



Laser spectroscopic analysis of ambient N₂O isotopomers for source identification

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The intramolecular distribution of ¹⁵N in N₂O can be used to obtain important information on the geochemical cycle of N₂O because many biological and chemical processes have distinct isotopic signatures. N₂O is a linear, non-symmetric molecule (N–N–O), with one nitrogen atom at the center (a site) and one at the end (b site). Therefore, one can distinguish between two structural isomers containing one heavy isotope of nitrogen, namely ¹⁴N¹⁵N¹⁶O and ¹⁵N¹⁴N¹⁶O, referred to as ¹⁵Na and ¹⁵Nb, respectively.

Employing recently available quantum cascade lasers (QCL) we are able to perform continuous and precise analysis (0.1 per mille) of the site-specific isotopic ratios d¹⁵Na and d¹⁵Nb of N₂O [1]. Coupling the QCL spectrometer to a specifically engineered liquid nitrogen free and fully-automated preconcentration unit we achieve quasi-continuous and high precision analysis of N₂O isotopomers at ambient concentrations [2].

Results from recent measurement campaigns will be presented ranging from continuous analysis of N₂O isotopomers (1 Hz) at elevated concentrations in soil and wastewater incubation experiments to ambient air monitoring of N₂O isotopic ratios. Incubation experiments under controlled conditions were performed to determine the site-specific isotopic signatures of distinct N₂O source and sink processes. These source signatures in combination with ambient N₂O isotopomer time series can then be employed for source allocation and partitioning on a local, regional or even global scale.

[1] Wächter, H., Mohn, J., Tuzson, B., Emmenegger, L., and Sigrist, M. W.: Determination of N₂O isotopomers with quantum cascade laser based absorption spectroscopy, *Opt. Express*, 16, 9239–9244, 2008.

[2] Mohn, J., Guggenheim, C., Tuzson, B., Vollmer, M. K., Toyoda, S., Yoshida, N. and Emmenegger, L., A liquid nitrogen-free preconcentration unit for measurements of ambient N₂O isotopomers by QCLAS, *Atmos. Meas. Tech.*, 3, 609–618, 2010.