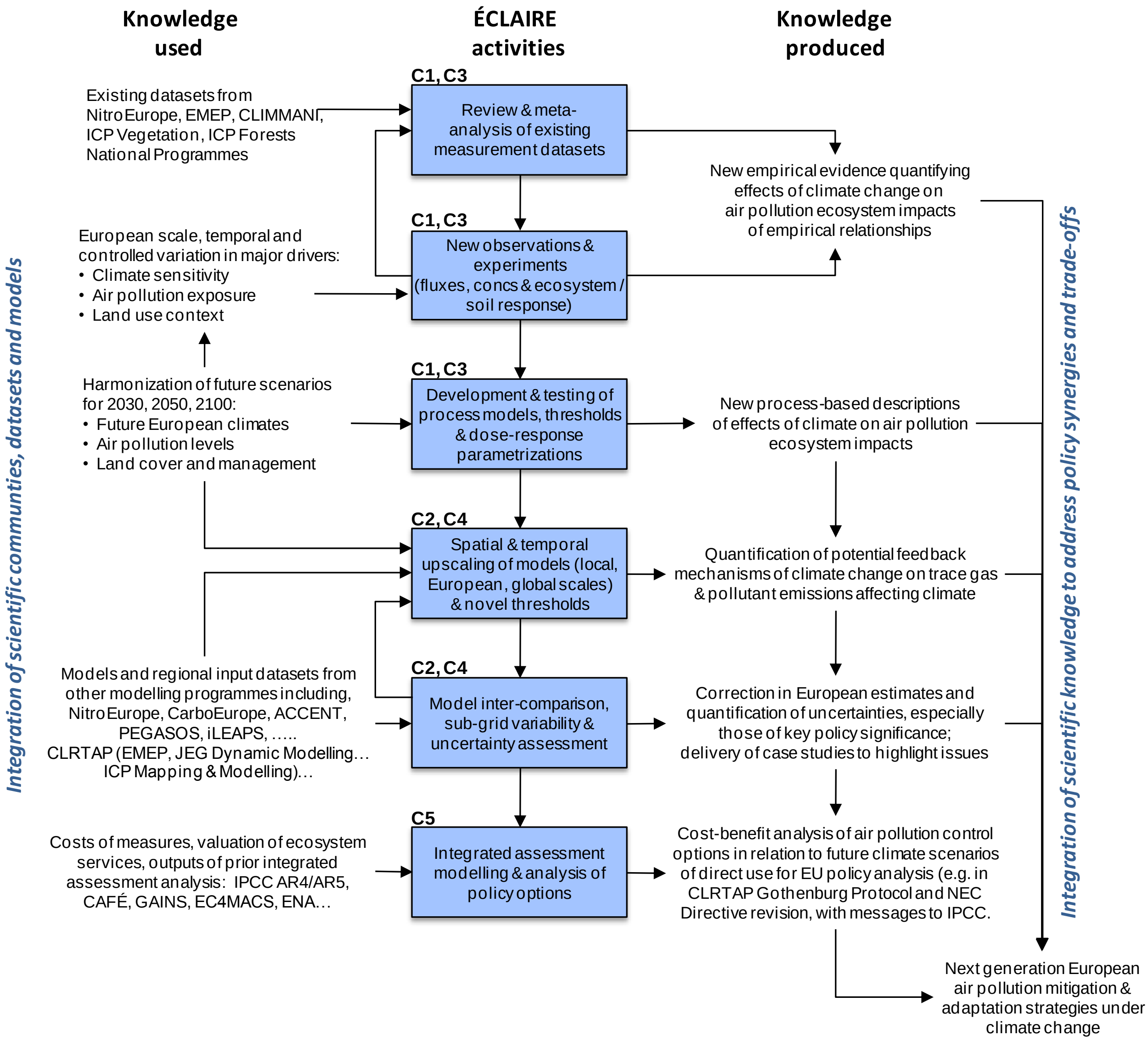

Figure 3.1: Summary of the impact of ÉCLAIRE hightlighting the pathway of knowledge use and generation. The main science components (C1-C5) are shown according to Figs 1.1 and 1.6. In order to simplify the knowledge pathway shown here issues related to air pollutant fluxes, concentrations and ecosystem effects are combined.

Figure 3.1 covers the full chain from incorporation of existing datasets, through field and laboratory measurements to the development and testing of process models. These are then upscaled through multiple scales, including consideration of the interactions, feedbacks and uncertainties as a basis to inform the integrated assessment modelling needed for the overall policy analysis. On the left of the figure *knowledge inputs* to ÉCLAIRE highlight the integration of different communities and datasets, while on the right, *knowledge generated* by ÉCLAIRE highlights the integration vital to address the policy interactions.

3.1.2. Institutional impacts including strengthening the ERA

From the sections describing the overall consortium (Section B2.3), it is clear that ÉCLAIRE represents a major endeavour that will contribute substantially to strengthening the European Research Area (ERA). Based on the target impacts and importance for European environmental policies, it is absolutely vital that a broad approach is taken to this project, that links each of the issues, pollutants and approaches outlined above.

Integration of science communities. Scientifically, ÉCLAIRE will have a major impact in integrating scientific communities, which have previously operated rather separately:

- Biosphere-atmosphere exchange measurement and modelling communities;
- Global, regional and local atmospheric emission, dispersion and deposition modelling communities;
- Research communities assessing the ecosystem and soil effects of ozone, nitrogen, aerosol and CO_2;
- Dynamic Global Vegetation Modelling (DGVM) and Dyanmic Soil Vegetation Modelling (DSVM) modelling communities, linking these with Chemistry Transport Modelling (CTM);
- Ecosystem-climate and ecosystem-pollution related research communities, including those traditionally linked to IPCC and the Framework Convention on Climate Change (FCCC) with those closely linked to the CLRTAP;
- Economic and integrated assessment communities with experimentalists and process modellers.

