1.038 Isotopic constraints on sulfate and nitrate aerosol formation mechanisms in Chinese haze events.

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Abstract:

An estimated 1.6 million people die prematurely annually in China due to severe air pollution. Particulate matter smaller than 2.5 microns in diameter ($PM_{2.5}$) is the worst offender, and concentrations can reach upwards of 500 mg m^{-3}. Observations have shown that secondary inorganic aerosols (sulfate, nitrate, ammonia) are a large component $PM_{2.5}$ mass, and that their mass fractions increase substantially during haze events, suggesting increased heterogeneous formation rates. Models have been unable to simulate the high concentrations of $PM_{2.5}$ and sulfate that are observed, and this low model bias has been attributed to a missing chemical source of sulfate aerosol production in models. We present observations of the oxygen isotopic composition of sulfate and nitrate aerosol from samples collected in fall and winter in Beijing. The oxygen isotopes of secondary sulfate and nitrate aerosol are determined by their chemical formation pathways, and thus provide an observational constraint on the unique chemistry occurring in this megacity. We use a global model (GEOS-Chem) with a high-resolution nested grid over China, which contains the oxygen isotope tracers, to quantitatively interpret the isotope observations. We will provide the first observation-based estimate of the dominant formation mechanisms of sulfate and nitrate aerosol during Beijing haze events, and insight into the missing source of sulfate in air quality models.