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Isotopic Constraints on the Global Budget and Trend of Atmospheric Nitrous Oxide

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The importance of N_2O arises from the fundamental role it plays in stratospheric chemistry and its extraordinary potency as a greenhouse molecule. There may be a future unintended source of N_2O. Ocean iron fertilization is being considered as a strategy for sequestering CO_2 from the atmosphere. Perhaps the most valuable insight we can gain from a deeper understanding of N_2O is a window into the nitrogen cycle. The use of isotopic fractionation data could reduce uncertainties in the sources and sinks of a biogenic species, as is well known in the study of CO_2 and CH_4. We develop a simple model for various isotopologues of nitrous oxide ($^{14}N^{14}N^{16}O$, $^{14}N^{15}N^{16}O$, $^{15}N^{14}N^{16}O$, $^{14}N^{14}N^{17}O$ and $^{14}N^{14}N^{18}O$). The model is based on laboratory kinetics measurements and constrained to reproduce the age of air in the stratosphere. We study two types of models. The standard model assumes that the primary sources of N_2O are the land, the ocean and agriculture, and the primary sink is destruction in the stratosphere. The non-standard model explores two additional hypotheses: the consequences of a climate-related slowdown of the Brewer-Dobson circulation that transports N_2O from the troposphere to the stratosphere and the effect of a biological sink for N_2O in the soil.