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Controls on microbial nitrogen use efficiency in soil

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Microbial nitrogen use efficiency (NUE) reflects the partitioning of organic N taken up between (i) incorporation into microbial biomass and (ii) mineralization and release of N in excess of microbial demand to the environment in the form of ammonium. Microbial NUE therefore determines the availability of inorganic N in soils, influences subsequent inorganic N transformation processes (e.g. nitrification) and may affect soil organic N sequestration through assimilation and microbial turnover. While many studies in the past focused on inorganic nitrogen transformation processes very few assessed microbial NUE and organic N cycling processes. A recent study found that microbial NUE was strongly related to resource C:N stoichiometry. However, if and how soil temperature and moisture may affect microbial NUE and subsequent inorganic N processes has not yet been studied.

To this end, mineral soils (0-10 cm) from an arable field, pasture and forest were sampled from two adjacent sites differing in geology, Moarhof (limestone; 47˚31'N, 14˚4' E) and Gumpenstein (gneiss; 47˚30' N, 14˚6' E), Austria. Three short-term temperature (5, 15 and 25˚C) and three soil moisture (30%, 60% and 90% water holding capacity) treatments were applied to the soils in four replicates, respectively and gross rates of protein depolymerization, N mineralization and nitrification and the corresponding immobilization processes were measured with ^{15}N-isotope pool dilution techniques. Three different ^{15}N tracers (mixture of 20 amino acids, $(NH_4)_2SO_4$ and KNO_3, 98 atom% ^{15}N) were added to the corresponding N pools and labeled soils were extracted with 1M KCl solution after two incubation times for further analysis of N content and isotope ratios.

We will present the data from these experiments and discuss major effects of soil temperature and moisture on microbial NUE and soil inorganic N availability. This study will thereby provide important parameters for terrestrial N cycle models where microbial NUE is (if represented) often assumed as constant.