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Are microbial N transformation rates in a permanent grassland soil after 17 years of elevated atmospheric CO_2 sensitive to soil temperature?

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Long-term observations (17 years) within the Giessen Free Air Carbon dioxide Enrichment (Giessen FACE) study on permanent grassland showed that the carbon fertilization caused significant changes in the ecosystem nitrogen cycle. These changes are responsible for a doubling of annual N_2O emissions under elevated atmospheric CO_2 (eCO_2) caused by increased emissions during the plant growing season. The goal of this lab study was to understand how soil temperature influences the long-term effects of eCO_2 and plant carbon input on microbial N transformations in the Giessen FACE. Therefore, a pulse labelling study with ^{15}N tracing of $^{15}NH_4^+$ and $^{15}NO_3^-$ was carried out with incubated soil samples from elevated and ambient CO_2 FACE rings in climate chambers at two different temperatures (10°C and 19°C), while water filled pore space of the samples was adjusted to the same level. The various N pools in the soil (NH_4^+, NO_3^-, NO_2^-, soil organic matter), N_2O emissions and simultaneous gross N transformation rates were quantified. The quantification of the gross N transformations are based on the turnover of $^{15}NH_4^+$, $^{15}NO_3^-$, $^{15}NO_2^-$ and shall illuminate the interaction between carbon fertilization, temperature and changes in nitrogen cycle in this grassland soil. While the soil respiration after labelling was significantly increased at 19°C compared to 10°C, N_2O emissions showed no significant differences. There were also no significant differences of N_2O emissions between soil samples from control and elevated CO_2 rings within each temperature level. As the soil temperature (within the range of 10-19°C) had no significant effects on N transformations responsible for the observed doubling of N_2O emissions under eCO_2, it seems most likely that other factors like direct carbon input by plants and/or soil moisture differences between ambient and elevated rings in the field are responsible for the observed increase in N_2O emissions under eCO_2.