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Temperature sensitivity of different soil carbon sources

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Soils contain the largest carbon pool in terrestrial ecosystems and it is widely assumed that even if a small fraction of this pool is mobilized due to global warming, this might affect the CO_2 concentration in atmosphere. The effect of temperature and the influence of fresh substrate on soil organic matter decomposition are two key issues, which we need to understand in order to forecast soil carbon dynamics under climate change. The objective of this study was to investigate the temperature sensitivity of freshly added organic matter and bulk soil carbon to test the kinetic assumption of substrate quality. Further we were able to investigate if the addition of fresh organic matter accelerates decomposition of soil organic matter ("priming effect (PE)") and does this effect depends on temperature.

We performed a laboratory incubation experiment in a newly developed through-flow soil incubation system and incubated sieved soil samples with and without ^{13}C labeled litter for 199 days. The soils were incubated with two temperature treatments, one with diurnally temperature cycle between 5 and 15˚C, the other between 15 and 25˚C. Soil CO_2 production was continuously monitored with an infrared gas analyzer, while the ^{13}C signal was determined for -1, 2, 15, 42, 70, 93, 135, 158 and 199 days after litter addition. We observed that the instantaneous temperature sensitivity does not differ between the original and the amended soil. However, in the amended treatment the temperature sensitivity increased during the incubation time, along with increasing microbial biomass. Further, we found in both temperature treatments a stimulation of the soil organic matter decomposition by the freshly add organic matter. This relative stimulation was smaller in the warm treatment (46%) and in the cold treatment (54%). Overall we conclude that there is no simple substrate-temperature sensitivity relationship, but complex interactions governing the emergent temperature sensitivity.