4.008 Temperature dependence of bromine activation due to reaction of bromide with ozone in a proxy for aerosols and sea ice.

Early Career Scientist

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Abstract:

The discovery of boundary layer ozone depletion events (ODEs) in the Polar Regions and in the mid-latitudes, two areas of very different temperature regimes, begs the question of temperature dependence of reactions responsible for these observations. These ODEs have been attributed to ozone reacting with halides leading to the formation of reactive halogen species (halogen activation) of which bromide is extensively studied, R1 – R3 (“mp” means multiphase reaction).

$O_3 + Br^- \rightarrow O_2 + OBr^-$ mp (R1)

$OBr^- + H^+ \leftrightarrow HOBr$ (R2)

$HOBr + H^+ \rightarrow Br_2 + H_2O$ (R3)

Despite extensive studies of ozone-bromide interactions in different media, the temperature dependene of and the role of the matrix on bromide activation are not clear; this limits the parameterization of the relevant processes in atmospheric models. In addition, properties of the matrix such as diffusivity (and viscosity), and gas solubility, which are also temperature dependent are not well characterized for binary and complex matrices involving both organics and inorganics, and at low temperatures (such as in aerosols, snow, or sea ice). In bromide-ozone systems, these properties influence the reactive uptake of ozone.

With the application of flow tubes, the aim of this study is to investigate the temperature dependence of bromine activation via ozone interaction in a bromide containing film. Citric acid was used as a hygroscopically characterized matrix in the film, which is of relevance to atmospheric chemistry.

We present reactive ozone uptake measured between 258 and 289 K. The data show high reproducibility. With available knowledge, we have compared the measured uptake with modelled bulk uptake while accounting for temperature dependence of the substrate’s properties. The extrapolated model parameters are discussed.