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CarboZALF-D – An interdisciplinary field experiment on carbon dynamics

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Understanding carbon cycling and carbon sequestration in soils has made a substantial progress during the last decade. However, studies on complex interactions between different processes are scarce at landscape scale. Especially feedback mechanisms between lateral fluxes (in-/output by erosion and/or farming practice) and CO2 exchange deserve more attention (van Oost et al., 2007), because they are the rule rather than the exception in real world landscapes. Thus we initiated an interdisciplinary project, so-called "CarboZALF", which involves soil scientists, biogeochemists, agronomists and modellers.
In the talk we would like to present our experimental approach (CarboZALF-D) in a soil landscape of hummocky ground moraine. First we identified (presumed) sensitive as well as spatially relevant sites (Sommer, 2006) in a representative section of younger moraine landscapes (NE Germany). To do so we applied Digital Soil Mapping (DSM) techniques in a top-down approach - remote sensing, electromagnetic induction (EM38DD) and terrain analysis on basis of high resolution DEM5. From soil landscape analysis (based on DSM) we finally selected and characterized a representative landscape segment of 6 ha. This includes sensitive areas on which plot scale investigations are performed: (i) two soil types of different erosional stage - Haplic Regosol (calcaric), eroded Luvisol, (ii) one depositional soil type (Colluvic Regosol), and, (iii) one non-eroded soil type (Haplic Luvisol) as a reference (steady state in terms of erosion). Special emphasis is given to erosion induced transient states. Therefore soil manipulations were conducted at midslope and in adjacent depression. Six centimeter of topsoil material is removed from eroded Luvisol area and deposited at Colluvic Regosol which in principal simulates the effect of tillage erosion (no selective transport/deposition).
At 9 plots we quantify long-term changes in the soil organic carbon stock (12 years minimum) by annual carbon budgets according to:

Δ SOC = NEE + (Corg.manure − Charvest) + (SOCpin − SOCpout) + (DOCin + DICin) − (DOCout + DI-Cout)
SOC = change in soil organic carbon [g m-2 depth-1] during observation period
NEE = net ecosystem exchange (CO2),
Corg.manure = C-input by organic manure,
Charvest = C-output by harvest products,
SOCpin = particulate SOC-input (deposition),
SOCpout = particulate SOC-output (erosion),
DOC = dissolved organic carbon,
DIC = dissolved inorganic carbon
[all in g C m-2 y-1]

NEE is monitored by transparent static chambers, Reco by non-transparent static chambers in 3-4 week intervalls (three replicates per site). At three plots NEE is monitored ongoingly by high resolution automatic chambers (2.5m height, 30 min. measurement intervalls, four replicates per site). Further, CH4 and N2O fluxes are determined biweekly also by non-transparent static chambers to quantify total climate impact (CO2-Ceq). Soils are instrumented at gas flux sites with TDR, tensiometers and suction cups (three depths) to determine / model water regime and solute fluxes, especially DOC- and DIC-fluxes. Subscale experiments in the lab include C sorption experiments as well as isotopic studies of C flux separation to enhance a mechanistic understanding of the phenomena observed in the field. A baseline for the spatial pattern of SOC (contents, stocks) will be achieved on basis of DSM results. Sampling will be repeated after 6 and 12 years to quantify SOC changes independently from flux measurements.

Keywords
Carbon dynamics, soil landscapes, system approach.

References

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