Geophysical Research Abstracts
Vol. 12, EGU2010-7049, 2010
EGU General Assembly 2010

Mechanistic modeling of the vertical soil organic matter profile in terrestrial ecosystems

Maarten Braakhekke (1,2), Christian Beer (1), Marcel Hoosbeek (2), Markus Reichstein (1), Bart Kruijt (2), Thomas Wutzler (1), Jens Kattge (1), Marion Schrumpf (1), and Pavel Kabat (2)

(1) Max Planck Institute for Biogeochemistry, Jena, Germany (mbraak@bgc-jena.mpg.de), (2) Wageningen University, Earth System Science group, Wageningen, The Netherlands

Modelling and measuring studies of soil organic carbon have traditionally focused on the 30 cm of the soil. In the recent past however, interest in the vertical distribution of soil carbon has increased due to 1) estimates suggesting that the deep soil globally stores a large amount of carbon, and 2) increasing evidence that soil carbon stabilization is be controlled by different processes at different depths that are likely to respond varyingly to future global changes, possibly leading to release of previously stabilized carbon. Therefore the 'bucket' approach employed in traditional soil carbon models is not sufficient to adequately predict future soil carbon dynamics on long time scales. Furthermore, aggregation of soil temperature and moisture response of the whole profile may lead to biased results on short time scales as well.

Hence, a more vertically explicit representation is needed, but development and parameterization of such models is hindered by lack of understanding of the processes involved in SOM profile development. Our study aims to answer the following questions: 1) what are the key driving processes that determine the vertical profile of soil organic matter and their comparative strength? and 2) can we improve soil carbon cycle models by accounting for the vertical SOM profile?

In this scope we have developed SOMPROF, a new soil carbon model that dynamically simulates the vertical profile of the SOM fraction in the mineral soil, as well as the storage of organic matter in organic surface horizons L, F and H. The model includes two mechanisms of vertical organic matter transport: 1) diffusion, representing bioturbation (mixing of the soil matrix by soil biota), and 2) advection, representing downward movement with infiltrating water. Furthermore organic matter may be input directly at depth by root turnover. The model includes 5 organic carbon pools that differ with respect to their transport behavior and decomposability.

The model has been parameterized for two Europe forests with strongly contrasting soil conditions: Loobos, a young Pinus Sylvestris forest on an acid sandy soil in the Netherlands, and Hainich, an old Fagus Silvatica forest on a basic clay soil in Germany. SOMPROF is well able to reproduce the vertical SOM profiles of both sites, as well as effective turnover rates at different depths in Hainich. However, due to the large number of parameters (10-12) and limited availability of measurements, parameter optimization is somewhat problematic. We therefore implemented a Monte Carlo Markov Chain algorithm to explore the parameters space. Furthermore, we investigated the information content of the available data. This approach allows us to define the type and amount of data needed to constrain the different processes involved in the development of vertical SOM profile.