Integration across each of these domains for the first time in ÉCLAIRE can be expected to have substantial benefits for the project impact, both cross fertilizing different scientific perspectives and building new links across the European Research Area. These impacts will emerge naturally during the life as the project as the conventional thinking of the different science communities is mutually challenged by the other perspectives.

Critical mass across the European Research Area. The broad appoach of ÉCLAIRE will also ensure that it maximizes the potential *impact at the European scale*. In order to cover the different issues and perspectives that need to be addressed requires a large consortium of many partners. This has the advantage to provide broad representation both in the measurements across European climate-space and in integrating Partners from many different European countries. Overall, 18 countries (13 EU countries plus Norway, Switzerland, Croatia, Russia and Ukraine) are represented in ÉCLAIRE (Fig. 2.1), covering all major biogeographical and socioecononic areas. An important element is the inclusion of southern and south east Europe in the consortium, which will add significantly both to the scientific expertise and regional representativeness. This includes key partners from Spain (UPM, CIEMAT), Italy (CNR), Croatia (HMSC) and Bulgaria (BAS-IFRG). In addition, in order to extend the wider impact of ÉCLAIRE, two eastern European partners are included from Russia (IPBPSS) and Ukraine (ONU). As well as providing key inputs to extend the European representativeness (access and processing of East European spatial datasets, flux measurements under eastern Steppe climate), inclusion of these partners from International Cooperation Partner Countries (ICPC) supports the role of ÉCLAIRE in developing the European Research Area.

It is important to recognize the associated risk in maximizing the impact at a European scale, as this increases the project management complexity and reduces the EC resources to be allocated to each partner. These risks are addressed in two main ways to ensure maximum impact of ÉCLAIRE across the ERA. The first is the establishment of a strong central coordination team (Section B2), with an effective project design based on five main components components. This approach has already been used with great success in NitroEurope IP (64 partner institutes) and has been shown to operate extremely smoothly. Linked to this, a clear structure is included in the partner roles, clearly distinguishing partners with major roles, including cross-cutting actions in different Components (Core Partners), while providing space to include partners with smaller roles specific to individual Work Packages and Tasks according to expertise. This approach has the great advantage to maximize European involvement in key issues, while ensuring a strong project core.

Principles of Common Progamming. The second approach to manage risk and maximize the impact of the EC resources dedicated to ÉCLAIRE is to include an element of 'common programming'. At present, the European Union research funding landscape is seeing several changes that move in opposite directions. Compared with previous Framework Programmes over the past 20 years, many partners are now eligible under FP7 for 75% funding rather than 50% funding contribution to the research activities. By this approach, a smaller contribution of national research activities is formally drawn into FP7 research activities. By contrast, European Union research now includes other tools including ERANET activities and Joint Programming initiatives which use a small amount of 'seed' funding to draw in research funds from Member States and Associated Countries in order to strengthen the European Research Area.

Regognizing these counter-currents, ÉCLAIRE will maximize its impact by including the principles of common programming as far as possible into its work. For this purpose, *the ÉCLAIRE coordinator has negotiated with several of the partners voluntarily to contribute a full 50% cofunding to the research activities.* Although it is not feasible for all partners to adopt this approach, the voluntary 50% model (including other options with less than 75% EC funding) has been agreed by several ÉCLAIRE partners including NERC (UK), met.no (NO), CNR (IT), KIT (DE), INRA (FR), UGOT (SE), BOKU (AT), UPM (ES), CIEMAT (ES), CNRS (FR), HMSC (HR), AU (DK). This this has a major advantage in drawing in substantial additional funds into the ÉCLAIRE programme, demonstrating a commitment to collaborate effectively to meet the project goals. *Overall, as a result of implementing this policy, an extra €1.6 million of national funds will be formally committed to the ÉCLAIRE* budget compared with full use of the 75% maximum funding for RTD activities based on FP7 rules, providing a significant boost to maximize the project impact.

In addition to this formal commitment, ÉCLAIRE will bring many informal co-benefits, through equipment, infrastructure and accesss to other projects which are not officially recognized in the project co-funding. Through both these formal and informal contributions, ÉCLAIRE will combine the core EC funding with a strong networking approach that maximizes its impact at both European and global levels.

Durable integration of research partners and facilities. One of the aims of the European Research Area is to develop durable integration of European research partnerships, with the long-term benefit of increasing European cohesiveness and competitiveness. ÉCLAIRE contributes both by forming new partnerships (between insitutes and research domains), which have not previously worked together, and by building on and extending existing partnerships. ÉCLAIRE thus builds on the success of many previous EU projects over successive Framework Programmes and other networking initiatives, extending from actions such as EUROTRAC, BIATEX, GENEMIS, LOOP in the 1990s to more recent major collaborations including NOFRETETE, GREENGRASS, NitroEurope IP, CarboEurope IP, ACCENT NoE, ICP Vegetation, ICP Forests, and the ESF programmes Nitrogen in Europe and VOCBAS. In addition, it may be noted that the coordinating partner (NERC) is strongly engaged in the Partnership for European Environmental Research (PEER) network (together with JRC, ALTERRA and AU) which represents a long-term activity developing durable integration of Europe's leading environmental research institutes.

