Project Number 282910

ÉCLAIRE

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

Seventh Framework Programme

Theme: Environment

D15.2 Collated dataset of European soil ^{14}C data used to define soil turnover times as a function of soil/vegetation type, for model parameterisation (*Month 24*)

Due date of deliverable: **30/09/2013** Actual submission date:**22/11/2013**

Start Date of Project: **01/10/2011** Duration: **48 months**

Organisation name of lead contractor for this deliverable :
NERC

Project co-funded by the European Commission within the Seventh Framework Programme		
Dissemination Level		
PU	Public	☐
PP	Restricted to other programme participants (including the Commission Services)	X
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)	☐

1. Executive Summary

Soil organic matter turns over at a range of rates, which can be hours or days for easily-decomposed material, or thousands of years for more recalcitrant material. The rate of turnover of soil organic matter affects carbon sequestration and the storage and release of nitrogen, and rate constants for slower pools are key uncertainties in models of soil organic matter dynamics. It is difficult to assess turnover rates of slow pools by examining input and output fluxes over short timescales, since the fluxes into these pools are small relative to total litterfall or soil respiration. Using ^{14}C dating allows model estimates of turnover rates and mean residence times to be constrained. A dataset of soil ^{14}C measurements has been assembled from 173 European sites. Preliminary analyses show effects of vegetation type, suggesting that the partitioning of plant carbon between root, soft-shoot and woody material may have critical effects on organic matter turnover. Mean residence times for organic matter were longest in grasslands and shortest in forests. The data are available for use by all ECLAIRE modelling groups.

Objectives:

This deliverable relates to Objective 15.3, "To forecast future changes in soil quality and plant species diversity under different air pollution and climate scenarios for forests and semi-natural systems. One of the major uncertainties in the models of soil quality that are being applied in ECLAIRE (e.g. VSD+ and MADOC) is the turnover rate of more recalcitrant soil organic matter. This rate is important for determining the likely duration of carbon storage (for example of the extra carbon inputs when productivity is stimulated by N deposition), and medium- to long-term effects on rates of N mineralisation from soil. Estimates of the rate of soil carbon turnover can be constrained using ^{14}C measurements, since ^{14}C concentrations in total C generally decline after fixation into plant material. The spike in atmospheric ^{14}C caused by nuclear bomb testing in the mid-20th century can also be used to constrain the age of soil C.

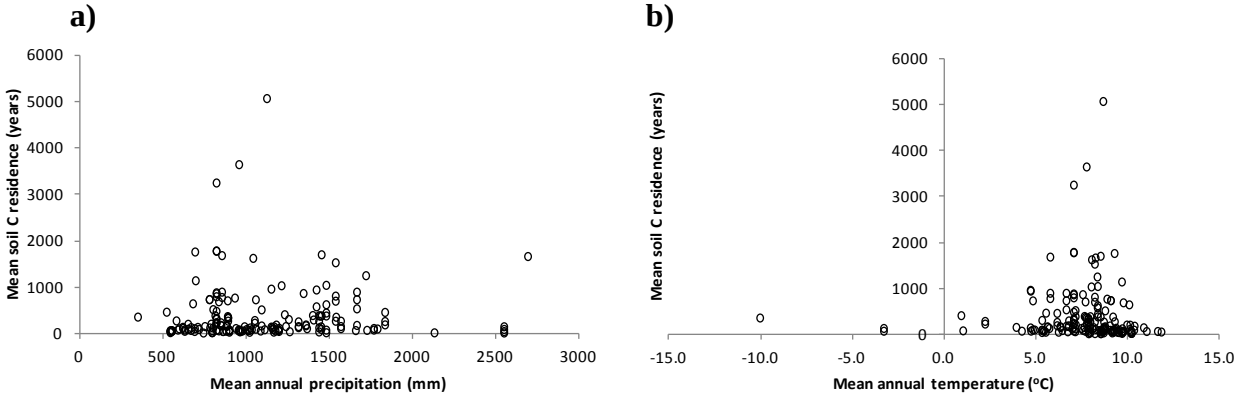
2. Activities:

Available data on soil ^{14}C signatures were collated from a variety of sources.

3. Results:

The ^{14}C data have been collated into a database which is available to ECLAIRE project members for model testing and calibration. A total of 173 measurements of ^{14}C are included from across Europe. Using the N14C model to incorporate the temporal pattern of bomb-^{14}C, ^{14}C concentrations were converted into mean residence times (MRT) for illustration. Preliminary analyses showed no consistent effects of site temperature or precipitation on MRT (Figure 1). However, mean residence time was affected by vegetation type, with mean (+/- standard error) MRT values of 665 +/- 104 years for herbaceous ecosystems (e.g. grasslands), 392 +/- 56 years for shrublands, and 113 +/- 21 years for forests.

Figure 1. Effects on mean residence time of soil carbon of: a) mean annual precipitation and b) mean annual temperature.



4. Milestones achieved:

This deliverable is not directly linked to a specific Milestone, but contributes to MS66 (due May 2014) "Parameterisation and linking of DSVMs with EUMOVE at European scale".

5. Deviations and reasons:

There have been no deviations from the planned activity.

6. Publications:

Paper on results is presented in

Mills, R. T. E., E. Tipping, C. L. Bryant and B. A. Emmett, 2013. Long-term organic carbon turnover rates in natural and semi-natural topsoils. Biogeochemistry (in press).
http://link.springer.com/article/10.1007/s10533-013-9928-z
Beware that this work has been done outside Eclaire.

7. Meetings:

None

8. List of Documents/Annexes:

None