

Objectives

The 4per1000 initiative aims to an enhanced C sequestration into soils. However, a sustainable effect can only be achieved in soils being undersaturated in SOC, hence in soil systems far from equilibrium. The basic principles can be tested in soils affected by erosion since this process brings undersaturated subsoil to the surface. We studied the magnitude, rates and mechanisms of C sequestration at eroded croplands of the field-scale manipulation experiment CarboZALF-D (NE Germany).

Implementation

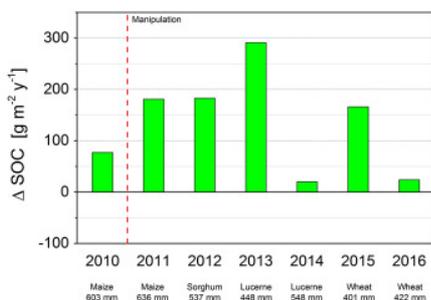
- Manipulation experiment (2011) with artificial erosion / deposition in a hummocky ground moraine.
- Dynamics of all C fluxes (NEE, C export, DOC/DIC) to derive full C balance (= Δ SOC)
- 14 C tracer study (CO_2 pulse labelling, 25 d) with maize to quantify the assimilate distribution in topsoils of an eroded and non-eroded site.



The CarboZALF-D approach: combining topsoil translocation and CO_2 flux measurements by automatic chambers

Results

- Very high mean C sequestration rates of $144 \text{ g C m}^{-2} \text{ y}^{-1}$ at the eroded cropland site (Calcic Luvisol), in total plus 0.9 kg C m^{-2} after 6 years of manipulation, decreasing rates after 3 years.
- The eroded site showed a very fast and doubled fresh plant C transfer (rhizodeposition) into the most protective SOM fraction compared to the non-eroded site.



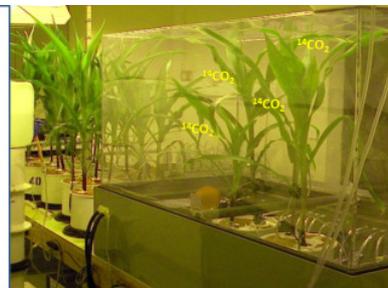
Temporal dynamics of C balances based on CO_2 flux measurements at the eroded site of the CarboZALF manipulation experiment



Calcic Luvisol
(6 kg SOC m^{-2})

Rhizodeposition < 300 μm (mg C per plant)	
4.4 (eroded)	4.1 (non-eroded)
% of rhizodeposition in protective SOM fraction*	
54% (eroded)	29% (non-eroded)

* Mineral associated + aggregates < 20 μm . (M. Kaiser et al., 2010, Soil Biol. Biochem.)



Accumulation of fresh maize C in soil fractions of eroded and non-eroded Ap horizons

Outcome

Our study on eroded soils proved the concept of a high, fast and sustainable C sequestration in soils being undersaturated in C. The same effect will be achieved by a controlled admixture of subsoils with a high C saturation deficit into Ap horizons. Specific tillage systems has to be developed and tested in future research to achieve a sustainable C sequestration without a loss of soil fertility.

Contact

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Landscape scale monitoring system for the impact of farming practice and subsoil mixing on CO_2 fluxes and C sequestration

