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Long-term effects of chronic N deposition on soil organic matter quality in two temperate forests

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Increased nitrogen (N) deposition as a result of anthropogenic activities may boost organic soil carbon (SOC) storage in boreal forests. However, temperate forests are usually less N limited and hence may respond differently to increased N deposition. Changes of both soil C quantity and quality in temperate forest soils may be due to increased net primary production, reduced below-ground C allocation in roots as well as changes in litter chemistry, composition of microbial communities and decomposition rates. These parameters may modify soil organic matter (SOM) chemistry and affect SOC sequestration in the long term.

Here, our focus is on the effect of long-term N deposition on SOM quality in two experimental long-term Norway spruce forest sites in Klosterhede (Denmark, Podzol) and Alpthal (Switzerland, Umbric Gleysol). Increased N deposition was simulated by regularly applying $NH4NO_3$ in the range of 35 kg N ha-1 yr-1 (Denmark site, since 1992) and 25 kg N ha-1 yr-1 (Switzerland, since 1995), respectively. Samples were taken in April and June 2014 from different soil horizons including two organic and 2-4 mineral horizons. Soil samples are subject to mid infrared spectroscopy (MIR, formerly known as FTIR), tracking changes of SOM functional groups upon N deposition. In order to differentiate plant- and microbially derived molecular fragments, these analyses are complemented with pyrolysis- gas chromatography/ mass spectrometry (PyGC/MS).

We hypothesize that chronic N deposition in forest soils increases N-containing SOM compounds due to increased incorporation of N. We expect diverging effects of N deposition on the degradation of labile and recalcitrant compounds that may be reflected in decreased relative abundance of carbohydrates and increased relative abundance of phenols and long-chain aliphates in organic soil layers. In mineral horizons, we expect an increase in stabilized peptidic N indicating slower turnover rates.