3.1.3. Provision of information to improve the integration of European policies

As the information path of Fig. 3.1 highlights, ÉCLAIRE is specifically targeted provide information that can directly support the further integration of European policies. In particular, until now, climate and air pollution policies have remained distinct domains, but recent efforts (Pleijel, 2009) have focused on strengthening the links in order to develop more holistic policies that emphasize the co-benefits and minimize inter-pollutant and inter-issue trade-offs.

Impact on policies via the Convention on Long-range Transboundary Air Pollution and NEC Directive.

Fundamental to making advances in the integration of European air pollution and climate policies will be a better knowledge foundation of how projected climate change alters air pollution threats to land ecosystems. It was these threats that primarily drove the signing of the UNECE Gothenburg Protocol and the adoption of the EU National Emissions Ceilings (NEC) Directive (both in 1999), and these continue to be central to the current ongoing revision of the UNECE Gothenburg Protocol. In current negotiations under the Working Group on Strategies and Review (WGSR, see Fig. 3.2), delegations have made it clear that they have a clear preference for future strategy optimization to remain closely linked to environmental impacts (rather than approaches based on equity sharing or 'gap-closure' progress toward emission targets) (UNECE, 2010b). This position highlights the ongoing importance of improving procedures for calculation of robust thresholds, including those that make the link to dose-response relationships. Under the context of climate change with the long term strategy after 2020 (i.e. 2030, 2050 and beyond), it becomes increasingly evident that the thresholds and dose-response relationships, as well as the modelling of air pollutant emissions, transport and deposition, must take account of the climate dependences (UNECE, 2010a).

The work to be conducted under ÉCLAIRE is thus of central importance to the future underpinning work within the CLRTAP, of which the European Union is a Party, as well as to the parallel work to revise the NEC Directive.

Considering the whole information chain summarized in Fig. 3.1, ÉCLAIRE will have multiple impacts across the whole of the CLRTAP. The ÉCLAIRE consortium is extremely well placed to maximize the achievement of these objectives many members contribute in close partnership and in leading positions within the work of the convention (see Figure 3.1). The following elements will be central to achieving the expected impact:

Mills and Harmens (NERC (BAN), UK): Head of the Programme Centre of and Chair of the Task Force, respectively, of the International Cooperative Programme on Vegetation.

Benefit for ÉCLAIRE: Access to pan-European ICP datasets on ozone impacts on crops and semi natural vegetation.

Impact from ÉCLAIRE: Rapid uptake and incorporation of the results into revision of the UNECE manual for mapping air pollution effects on ecosystems (e.g., Mills et al., 2007).

De Vries (ALTERRA, NL): Expert to the International Cooperative Programme Task force on Mapping and Modelling.

Benefit for ÉCLAIRE: Access to other datasets and modelling approaches, including datasets for mapping outside of the EU and other critical loads, levels and dynamic modelling approaches.

Impact from ÉCLAIRE: Contribution to preparing a new chapter on in the UNECE manual for mapping air pollution effects on ecosystems to take account of the climate dependencies.

Dobbertin (WSL, CH): Expert contributing to the Task Force of the International Cooperative Programme on Forests.

Benefit for ÉCLAIRE: Access to pan-European level 2 forests database to be exploited specifically in ÉCLAIRE to investigate relationships between growth and tree development linked to ozone, nitrogen deposition and climate interaction (WP9).

Impact from ÉCLAIRE: Immediate application of the results back into the ICP Forest Task Force.

Hettelingh (RIVM, NL): Head of the Coordination Centre for Effects (CCE).

Benefit for ÉCLAIRE: Immediate synergy with the CCE programme on developing thresholds and dose response relationships for mapping across Europe.

Impact from ÉCLAIRE: The work in developing (WP12) and Europe-wide mapping (WP16) to take account of interactions with climate change will be automatically incorporated and widely disseminated across the CLRTAP programme.

Vidic (HMSC, Croatia): Chair of the EMEP Steering Body.

Benefit for ÉCLAIRE: Fast access the latest negotiations on atmospheric modelling and measurements within the CLRTAP, including feedback from the Convention Executive Body.

Impact from ÉCLAIRE: New approaches to assess the climate dependence of European scale air pollution transport, including implications for future modelling, assessment and air monitoring requirements.

Reis (NERC (EDI), UK): Expert to the Task Force on Emissions Inventories and Projections.

Benefit for ÉCLAIRE: Access the latest agreed positions on emissions calculations, including those from combustion and other anthropogenic sources and to future air pollution emission scenarios.

Impact from ÉCLAIRE: Rapid incorporation of lessons learned in accounting for climate dependence of biogenic and agricultural emissions (NO_x, NH_3, VOCs) for wide application by other Parties, and on outcomes of ÉCLAIRE efforts toward harmonization of scenarios for climate, air emissions and landuse.

Fagerli and Simpson (met.no, NO): Head of the Meteorological Synthesizing Centre West of EMEP and expert contributing to the Task Force on Measurement and Modelling.

Benefit for ÉCLAIRE: Access to leading expertise in the development and application of the EMEP model, the official air pollution model of the Convention on which the Gothenburg Protocol is based.

Impact from ÉCLAIRE: Direct incorporation into the EMEP model of new parametrizations and source receptor relationships that take account of the ways in which climate change will alter air pollution transport.

Amann and Winiwarter (IIASA, AT): Head of the Centre for Integrated Assessment Modelling and expert contributing to the Task Force on Integrated Assessment Modelling.

Benefit for ÉCLAIRE: Access to leading expertise in the development and application of the GAINS model, which is the official integrated assessment model of the Convention.

Impact from ÉCLAIRE: Direct incorporation into the GAINS model of new source receptor relationships, new effects thresholds and dose response relationships and new information on valuation of ecosystem services for application in the cost-benefit analysis under the Convention.

