O-24

Session 7) 40th anniversary of N_2O isotopomer research

40 years of N_2O isotopomer research: Advances in analytics and exemplary applications

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Variations of nitrogen isotope ratios in N_2O in nature were first reported by Yoshida et al. 40 years ago [1,2]. Subsequent studies have developed analytical techniques for oxygen isotope ratios, intramolecular nitrogen isotope distribution (isotopomers), and molecules doubly substituted with heavy isotopes (clumped isotopes).

In the pioneering works, N_2O had to be converted to N_2 and O_2/CO_2 for elemental isotope ratio measurements on an isotope ratio mass spectrometer (IRMS) with double collectors. But modern IRMS equipped with multi-collector system and GC has enabled direct mass analysis of N_2O and its fragment NO from gas/water samples [3]. More recently, high-resolution IRMS allows analyses of clumped N_2O molecules and $^{17}O/^{16}O$ ratio that is a key parameter to assess non-mass dependent fractionation of three O isotopes [4].

Mid-IR laser spectroscopy has been established as a complementary approach, offering high temporal resolved data and selectivity for isotopomers. Depending on the target isotopic species and research question, analyzers employing different wavelength regions and detection schemes are at hand [5]. Using different analytical settings, applications ranging from on-line analysis in ambient air to high-precision analysis of clumped isotopic species have been realized [6].

Analysis of N_2O isotopomers/isotopologues/isotopocules has been applied to elucidate the global cycle and production/decomposition mechanisms of this greenhouse gas and ozone-depleting gas in the atmosphere, hydrosphere, and biosphere. We would like to review N_2O isotope studies to date and discuss current achievements and future challenges.

References

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