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Atmospheric nitrate and its isotopic composition

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In the recent years, isotopic ratio analyses of atmospheric trace species have gained a renewed interest thank to the sensitivity improvements of the analytical instrumentation and the discovery of the so-called oxygen and sulphur isotope anomalies, caused by Mass Independent isotopic Fractionation (MIF).

Nitrate is probably the species that symbolizes the most these modern advances. The recent analytical developments have allowed establishing the full isotopic cartography of nitrate, i.e. δ^{15}N, δ^{17}O and δ^{18}O, at 10s of a nanomol level. Such a feat has opened new fields of investigation unimaginable just a few years ago and adds to the concentration measurement alone a whole new dimension with a wealth of information about environmental cycles and processes. Now, oxygen and nitrogen isotopes of nitrate can be measured in variety of environments such as the ice, atmosphere, ocean and sediments at a sampling resolution compatible with the dynamics of such natural systems. Nitrogen isotopes of nitrate enable us to better understand the atmospheric nitrogen cycle quantifying sinks and sources. In addition, the discovery of large oxygen isotope anomalies in nitrate, inherited from ozone during oxidation processes, boosted the analysis of the long disregarded ^{17}O stable isotope, with the idea in mind that the oxygen isotopes of nitrate should reflect the oxidation history of the nitrogen oxides and thus should possess some kind of information about the oxidation state of the atmosphere. If true, we are at the door step of the development of a quantitative proxy for the relationship between climate fluctuations and the oxidative capacity of the atmosphere using ice core records of nitrate.

During my talk, I will present an overview of our recent findings on the isotopic composition of atmospheric nitrate and its environmental conditions of formation. I will show how the oxygen and nitrogen isotopes of nitrate carry the imprint of the chemical

state of the atmosphere and its physical conditions, travelling from South Pole to the North Pole and discuss future research needed in the atmospheric sciences to integrate these observations into a modelling framework.