Comparison of satellite tropospheric BrO observations with model simulations in the Arctic

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Bianca Zilker, Andreas Richter, Stefanie Falk, Luca Reißig, Björn-Martin Sinnhuber, Jennie Thomas, Hartmut Bösch

1. Introduction and Motivation

Bromine Explosion Events (BEEs) and Ozone Depletion Events (ODEs)

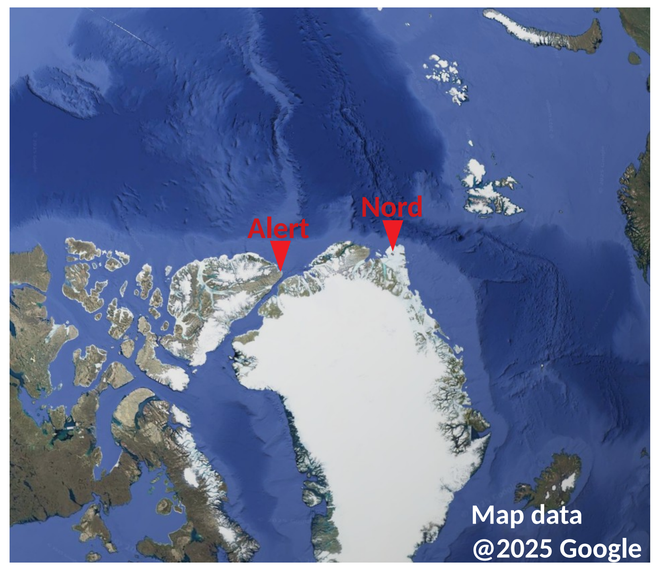
- During polar spring explosive release of halogens (mainly Br) from the cryosphere often coincides with low concentrations of tropospheric ozone
- 3D atmospheric models often underestimate the amount of halogens and overestimate ozone during such events
- The implementation of polar halogen chemistry and its influence on tropospheric ozone remains an ongoing task for atmospheric models

Arctic Bromine Model Intercomparison Project

- Comparison and evlaluation of different 3D atmospheric models that include polar halogen chemistry to study BEEs and ODEs during Arctic spring
- Participating models: WRF-Chem, **EMAC**, CAM-CHEM, Geos-Chem, GEM-MACH-Arctic, p-TOMCAT
- The model results are evaluated against each other and in situ and satellite observations in two different case studies: Spring 2012 and Spring 2020
- University of Bremen provides BrO satellite measurements from GOME2b for 2012 and TROPOMI for 2020

Goals of this study

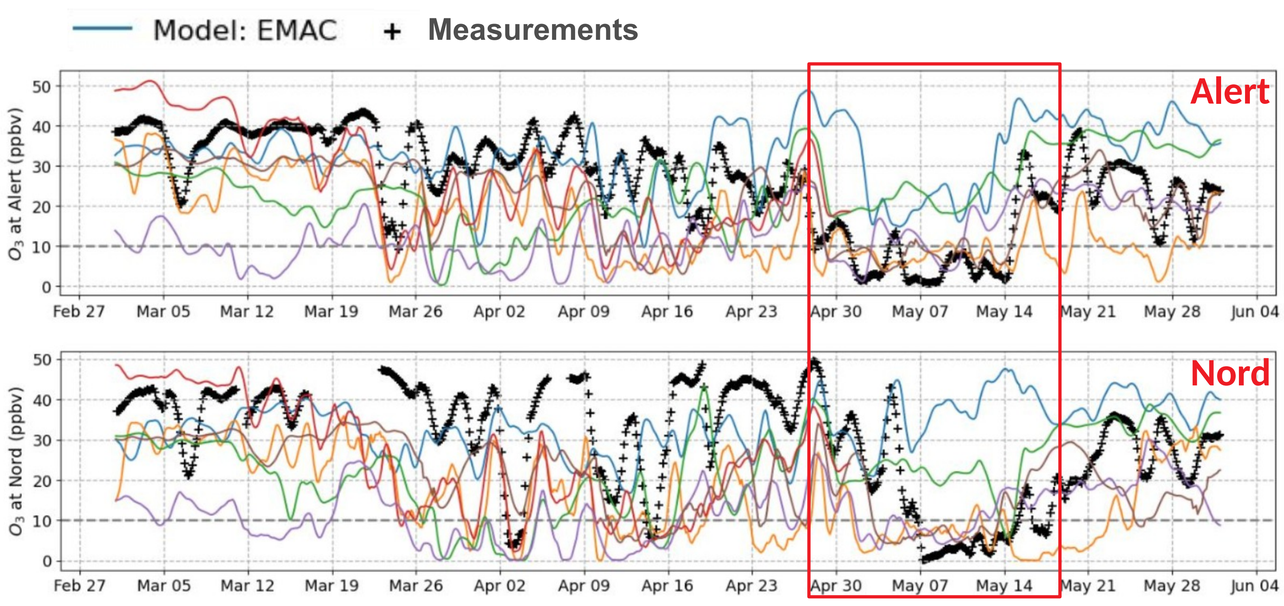
Comparison and evaluation of TROPOMI tropospheric BrO against 3D atmospheric models which include polar halogen sources in the Arctic for Spring 2012 and Spring 2020.



