Development of new N_2O reference materials for $\delta^{15}N$, $\delta^{18}O$ and ^{15}N site preference within the EMPIR project SIRS

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In recent years, research on nitrous oxide (N_2O) stable isotopes has significantly advanced, addressing an increasing number of research questions in biogeochemical and atmospheric sciences [1]. An important milestone was the development of optical isotope ratio spectroscopy (OIRS), which is inherently specific for structural isomers ($^{15}N^{14}N^{16}O$ vs. $^{14}N^{15}N^{16}O$) and capable to collect real-time data with high temporal resolution, complementary to the well-established isotope-ratio mass-spectrometry (IRMS) method.

The compatibility between different IRMS and OIRS laboratories, however, was shown to be limited, in particular for ^{15}N site preference, i.e. the difference between ^{15}N abundance in central (N*NO) and end (*NNO) position [2]. This was attributed to two reasons, first no WMO-GAW Central Calibration Laboratory (CCL) for N_2O stable isotopes currently exists and second no international reference material in the form of gaseous N_2O with stated uncertainty is available. In addition, the accuracy of the NH_4NO_3 decomposition reaction, which provides the link between ^{15}N site preference and the international $^{15}N/^{14}N$ scale, was recently found to be limited by non-quantitative NH_4NO_3 decomposition in combination with substantially different isotope enrichment factors for both nitrogen atoms [3].

The above tasks will be addressed in the upcoming European Metrology Programme for Innovation and Research (EMPIR) project “Metrology for Stable Isotope Reference Standards (SIRS)” 2017-2020. With respect to N_2O reference materials the SIRS project will focus on the following subjects:

1) Develop improved techniques to characterise N_2O gases for $\delta^{15}N$, $\delta^{18}O$ and the ^{15}N site preference with reference to the respective international isotope ratio scales including an uncertainty assessment.
2) Develop at least three new international gaseous N_2O reference materials for $\delta^{15}N^{\alpha}$, $\delta^{15}N^{\beta}$, $\delta^{15}N$ and $\delta^{18}O$, available both as pure substance and diluted in whole air.

References

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