Geophysical Research Abstracts
Vol. 14, EGU2012-13228, 2012
EGU General Assembly 2012

Novel instrumentation for direct measurements of site-specific isotopic nitrogen and isotopic oxygen in ambient nitrous oxide

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The stable isotope composition of atmosphere trace gases provides information of their origin and fate that cannot be determined from their mole fraction measurements alone. Biological source and loss processes, like bacterial production of N_2O, are typically accompanied by isotopic selectivity associated with the kinetics of bond formation and destruction. Due to the relatively low N_2O concentration in ambient air, of the three major biologically mediated greenhouse gases (CO_2, CH_4 and N_2O), the understanding of N_2O isotopic budget lags behind the other gases.

We report on the development of novel instrumentation for real-time measurements of site-specific isotopic nitrogen and of isotopic oxygen ($\delta^{15}N^a$, $\delta^{15}N^b$, $\delta^{15}N$, $\delta^{18}O$) and mole fraction [N_2O] of nitrous oxide over a wide range of mixing ratios. This novel technology, which employs cavity enhanced absorption and a mid-infrared tunable quantum cascade laser and does not require any cryogenic components, has been developed for *in situ* simultaneous measurements of the mole fractions of main isotopomers – $^{14}N^{14}N^{16}O$, $^{15}N^{14}N^{16}O$, $^{14}N^{15}N^{16}O$ and $^{14}N^{14}N^{18}O$, which leads to the nitrogen-isotope ratio ($\delta^{15}N$) and the ^{15}N site-specific enrichment. A precision of better than 1 per mil may be achieved in ambient air (with 320 ppb N_2O) in less than 100 seconds measurement time. For higher mole fractions, which may be obtained using preconcentration, better precision (approaching 0.1 per mil) may be achieved. Further details on the operation and performance of the instrument will be presented.