Dentener (JRC, IT): Expert contributing to the Task Force on Hemispheric Transport of Air Pollution (HTAP).

Benefit for ÉCLAIRE: Access to latest developments within HTAP, including links to SE Asia and North America. Intercomparison with other hemispheric and global models as part of wider ensemble inter-comparisons.

Impact from ÉCLAIRE: New information on the interaction between increasing ozone hemispheric background taking on board new climate dependent relationships on biogenic and agricultural emissions and on bi-directional/dry deposition surface exchange schemes.

Sutton (NERC (Edinburgh), UK): Co-chair of the Task Force Reactive Nitrogen.

Benefit for ÉCLAIRE: Access to the development of a wider vision that links nitrogen threats in the context of air pollution (eutrophication, ozone formation, aerosol impacts) developing the long term integration to between water, air, greenhouse balance, ecosystems and soils. Direct regular feedback from the Working Group on Strategies and Review on the ongoing negotiations for the Gothenburg Protocol revision, including potential of future control measures in the agricultural sector.

Impact from ÉCLAIRE: A new perspective to inform on the links between air pollution and climate, with a special focus on land ecosystems and soils. Material to update WGSR delegates with findings and implications for the long-term strategy of the Convention.

These contributions to the CLRTAP work hand-in-hand with the development of European Union policies particularly under the CAFÉ programme and the revision of the National Emissions Ceilings Directive.

Links to international programmes beyond Europe:

Dentener (JRC, IT): Lead author of AR5 of the Intergovernmental Panel on Climate Change (IPCC).

Benefit for ÉCLAIRE: Assistance in prioritising ÉCLAIRE research according to emerging needs of IPCC and in harmonising approaches (e.g. through the use of common emission scenarios).

Impact from ÉCLAIRE: Prompt dissemination of ÉCLAIRE's findings on air pollution – climate – ecosystem interactions into the IPCC process.

Winiwarter (IIASA, AT): Expert contributing to the work of IPCC. A lead author to the 2006 Guidelines for National Greenhouse Gas Inventories himself, he provides an institutional link to the 7 lead authors of IIASA nominated to contribute to IPCC's 5th assessment report.

Benefit for ÉCLAIRE: Access to global emission data of the Representative Concentration Pathways (RCP), the scenarios used in IPCC's AR5 which are hosted at IIASA, and to tacit knowledge beyond the openly accessible datasets.

Impact from ÉCLAIRE: Consideration of air pollution / climate interaction will be made available to IIASA's lead authors to IPCC.

Erisman (ECN, NL): International Council for Science Appointed Member to the International Geosphere-Biosphere Programme (IGBP).

Benefit for ÉCLAIRE: Possibility to link to existing and emerging international scientific networks dealing with interactions between climate change and air pollution effects on vegetation outside Europe.

Impact from ÉCLAIRE: To provide a portal for IGBP to link into the European scientific community on climate and effects studies.

Arneth (ULUND, SE): Member of the Scientific Steering Committee to the integrated Land-Ecosystem-Atmosphere Process Study (iLEAPS) of IGBP; the iLEAPS Project Office is further operated by UHEL.

Benefit for ÉCLAIRE: Co-ordination of the ÉCLAIRE work programme with complementary science activities outside Europe.

Impact from ÉCLAIRE: Dissemination of ÉCLAIRE integrated biosphere-atmosphere-climate science through iLEAPS Conferences and Newsletters. It will be considered to put ÉCLAIRE under the umbrella of iLEAPS to further ensure its international visibility.

Other impacts from ÉCLAIRE to integrated environmental policy development

Hicks (Univ York, UK): Secretariat to the Global Air Pollution (GAP Forum):

Benefit for ÉCLAIRE: Access to the development of policy approaches that set the UNECE activities in the context of global action to mitigate air pollution, with a special focus on ozone, black carbon and nitrogen.

Impact from ÉCLAIRE: Outcomes on the relationship between climate change and air pollution impacts will be rapidly disseminated the GAP global network.

