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Effects of long-term soil warming on nitrogen fluxes in forest soils

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Forests are the main contributors to the global terrestrial carbon (C) sink but several studies suggest that global warming could significantly reduce their CO_2 mitigation potential. The capacity of forest plants to sequester C is closely linked to soil nitrogen (N) availability, a major control of plant growth and ecosystem functioning. An increase of soil temperature caused by global change is critically affecting soil N supply rates, both directly by increasing diffusive N fluxes in the soil solution and indirectly by accelerating soil N turn-over rates. In recent short-term laboratory incubation studies, an increase in soil temperature has not only led to a significant increase in diffusive N fluxes but also to a concomitant shift in N quality available for plant uptake towards a higher portion of inorganic N forms compared to small organic N forms such as amino acids. However, until now long-term effects of soil warming on soil N fluxes have not been studied. Here, we present first results from a study on soil N availabilities at the long-term soil warming experimental site Achenkirch (Austria) in the Limestone Alps. This site is one of the few *in situ* climate manipulation experiments operational for more than 10 years and has already provided a wealth of novel insights into the potential effects of global warming on forest ecosystem responses. Applying *in situ* microdialysis, we estimated diffusive fluxes of inorganic N and amino acids along the growing season in soils warmed by resistance heating cables since 2005 (+4 °C compared to control plots) and control soils. Fluxes of all N forms were highly variable within each subplot (2 x 2 m) and reflected the high heterogeneity of soils at this forest site. Interestingly, fluxes of amino acids were less variable than of nitrate or ammonium throughout the year, indicating comparably stable protein depolymerization rates. In summary, long-term soil warming affected diffusive N fluxes but less than other factors operating on smaller (< 1 cm) scales.