

Modelling volcanic sulphates: numerical modelling of isotopic mass-independent fractionations in tropospheric sulphates

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Atmospheric sulphates play an important role in the radiative balance of the Earth. Volcanic emissions and volcanic eruptions are among the major natural sources of sulphur in the atmosphere. Once injected in the atmosphere, volcanic sulphur is oxidized and finally converted to sulphate particles. However, there are still significant uncertainties pertaining to the atmospheric oxidation of sulphur at different layers of the atmosphere and in different regions of the planet. Mass-independent isotopic fractionations (MIF) of sulphur oxidized species can be used as quantitative markers of oxidation pathways in the atmosphere, and as a constraint to the sulphur cycle. The majority of the oxygen MIF anomalies observed in sulphates originate from the ozone anomaly transferred during the reactions of oxidation, while photolysis of sulphur species is mainly responsible for sulphur MIF anomalies in the atmosphere.

We present here the analysis of the isotopic data using a photochemical box-model (CiTTyCAT) that contains a detailed description of tropospheric chemistry. It can be coupled to a Lagrangian model (FLEXPART) to simulate the transport of chemically evolving air masses. We have added a sulphur chemistry scheme, including heterogeneous chemistry in aqueous phase. We have also implemented, linked to the sulphur scheme, an isotope sulphur oxygen scheme that allows to model the time evolution of MIF-oxygen in volcanic sulphate during the oxidation of volcanic sulphur. The modeled volcanic sulphate MIF anomalies are compared to the isotopic composition of sulphate samples collected from volcanic deposits of different regions of the planet.