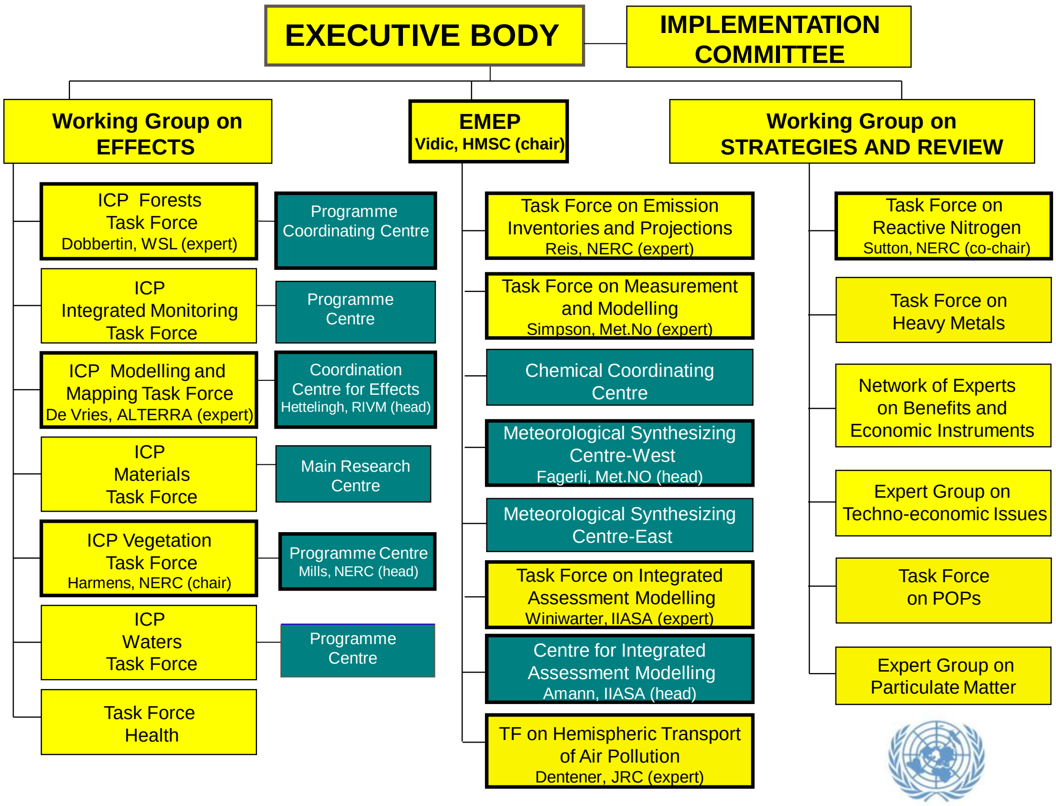

Figure 3.1: Organizational structure of the UNECE Geneva Convention on Long-range Transboundary Air Pollution (CLRTAP) highlighting the central contribution of the ÉCLAIRE consortium. The convention is organized as three main pillars containing Task Forces, Coordinating Centres and International Cooperative Programmes (ICP) (the last two are dark shaded). Activities relevant to ÉCLAIRE are shown with a bold border, with the name of the lead person from ÉCLAIRE and their role within the activity. EMEP is the European Monitoring and Evaluation Programme.

B 3.2 Plan for the use and dissemination of foreground

B 3.2.1 *Dissemination plan*

Dissemination and communication activities are coordinated within WP 9 with NERC (CEH Edinburgh) and UEDIN taking a lead role. In addition to these activities, training (WP 8) can be viewed as a dissemination activity specifically targeted towards young scientists. A detailed communication and dissemination plan will be elaborated as a deliverable of WP9 (D9.2) and continuously updated and evolved throughout the project duration.

A variety of potential users of ÉCLAIRE research findings can be identified and – taking into account their varying backgrounds and information needs – require dedicated communication and dissemination strategies and methods to achieve sufficient impact. These strategies are briefly outlined in the following sections for key target audiences:

The scientific community: publications in peer-reviewed literature are the primary mechanism of reaching a wider scientific audience beyond the project partnership. Within ÉCLAIRE, publications will be a key vehicle of delivering scientific results, with a priority being given – where feasible – to open access journals (see Section B3.2.2.ii below on Special Clause 39). ÉCLAIRE will furthermore engage with scientific conferences and events held, for instance, by the European Geophysical Union (EGU), American Geophysical Union (AGU) and similar bodies to organise thematic sessions or workshops on relevant topics. In addition, the planned ÉCLAIRE summer school (WP8) and other workshops organised in cooperation with other research projects will promote the generation of joint publications, including, but not limited to, special issues or special sections in peer-reviewed journals.

Finally, a key resource compiled within ÉCLAIRE will be the substantial datasets contributed by the flux measurement networks in Component 1 and the manipulation experiments in Component 3. In order to facilitate the usability of these datasets (regulated by the ÉCLAIRE data policy), the project database will be integrated into a larger research database platform named ENCORE, which is currently under development. This will allow the querying and analysis of ÉCLAIRE datasets alongside data from other large scale research projects in a harmonised and accessible manner (see Section B3.2.2).

International bodies and networks: the delivery of key results to international bodies such as the UNECE *Convention on Long-Range Transboundary Air Pollution* has already been highlighted in Section B3.1. ÉCLAIRE will in addition link closely to activities under IGBP-iLEAPS (e.g. the *International Nitrogen Initiative*, INI), Actions under the COST Domain *Earth System Science and Environmental Management* (ESSEM, e.g. ES0804), and ESF Research Networking Programmes (e.g. *Climate Change - Manipulation experiments in terrestrial ecosystems*, CLIMMANI). The close liaison within these networks will be mutually beneficial for information exchange and allow for direct dissemination of ÉCLAIRE results by exchanging scientists in collaboration activities, joint workshops or field experiments and resulting publications.

Policy stakeholders and regulatory bodies: in the policy domain, ÉCLAIRE results will be relevant at different levels of the decision making process. Information on effects, novel thresholds etc. will be required in the planning and development process of new directives and limit values, whereas data on impacts and ecosystem effects will be essential for monitoring and compliance assessment purposes. Thus, ÉCLAIRE will target key individuals and teams in the European Commission (DG Environment) and in national and local governments, where applicable, to directly communicate results and elaborate on their implications for policy development. These direct communication activities will be underpinned by the provision of an annual 'Key Messages for Policymakers' report (as part of the Annual Scientific Progress Report and newsletter issues specifically written for policy stakeholders, with a clear emphasis on the policy relevance of results and how they can inform the policy development process. In addition to this, three specific opportunities will be provided for stakeholders to interact with the ECLAIRE project; at the kick-off meeintg (Month 1), in association with the first General Assembly (Month 18) and at the final General Assembly (Month 48). This provides policy stakeholders with the opportunity to not only receive results which underpin their policies but to engage in dialogue with scientists right at the start of the process regarding their technical needs and concerns.

In addition to these dedicated dissemination activities, generic means of information distribution are implemented within ÉCLAIRE from the start. The project web portal will serve as a first port of call for all project relevant information needs (institutions, contact points, research highlights, newsletters and suchlike). The portal will serve both the ÉCLAIRE project consortium and its internal communication needs via a password protected work space. The public face of the portal will make use of state-of-the-art networking tools (wiki, blogs, newsletters and mailing lists) to provide both active and passive means of providing project related information.

