EGU22-2247
https://doi.org/10.5194/egusphere-egu22-2247
EGU General Assembly 2022

Distinct short term response of C exchange to topsoil dilution and N-fertilization form at erosion affected arable land

Shrijana Vaidya[1], Marten Schmidt[1], Katja Kramp[1], Peter Rakowski[2], Nobert Bonk[2], Robert Buddrus[2], Gernot Verch[2], Michael Sommer[3,4], Jürgen Augustin[1], and Mathias Hoffmann[1]
[1]Leibniz Centre for Agricultural Landscape Research (ZALF), Isotope Biogeochemistry and Gas Fluxes, Eberswalder Str. 84, 15374 Müncheberg, Germany
[2]Leibniz Center for Agricultural Landscape Research (ZALF), Research Station, Steinfurther Straße 14, 17291 Prenzlau, Germany
[3]University of Potsdam, Institute of Environmental Science and Geography, Karl-Liebknecht-Str.24-25, 14476 Potsdam, Germany
[4]Leibniz Center for Agricultural Landscape Research (ZALF), working group for Landscape Pedology, Eberswalder Str. 84, 15374 Müncheberg, Germany

On arable land, C dynamics and storage are significantly influenced by tillage and N fertilization. Therefore, new practices such as the combination of topsoil dilution (e.g., through fractional deep tillage) and organic N fertilization may not only ameliorate soil's physical and chemical properties and promote root development but might also enhance soil organic carbon (ΔSOC) stocks. However, the impact of these practices depends on site-specific conditions as agricultural landscapes are often characterized by distinct small-scale soil heterogeneities. To upscale and evaluate the effects or benefits of these new farming practices, accurate and precise information on the complex spatio-temporal C flux pattern and their drivers are thus needed.

To investigate the impact of topsoil dilution and organic N fertilization on SOC storage, we performed a study in the strongly erosion affected arable landscape of NE Germany (Uckermark region, 53° 23' N, 13° 47' E; ~50-60 m a.s.l). The study area consisted of 36 measurement plots, of which each 12 covered one out of three erosion induced soil types; Calcic Luvisol (non-eroded), Nudiargic Luvisol (strongly eroded) and Calcaric Regosol (extremely eroded). During July 2020, a two factorial experimental design was established (topsoil dilution vs no topsoil dilution and mineral N fertilization vs organic N fertilization) through implementing topsoil dilution and organic N fertilization on three replicates of each of the three measured soil types. Topsoil dilution was achieved by removing the upper 6 cm of the topsoil layer adding/mixing equivalent weight of subsoil into it.

Subsequently, relevant C fluxes, especially the CO_2 exchange, were measured using a new robotic chamber system. C in plant biomass was measured by weekly biomass sampling on a nearby reference site and related to plot measurements of CO_2 through NDVI (normalized difference vegetation index) and RVI (ratio vegetation index) measurements. Here, we present our first results on the effect of soil type, topsoil dilution, and N-fertilization form on CO_2 and C exchange

of winter rye. Our results show that there are not only differences between the distinct soil types but also differences between the non-diluted and diluted topsoil treatments. The latter show lower cumulated ecosystem respiration and gross primary productivity, as well as a lower RVI/NDVI and above-ground biomass production, compared to the non-diluted soil. No substantial difference, however, was detected in the case of net ecosystem exchange. As a result, net ecosystem carbon balance was lower for diluted topsoil compared to the non diluted treatments.