Geophysical Research Abstracts
Vol. 12, EGU2010-15029, 2010
EGU General Assembly 2010

Understanding the driving forces behind the losses of soil carbon across England and Wales

Patricia Bellamy
Natural Resources Department, Cranfield University, MK43 0AL, UK

More than twice as much carbon is held in soils as in vegetation or the atmosphere, and changes in soil carbon content can have a large effect on the global carbon budget. The possibility that climate change is being reinforced by increased carbon dioxide emissions from soils owing to rising temperature is the subject of a continuing debate. But evidence for the suggested feedback mechanism has to date come solely from small-scale laboratory and field experiments and modelling studies. Here we use data from the National Soil Inventory of England and Wales obtained between 1978 and 2003 to show that carbon was lost from soils across England and Wales over the survey period at a mean rate of 0.6% yr-1 (relative to the existing soil carbon content). We find that the relative rate of carbon loss increased with soil carbon content and was more than 2% yr-1 in soils with carbon contents greater than 100 g kg-1. The relationship between rate of carbon loss and carbon content is irrespective of land use, suggesting a link to climate change. Our findings indicate that losses of soil carbon in England and Wales—and by inference in other temperate regions—are likely to have been offsetting absorption of carbon by terrestrial sinks.
To investigate the possible driving forces of the measured losses of soil carbon we applied a simple model of soil carbon turnover to evaluate alternative explanations for the observed trends. We find that neither changes in decomposition resulting from the effects of climate change on soil temperature and moisture, nor changes in carbon input from vegetation, could account on their own for the overall trends. Of other explanations, results indicate that past changes in land use and management were probably dominant. The climate change signal, such as it is, is masked by these other changes.
A more sophisticated model of carbon change (DAYCENT) has now been applied across the whole range of soils in England and Wales. This model has been validated using the NSI data and three different ways of initialising the model have been tried. This has shown that the observed sites cannot be considered to have been at equilibrium when first measured. Without a detailed long term record on past land use and management it is not possible to accurately determine why this is. However it has been shown that the assumed initial state is important for predicting magnitude and direction of losses, but less important for predicting differences between scenarios. Assuming that the model's assumptions about climate effects on plant growth and carbon turnover rates are essentially correct, running DAYCENT for a range of climate scenarios showed the only climatic factor that had any significant effect on the carbon loss rates under our conditions was summer soil temperature, in arable soils only. Changes in soil moisture appeared to be too small to have any effect.