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A comparison of commercially-available laser spectrometers to measure N2O isotopocules (δ15Nα, δ15Nβ & δ18O) at ambient mole fractions

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Nitrous oxide (N2O) is a potent greenhouse gas with a global warming potential roughly 300 times that of carbon dioxide. Its abundance has been increasing with increased human agriculture. While the concentration and increase of N2O has not been on the same scale as for carbon dioxide and methane, it still constitutes a relevant addition to the anthropogenic climate change. Monitoring its changes is therefore relevant to understanding the effect it will have on the climate.
Due to the molecular structure, N2O has three different relevant isotopic compositions besides the most common one of 14-14-16. The location of heavier isotopes in the molecule carries information about its formation, destruction and source of origin. Measuring changes in the ratio of these can therefore help explain and track the changes observed in the concentration of N2O.
The abundances of these isotopocules are by their nature low, which puts high demand on the analysis method, in order to pick up on the minute changes in it. Methods of measurements have therefore previously been limited to mass spectrometry, which does not lend itself easily to field measurements.
In the past two decades spectroscopic measurements have developed significantly by the development of quantum cascade laser spectrometry, cavity ring down technique and better sensors to the point where the peaks of the isotopocules of N2O can be reliably resolved.
In this study we compare three commercially-available instruments using spectroscopy to resolve the concentration of N2O and its isotopocules. The instruments in question are N2OIA-30e-EP model 914-0027 by LGR, G5131-I by Picarro, and QC-TILDAS by Aerodyne.
Our comparison investigate the instruments precision, stability, and response to changes in the matrix. Through this work we hope to provide guidance on which instrument are best suited for the intended measurements, as well as informing about the limitations and providing the proper way to correct the collected data.