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Source portioning of N_2O emissions after long term elevation of soil temperature in a permanent grassland soil

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Several methods, such as source portioning, have been used to quantify the contributions of individual N pools to N_2O emissions. These methods however, assume the absence of hybrid reactions such as co-denitrification, which were previously identified as important. A straight forward method portioning N_2O fluxes into four different production processes, including a hybrid reaction, was therefore developed. This method portioned the N_2O fluxes in nitrification, denitrification, oxidation of organic matter and co-denitrification, using data on ^{45}R and ^{46}R of the N_2O flux and the ^{15}N content of the NO_3^- and NH_4^+ in the soil. This newly developed method was used to analyse the N_2O emissions from incubated soil, which was previously subjected to 6 years of elevated soil temperature of +0, +1, +2 or +3 ˚C. N_2O emissions were measured and analysed at four time points in the six days following, $NO_3^{15}\mathbf{NH}_4$ Gly or $^{15}\mathbf{NO}_3NH_4$ Gly, label addition. The oxidation of organic N was found to be the main source of N_2O fluxes at all sampling dates, comprising between 63 and 85% of the total N_2O flux. The percentage contribution made by organic N to N_2O fluxes increased over the sampling period, rising from a minimum of 40% in the control treatment, to virtually 100% across all treatments by Day 6. Compared to the control treatment, denitrification contributed less to N_2O from soil subjected to +2 and +3 ˚C warming ($p < 0.0001$ and $p=0.002$, respectively). Co-denitrification only contributed to the N_2O flux during the first day after substrate addition. The highest amount of N_2O produced via co-denitrification was found under the control treatment. From soil subjected to +2 and +3 ˚C treatments, the contribution of co-denitrification was minor. However, these differences in co-denitrification were not significant. This research showed the importance of the oxidation of organic N in N_2O emissions. It should therefore not be omitted as a potential source in source portioning. Emissions of N_2O in the first six days after fertilisation decreased for soils previously subjected to higher temperatures as a consequence of a reduction in the rates of denitrification and the oxidation of organic N.