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Temperature dependence of bromine activation due to reaction with ozone in a proxy for organic aerosols

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The discovery of boundary layer ozone depletion events in the Polar Regions [1] and in the mid-latitudes [2], two areas of very different temperature regimes, begs the question of temperature dependence of reactions responsible for these observations [3]. These ODEs have been attributed to ozone reacting with halides leading to reactive halogens (halogen activation) of which bromide is extensively studied, R1 – R3 [4, 5] (R1 is a multiphase reaction).

$$O_3 + Br^- \rightarrow O_2 + OBr^- \quad \text{(R1)}$$

$$OBr^- + H^+ \leftrightarrow HOBr \quad \text{(R2)}$$

$$HOBr + H^+ + Br^- \rightarrow Br_2 + H_2O \quad \text{(R3)}$$

Despite extensive studies of ozone-bromide interactions, the temperature dependence of bromine activation is not clear [3]. This limits parameterization of the involved reactions and factors in atmospheric models [3, 6]. Viscosity changes in the matrix (such as organic aerosols) due to temperature have been shown to influence heterogeneous reaction rates and products beyond pure temperature effect [7]. With the application of coated wall flow-tubes, the aim of this study is therefore to investigate the temperature dependence of bromine activation by ozone interaction while attempting to characterize the contributions of the bulk and surface reactions to observed ozone uptake. Citric acid is used in this study as a hygroscopically characterized matrix whose viscosity changes with temperature and humidity.

Here, we present reactive ozone uptake measured between 258 and 289 K. The data show high reproducibility. Comparison of measured uptake with modelled bulk uptake at different matrix compositions (and viscosities) indicate that bulk reactive uptake dominates, but there are other factors which still need further consideration in the model.

References

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