2. Case Study: End of April/Beginning of May 2020

Severe ODEs observed at two stations:

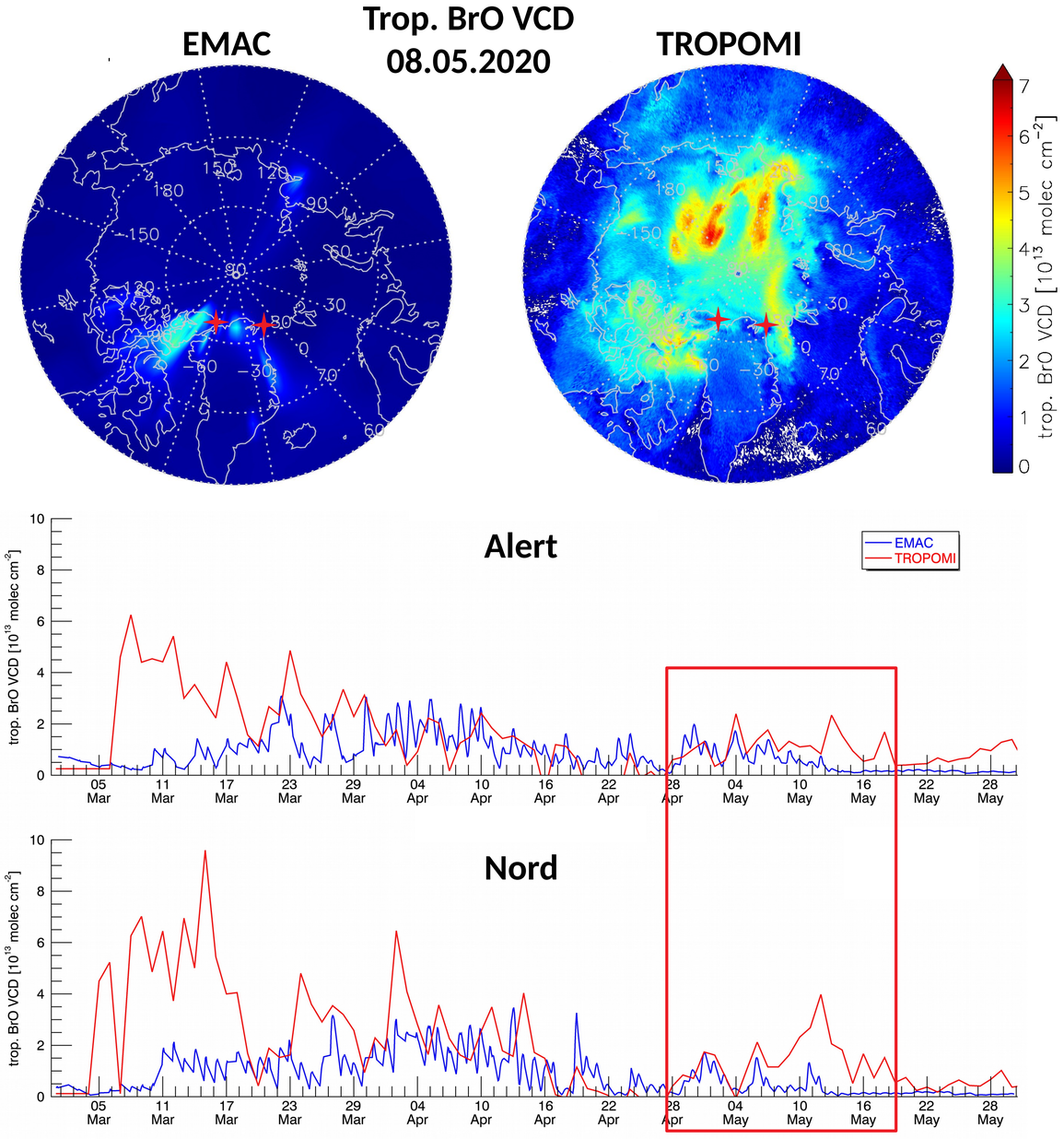
- Ozone loss is observed at the Canadian station Alert and the Greenland station Nord, and is reproduced by several, but not all, models
- The EMAC model shows ozone loss at *Alert*, but does not reproduce the observed ozone depletion at station *Nord*



Role of atmospheric transport during ODEs:

- Ozone is mainly depleted by the reaction of $Br + O_3 \rightarrow BrO + O_2$ in the lower troposphere → enhanced BrO values in this region
- Ozone depletion takes place at measurement site → high BrO
- Already ozone depleted air is transported to measurement site → low BrO

3. Comparison with TROPOMI trop. BrO column



4. Conclusions and Outlook

Conclusions

- EMAC model reproduced ODE at Alert, but not at Nord
- Large discrepancy in spatial distribution and magnitude of trop. BrO columns between EMAC model and TROPOMI for test days
- High TROPOMI BrO values in early spring may be too large
- Reasonable agreement between TROPOMI and EMAC trop. BrO during case study period

Outlook

- Improvements in modelling tropospheric ozone and BrO needed
- Improvement of the TROPOMI trop. BrO retrieval regarding stratospheric correction and air mass factor is in progress
- Comparison with other models from the model intercomparison project is planned

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