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Consistent simulation of bromine chemistry from the marine boundary layer to the stratopause

A. Kerkweg, P. Jöckel, R. Sander, H. Tost and J. Lelieveld
Max-Planck-Institute for Chemistry, Mainz, Germany

Until recently, model studies of tropospheric bromine chemistry were performed with box or column models. To our knowledge, the only global model studies performed so far used chemical transport models (CTMs) and contained parameterised reactive halogen sources. In our approach, we avoid most of these assumptions. Using the atmospheric chemistry general circulation model ECHAM5/MESSy we simulate bromine chemistry consistently from the surface up to the stratopause. Emissions of sea salt aerosol as the largest surface source and the chemistry in both, the gas phase and the aerosol phase are calculated explicitly, leading to a fully prognostically determined bromine release from the aerosol into the gas phase. As an additional bromine source, we included ocean emissions of several bromocarbons. Their degradation by photolysis and stratospheric halogen chemistry are also part of the model setup.

So far little is known about the origin of reactive bromine in the free troposphere. Potential sources are local production (photolysis of bromocarbons), upward transport from the boundary layer, and downward transport from the stratosphere. Due to the complex setup of our model simulation, we are able to assess the main sources of bromine in the free troposphere. Additionally, we investigate the aerosol pH, which is determined prognostically in our model, as well as the influence of halogen chemistry on other gas phase species, e.g. ozone and OH.