Geophysical Research Abstracts
Vol. 12, EGU2010-15192, 2010
EGU General Assembly 2010

Effects of soil relocation on soil organic carbon stocks in hilly agricultural landscapes

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Agricultural land use is well known to have a major impact on altering physical and chemical soil parameters. Among these, soil organic matter (SOM) is recognized as an important parameter for soil fertility and must be considered for modeling global carbon fluxes due to its magnitude and high content of soil organic carbon (SOC) in many soils. Former investigations on arable land concentrated on the plough layers of soils, ignoring redistribution of SOM due to erosional and depositional processes. It is widely discussed whether soil erosion can function as a carbon sink due to carbon burial on sedimentary sites, or as a source due to accelerated decomposition of SOC during transportation.

Beside land use, we assume topography to be the controlling unit for modeling total SOC. We postulate that the implication of vertical and lateral soil fluxes will largely improve our understanding of carbon dynamics on a landscape scale. We conducted a sampling campaign in different hilly agricultural regions in Central Europe and performed depth dependent analysis of SOC contents from agricultural soils with different soil substrates and land use following geomorphic gradients. We accompanied this study with an assessment of recent (since approx. 1950) lateral soil fluxes on our research sites using 137Cs radioisotopes and measured depth dependent bulk density for carbon stock estimations.

Our data gives clear evidence that traditional perceptions on SOC dynamics leave out major slope related controls and suffer from a lack of understanding landscape dynamics. An integrative approach from point to landscape scale of pedogenic and geomorphic processes and its effects on SOC dynamics is needed to improve our understanding of its role in the global carbon cycle.