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The impact of elevated nitrogen-inputs on organic matter decomposition in European forest soils, determined using a tool-box of stable isotope labelling techniques.

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Elevated atmospheric reactive nitrogen (N) deposition is considered one of the key components of global climate change, threatening biodiversity and possibly altering one of the forest's key ecosystem services carbon sequestration. Ignoring the impact of N on plant growth, any major physical, biological or anthropogenic process that alters the rate of conversion of soil organic matter to atmospheric CO_2 (decomposition), will have profound implications for the global C budget and consequently climate change. Soil inorganic-N concentrations are predicted to increase as the result of increased deposition and mineralization due to temperature increases. However, experimental results on the effects of increased N input on SOM decomposition in the field are inconsistent, reporting positive, negative and neutral responses of SOM to N input.
Recent meta-data analyses and the model based hypotheses state that global soil C storage is controlled by microbial scale processes of fungal competition for available nitrogen (N). It has been posited that higher SOM in ectomycorrhizal and ericoid mycorrhiza (EEM) systems is the result of EEM fungi's ability to uptake and assimilate low molecular weight organic N. It has been hypothesized that EEM's effectively scavenge all available organic and inorganic N leaving little N for the growth of the free-living decomposer microbial community and preventing further breakdown of SOM. We set out to test this hypothesis empirically in forest soils across Europe which had had received a medium term N deposition treatment on soil plots only. We traced carbon and nitrogen transformations of added isotopically labelled litter into inorganic, soil microbial and gaseous pools and monitored concomitant changes in gross mineralization and nitrification rates and enzymatic activity. We found no evidence to suggest that substantially increasing available nitrogen increased the decomposition rates of the labelled litters added. On the contrary in-line with emerging consensus, N deposition significantly reduced gross N mineralization rates and enzyme activity.
Having dug deep into the secrets of the soil, using a suite of direct stable isotope labelling methods in the forest, we found no evidence of accelerated organic matter decomposition as a result of experimentally elevated nitrogen deposition in forest soils across Europe.