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High resolution satellite observations and simulations of tropospheric BrO in a warming Arctic

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Abstract

Bromine Explosion Events (BEEs) have been observed since the late 1980s in the Arctic and Antarctic region and play an important role in tropospheric chemistry. In a heterogeneous, autocatalytic, chemical chain reaction cycle inorganic bromine is released from the cryosphere into the troposphere and depletes ozone often to below detection limit. Hence, BEEs occur in conjunction with Ozone Depletion Events (ODEs). Ozone is a source of the most important tropospheric oxidizing agent OH and the oxidizing capacity and radiative forcing of the troposphere are thus impacted. Bromine also reacts with and removes gaseous mercury, thereby enhancing the deposition of toxic mercury, which has adverse environmental impacts. It is assumed that cold saline surfaces, such as young sea ice, frost flowers, and snow are likely bromine sources involved in the bromine explosion. Different meteorological conditions seem to favor the development of BEEs. On the one hand low wind speeds and a stable boundary layer, where bromine can accumulate and deplete ozone. On the other hand high wind speeds above approximately 10 m/s with blowing snow and a higher unstable boundary layer. In high wind speed conditions, occurring for example along fronts of polar cyclones, recycling of bromine on snow and aerosol surfaces may take place aloft.

In order to investigate the changes of BrO in the troposphere, an already established long-term BrO satellite remote sensing data set by Bougoudis et al. (2020) will be extended. Here, a positive trend in tropospheric BrO was detected. To understand the development of the trend in tropospheric BrO in a warming Arctic – occurring as a result of changes in sea ice, temperature, etc. – an improved understanding on the formation, meteorological conditions, and sources of BEEs is required. Therefore case studies of BEEs, with a focus on the MOSAIC campaign are carried out, using high resolution S5P TROPOMI retrievals of BrO together with meteorological simulations by the WRF model and Lagrangian transport simulations of BrO by FLEXPART-WRF. In this talk an introduction on bromine in the Arctic as well as first simulation results from two case studies will be presented.