Public engagement: Finally, leading members of the ÉCLAIRE consortium will engage in activities linked to the public understanding of science to further highlight the need to understand interactions between climate change and air pollution. Contributions to popular discussion fora (newspapers, on-line discussions such as the BBC Green Room) will be backed up by the development of actions in partnership with the Science Media Centre in London.

3.2.2 Plans for the management of intellectual property

The partners of ÉCLAIRE recognize the need for effecctive monitoring, protection and management of intellectual property (IP) generated during the life of the project, including each of know-how, measurement methods, new models, including aspects suitable for commercial application. Overall, the focus of ÉCLAIRE is on generating open scientific knowledge, and with datasets that can be shared freely and with publication according to the principles of Open Access Publication following Special Clause 39. At the same time, in order to maximize the scientific and commercial exploitation of IP, the following principles shall be followed.

i) Coordinated curation of ÉCLAIRE datasets including the development of data searching and interrogation tools. All data collected under ÉCLAIRE, including measurement datasets and key modelling outcomes (inc temporal series and spatial estimates) will be stored in one of the two ÉCLAIRE Data Centres (ref 2.x): Site based data will be maintained in the ENCORE database, developed as an outcome of the NitroEurope IP in collaboration with the CLIMMANI Networking Programme of the European Science Foundation. ENCORE implements a multi-node approach to data management managed through a central portal, allowing data to be hosted at several sites (initially NERC, RISOE and KIT), though other nodes may be included in future as an outcome of the further refinement of this system in ÉCLAIRE. This approach has the advantage of developing wider buy-in across and beyond the program. For mapped datasets, data will be managed as part of the AFOLU (Agriculture Forestry and Land Use) database maintained by JRC, continuing the approach already successfully applied under NitroEurope IP.

ii) Scientific exploitation period followed by open access. The ENCORE and AFOLU systems to be used by ÉCLAIRE will be important to ensure ready access across project partners in support of scientific analysis and publication. According to the principles to be set out in the Consortium Agreement, data owners (the institutes generating particular datasets, individually or collectively according to deliverable) will have up to two years after the end of ÉCLAIRE to exploit the generated datasets, to promote open publication of the results. After this initial retention period, the ÉCLAIRE datasets managed through ENCORE and AFOLU will be put as open access. Full immediate access will be provided in the databases to metadata information on the nature of the datasets available, so that external users may obtain permission to collaborate on data exploitation subject to the permission of the data owners.

iii) Open Access Publication. According to the principles of FP7, Special Clause 39 will be followed providing for best efforts at Open Access Publication. This means that best efforts will be made by all partners to ensure that peer review publications are openly available. Both “Gold Open Access” and “Green Open Access” will be used. For “Gold Open Access”, this means that results are published in fully open access peer review journals (such as the European Geophysical Union journals, Biogeosciences and Atmospheric Chemistry and Physics etc.), which are immediately openly available as pdfs on the web. Subject to agreement by the General Assembly, at least one journal Special Issue will be prepared under Gold Open Access resulting from the work of ÉCLAIRE, in addition to individual papers. For “Green Open Access”, this means that authors deposit the peer reviewed manuscrips of their articles in open archives after an embargo period of up to 6 months, in order to allow publishers to recoup their costs. For this purpose a special publications site will be provided centrally as part of the ÉCLAIRE web portal, where all peer review publications will be listed and made available (including links to Gold Open Access publications). Examples of publishers allowing Green Open Acess include Nature Publishing Group, Elsevier and Springer. According to the principles of ‘best effort’, should a publisher not be willing to accept Open Access publication (at least within 6 months after publication date), then ÉCLAIRE partners will either a) seek to publish in a different journal or b) inform the Commission and provide a publisher’s letter of refusal.

iv) Commercial exploitation of new methods, systems and services. Notwithstanding that the main objective of open publication of peer reviewed scientific results in environmental focus of ÉCLAIRE, there will remain opportunities for commercial exploitation of other project outcomes by the partners. All technology transfer teams of the consortium partners will work together to identify opportunities for commercial exploitation of outcomes, informing the ÉCLAIRE ESB through the Secretariat as opportunities emerge. Where the IP is capable of industrial or commercial application, its owner shall provide for its adequate and effective protection, respecting the legitimate interests, particularly the commercial interests, of the other participants in the consortium. Should the IP owner(s) not wish to exploit the IP directly, the ESB will negotiate with other partners or third party to exploit the IP under licence. Advice will be available centrally from the NERC Knowledge Transfer Team to help identify IP that may be exploitable in this way.

The Consortium Agreement to be drawn up by the coordinating partner, in collaboration with the partner institutions will detail the procedures for handling of intellectual property rights. In the case of joint ownership of new knowledge, it is proposed that IP rights will be shared according to the proportionate contribution to the novel findings and developments.

Areas for which commercial exploitation may be anticipated to emerge from ÉCLAIRE include a) new methodological developments (e.g. in flux measurement techniques), b) new model approaches, c) new systems, including data handling tools. While the project will be alert to such opportunities, it should nevertheless be emphasized that the main objective of ÉCLAIRE will be the generation of openly available scientific knowledge, with an emphasis on supporting future policy analysis on air pollution - climate links.

B 4. ETHICS ISSUES

No ethics issues are expected for this project, and none were highlighted by the Evaluation Summary Report.

B 5. GENDER ASPECTS

The following Gender Action Plan is proposed for the duration of ÉCLAIRE, organised as a Task within Workpackage 22 (Management and Co-ordination).

