Impacts of nitrogen deposition on forest mineral - soil biogeochemical processes, across a trans-European gradient, investigated using a tool kit of stable isotope methods.

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Abstract

Forest soil in-organic-N concentrations are predicted to increase as the result of increased mineralization due to temperature increases, moreover elevated atmospheric reactive N deposition is considered one the proximate drivers of global climate change.

We measured the impact of simulated atmospheric nitrogen deposition, on forest soil carbon sequestration and examined the consequences for ecosystem function. We traced the isotopic and molecular pathways through the microbial biomass and measured the concurrent biogeochemical processes as they happened in the field, using a novel tool box of stable isotope and molecular techniques against a background of climate change in Austrian and European forests.

We directly traced the decomposition of isotope labelled litter in the forest, over two years across a European climatic gradient in highly spatially and temporally replicated experiments.

Keywords: N deposition, stable isotope, litter labelling.

1. Background.

Although air pollution has declined, elevated atmospheric reactive N deposition is considered to be an emerging threat, as it is one of the proximate drivers of global climate change, threatening biodiversity and one of the forest soil's key ecosystem services, C sequestration.

2. Research questions.

We set out to investigate:

1) Does N availability control the rate of organic matter breakdown in forest mineral soils?

2) Is the change in SOM breakdown rate related to a shift of the community structure or community activity?

3) Does increased N availability influence the gross N mineralization and nitrification soil/forest ecosystems?

Fig. 1: 8th Global Nitrogen Conference, 3rd – 7th May, 2020

3. Methods

In this study we set out to study the medium-term impact of N deposition on carbon and nitrogen mineralization, using stable isotope labeled litter bags (production shown in Fig 1.) in European forest soils, subject to experimental reactive nitrogen inputs. All sites (Location shown in Fig 1). had established replicated simulated N deposition treatments and have been running since 2010, as part of the trans-European ALTER-net-MSII network (apart from the UK site).

4. Results.

Contrary to the initially posited hypothesis, we found no evidence of accelerated decomposition under the +N treatment in line with the emerging consensus evident from the current literature. Moreover, in-depth process studies revealed that soil organic matter decomposition was decelerated under +N treatments and soil respiration reduced. Furthermore, we observed minimal impacts of +N treatment on the microbial community structure or function as determined by phospholipid fatty acid analysis and state of the art high-throughput molecular sequencing in the A hroizon.

Acknowledgements

This work was funded by the ACRP Klima Energie Fonds Austria, 7th Call (2014) B464719.