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Bulk and Surface reactivity in frozen salt-organic-ice mixtures.

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Tropospheric ozone depletion events (ODEs) via halogen activation are observed in both cold and warm climates [1-3]. Very recently, it was suggested that this multiphase halogen activation chemistry is the dominates in the tropical and subtropical upper troposphere. These occurrences beg the question of temperature dependence of halogen activation in sea-salt aerosol, which are often mixtures of sea-salt and organic molecules.

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 as a proxy for mixed organic – sea-salt aersol. Citric acid is used in this study as a hygroscopically characterized matrix and a proxy for oxidized organics, which is of relevance to atmospheric chemistry. Here, we present reactive ozone uptake measured between 258 and 289 K. The data show high reproducibility. With available knowledge, we have reproduced the measured uptake with modelled bulk and surface uptake while accounting for temperature dependence of the substrate's properties as diffusivity, viscosity, and gas solubility.

The data give evidence of the importance of surface and bulk processes in frozen systems. Further, the modelling of the bulk chemistry in these cold and viscous matrixes is discussed in detail.

This work is part of a cross-disciplinary project with the aim to investigate the impact of metamorphism on impurity location in aging snow and its consequences for chemical reactivity. Metamorphism drastically shapes the structure and physical properties of snow, which has impacts on heat transfer, albedo, and avalanche formation. Such changes can be driven by water vapour fluxes in dry metamorphism with a mass turnover of as much as 60% per day - much greater than previously thought. The consequences for atmospheric science are a current question of research. Here, we we also aim at addressing how the re-distribution of solutes during snow metamorphism in artificial snow impacts chemical reactivity.

Significance statement

Sea salt aerosol contain organics. Little is know about their reactivity to release halogens at Polar temperatures.

Primary author: EDEBELI, Jacinta (Paul Scherrer Institut)

Co-author: BARTELS-RAUSCH, Thorsten (Paul Scherrer Institut)

Presenter: BARTELS-RAUSCH, Thorsten (Paul Scherrer Institut)

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