Objectives:

1. To defend gender equality
2. To facilitate the role of female scientists in ÉCLAIRE

Specific tasks:

- Establishment of a project gender committee, by election of members.
- Establishment of a forum to discuss, highlight and possibly mitigate gender issues/problems.
- Facilitate recruitment of female researchers and students.
- Production of annual gender action reports.

Task 1: Project gender committee

ÉCLAIRE already has strong representation of female scientists among PIs, and females are present at all level of the hierarchical structure of the consortium. A gender committee will be elected to further defend gender equality, promote the role of female researchers in the project at all levels, and to facilitate the work involvement of scientists with young families. The gender committee will keep track of the gender share and responsibilities by means of periodic questionnaires being distributed to the consortium. It will organise a session at each General Assembly to report on the activity performed and discuss proposed actions. It will produce an annual gender action report on ÉCLAIRE, and monitor whether the gender action plan is properly applied. The gender committee will consist of 5 members elected by project participants (PIs, PostDocs, PhD students) for a two-year period; both men and women are eligible members, and can be re-elected.

Task 2: Forum on Gender issues

Under the auspices of the gender committee, on the ÉCLAIRE web site a forum will be open as a permanent site for discussion of gender issues, such as potential conflicts between employment and family and to exchange experience and highlight differences in the gender issues awareness between EU countries. The forum will also be a place for distribution of announcements for jobs and training opportunities, and it will act as the platform to channel experience and good ideas. Complaints raised in the forum will be addressed by the Gender Committee and where necessary reported to the ESB. The gender committee will explore ideas raised by the forum, which may include child care at ÉCLAIRE meetings and video-conferences, facilitating the participation of scientists with children.

Task 3: Facilitated recruitment of female researchers

ÉCLAIRE will encourage staff recruitment approaches that are non-discriminatory with respect to gender. In practice, this will mean consideration of the obstacles that inhibit the application and appointment of women scientists given that women are under-represented in science. All job announcements will equally encourage competent females and males scientists to apply. The schedule of the annual meetings will be organised to give equal visibility to the work of female and male scientists, solely on the basis of their scientific contribution.

Task 4: Periodic gender action report

The periodic gender action report will contain an inventory of what actions to promote gender equality have been performed and will document the overall success as compared to targets of promotion of female researchers and of promotion of involvement of scientist with young families. The gender committee will produce the report encouraging the input of all partners of ÉCLAIRE.

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B 7. Tables in Work Packages in Part A

Due to formatting issues with work package forms in the NEF and inserted tables, we are copying the original tables here, for reference.

Workpackage 1

Table 1.4: Summary of flux measurements performed across the ÉCLAIRE flux network

	Site	Partner	15 month fluxes (Task 1.1)				2 x 6-weeks (Task 1.2)			
			CO_2 / H_2O	O_3	NO flux	Other fluxes[b]	NH_3	VOC	Above-canopy NO	NO_2
Forests	1. Hyytiala, FI	UHEL/ FMI	IRGA	FAST-CL	Auto chamber	Total aerosol number	N/A[a)]	PTR-MS	N/A[a)]	N/A[a)]
	2. Speulder Bos, NL	ECN	IRGA	FAST-CL	Auto chamber	-	GRAHAM	-	-	-
	3. Ispra Forest, IT	JRC	IRGA	FAST-CL	Auto chamber	CH_4	QCL	PTR-MS	-	-
Grasslands	4. Auchencorth, UK	NERC	IRGA	ROFI	Auto chamber	SO_2	AMANDA	PTR-MS	EC	-
	5. Oensingen, CH	FDEA-ART	IRGA	LOZ-3	Auto chamber	-	eTR-MS	PTR-MS	Total N_r by TRANC	
	6. Bugac, HU	ERTI-FRI	IRGA	FAST-CL	Auto chamber	-	AMANDA	-	Gradient	Gradient
Arable	7. Grignon, FR	INRA	IRGA	Sextant Tech Ltd.	Eddy-covar.	SO_2	ROSAA REA	Ponctual Cuvette	EC	Luminox
	8. Brescia, IT	UNICATT	IRGA	FAST-CL	gradient	-	-	-	-	gradient
	9. Petrodolinskoye, UA	ONU	IRGA	ROFI	Auto chamber	-	AMANDA	-	-	-

[a)] Concentrations/fluxes below the detection limit of available instrumentation. [b)] Supported by national funding.

Workpackage 6

Table 1.5. Summary of DGVMs and DSVMs used to model emissions from vegetation and soils in ÉCLAIRE (WP2.2) and effects interactions at the European scale (WP4.1). **Abbreviations/input:** Radiation: R; Temperature: T; Precipitation: P; Wind speed: *u*; relative humidity: rh; atmospheric CO_2 burden: CO_2; Nitrogen deposition: N_{dep}; O_3 levels: O_3; Land use/land cover map: L_{uc}; **Abbreviations/output:** Ecosystem carbon cycling (e.g., productivity, respiration, C loss due to harvest and fire, C pools in vegetation and soil, leaf area index): C-cycle; Ecosystem nitrogen cycling (N pools in vegetation and soils, N trace gas emissions, C-N coupling): N cycle; Emissions of biogenic volatile organic compounds: BVOC; surface energy fluxes and/or soil water balance: FE, θ.

