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Can the intramolecular distribution of 15N in N2O be used to source partition N2O emitted from soil

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N2O is a potent greenhouse gas and plays an important role in the depletion of stratospheric ozone. Hence, many efforts are now geared towards quantifying and mitigating N2O emissions from soil in various ecosystems. This requires an in-depth understanding of the mechanisms and processes underlying N2O emissions, which has been methodologically challenging. Recently, it has been suggested that the intramolecular distribution of 15N in the N2O molecule (known as site preference or SP) can indicate which processes contribute to N2O fluxes. Here, we follow a framework of important validation steps to review the potential of SP to source partition N2O emitted from soils. In individual studies, significant effects of soil moisture content and soil type on SP values from soil-emitted N2O have been observed, supporting that SP could be a useful tool to source-partition N2O emitted from soil. While process-specific SP values based on pure culture studies have been used in isotope mixing and fractionation models to source partition N2O in environmental samples, effects of confounding factors such as unaccounted pathways, microbial community composition, process rate, and soil heterogeneity remain poorly quantified. This urges continued research to determine SP values for distinct N2O producing and consuming processes under controlled laboratory conditions for soils from a variety of ecosystems and environments. As mechanisms underlying N2O production and consumption are plentiful and complex, we recommend the creation of large isotope databases complemented with the development of more advanced models that take into account δ15N and δ18O of precursors, variability of overall isotope effects, and bulk δ15N, δ18O, and SP of N2O, as well as traditional proxies such as soil moisture content and C and N availability.