Model (Partner)	Spatial unit	Time units	Inputs	Outputs
Dynamic vegetation and trace gas emissions model (DGVMs)				
CLM 4.0, Community Land Model (JRC)*	0.25° at continental or 1° at global scale.	Sub-daily	R, P, T, u, rh, CO_2, N_{dep}, L_{uc}	F_E, θ, BVOC, C-cycle, N-cycle
LPJ-GUESS (ULUND)	10’ (Europe) or 0.5° (globe)	daily	P, R, T, CO_2, N_{dep}, O_3, L_{uc},	Forest, crop: C-cycle, N-cycle, BVOC, fire, θ

JULES (NERC)	0.5° to 3.75° x 2.5°	Sub-daily	R, P, T, u, rh, O_3, CO_2, L_{uc}	F_E, θ, C-cycle (incl. CH_4), BVOC emissions
ORCHIDEE (CNRS)	typically 1-2° (global)	Sub-daily	R, P, T, u, rh, CO_2, N_{dep}, L_{uc}	Forest, crop : C-cycle, N-cycle, BVOC
Soil process and trace gas emission models (DSVMs)				
DNDC-metamodel (JRC)*	EU at fine grid (HSMU)	As in DNDC-EUROPE model (daily)	R, P, T, N_{dep}, L_{uc}	N-cycle (agricultural soils)
DNDC-MOBILE	Variable	Sub-daily to daily	R, P, T, N_{dep}, L_{uc}, soil & vegetation properties	C-cycle, N-cycle, leaching, acidification
FORSPACE (ALTERRA)*	Variable	Daily to monthly	R, P, T, rh, CO_2, N_{dep}, soil & vegetation properties	C-cycle, N-cycle, disturbance impact, functional diversity (effect-response)
SUMO (ALTERRA)*	Point	Annual	R, P, T, rh, CO_2, soil & vegetation properties (incl nutrient content)	Biomass, element content of harvest and litter
VSD-$N^{14}C$ (RIVM, NERC)	Point	Annual	Deposition of S, N, Ca, Mg, K, Na & Cl; soil properties (physical, chemical)	Soil and biomass C & N pools; soil solution chemistry.

*) Model takes part in the spatial ensemble modelling activity of effects (WP14), but not in the emissions activity (WP6)

B 8. GLOSSARY

DALY	Disability Adjusted Life Years
AFOLU	Agriculture Forestry and Land Use
AGU	American Geophysical Union
AOT	Accumulated ozone over a threshold
APM	Air pollution model
AR5	Assessment Report No. 5 of the IPCC
BC	Black Carbon
BVOC	Biogenic Volatile Organic Compounds
CEIP	EMEP Centre for Emission Inventories and Projections

CH4	Methane
CIAM	EMEP Centre for Integrated Assessment Modelling
CLIMMANI	Climatic change - Manipulation experiments in terrestrial ecosystems
CLRAP	UNECE Convention on Long-Range Transboundary Air Pollution
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CTM	Chemistry Transport Model
DALY	Disability Adjusted Life Years
DESCA	DESCAis a comprehensive, modular consortium agreement for the Seventh Framework Programme (FP7)
DG	Directorate General (of the European Commission)
DGVM	Dynamic global vegetation model
DMC	Data Management Committee
DSVM	Dynamic soil vegetation model
EB	Executive Board (of the CLRTAP)
EC	European Commission
EC4MACS	European Consortium for Modelling of Air Pollution and Climate Strategies
ENCORE	Environment and Climate Observations and Research on Ecosystems database
EFISCEN	European Forest Institute
EGU	European Geophysical Union
EMEP	Co-operative programme for monitoring and evaluation of the long range transmission of air pollutants in Europe
ERA	European Research Area
ESA	European Space Agency
ESG	Executive Steering Group
EU	European Union

EUROTRAC-2	The EUREKA project on the transport and chemical transformation of trace constituents in the troposphere over Europe; second phase
FAO	Food and Agriculture Organisation
GAINS	Greenhouse gas and Air pollution INteractions and Synergies
GCM	Global Climate Model
GENEMIS	EUROTRAC-2 Subproject on generation and evaluation of emissions
GHG	Greenhouse gas
GRAMINAE	Biosphere-atmosphere interactions of ammonia with grassland across Europe
HNO_3	Nitric acid
HTAP	UNECE Task Force on Hemispheric Transport of Air Pollution
IAM	Integrated Assessment Model(ling)
ICP	International Cooperative Programme
IGBP	International Geosphere-Biosphere Programme
iLEAPS	integrated Land Ecosystem - Atmosphere Process Study
IMP	Intensive measurement period
INI	International Nitrogen Initiative
IP	Integrated Project
IPCC	Intergovernmental Panel on Climate Change
IPR	Intellectual Property Rights
JEG	UNECE Joint Expert Group on Dynamic Modelling
JRC	Joint Research Centre (of the European Commission)
LOX	Lipoxygenase compounds
MACR	Methacrolein
MVK	Methyl vinyl ketone
NEC(D)	National Emission Ceilings (Directive)
NH_3	Ammonia

NH_4^+	Ammonium
NO_3^-	Nitrate
NO_x	Nitrogen Oxides
NPP	Net Primary Productivity
N_r	Reactive Nitrogen
O_3	Ozone
PAR	Photosynthetically active radiation
PEGASOS	FP7 Research Project
POD	phyto-toxic dose
RCM	Regional Climate Model
RCP	Representative Concentration Pathways
SAB	Stakeholder Advisory Board
SO_2	Sulphur Dioxide
TFEIP	UNECE Task Force on Emission Inventories & Projections
TFIAM	UNECE Task Force on Integrated Assessment Modelling
TFRN	UNECE Task Force on Reactive Nitrogen
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
(NM)VOCs	(Non-methane) Volatile Organic Compounds
VPD	Vapour pressure deficit
VSD	Very Simple Dynamic Model
WGSR	Working Groups on Strategies and Review (of the CLRTAP)
WP	Work Package
YOLL	Years Of Life Lost