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Tropospheric bromine chemistry and impacts on ozone

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An off-line 3D tropospheric chemical transport model p-TOMCAT has been extended by incorporating a detailed bromine chemistry scheme, which contains gas-phase reactions and heterogeneous reactions on both cloud particles and background aerosols. Bromine emission from bromocarbons dissociation and sea-salt bromine depletion and bromine removal through dry and wet deposition are all included. Using this model, tropospheric bromine chemistry and ozone budgets are studied. The zonal mean of the sum of inorganic gas phase bromine compounds (BrX) is calculated to be 2-8 ppt in most of the troposphere, excluding low latitudes where the mixing ratio is less than 2 ppt in both hemispheres. Sea-salt Br emission plays the dominant role in total BrX in the lower troposphere while organic Br-containing compounds are important in upper layers. Several ppt of BrO over ocean under sunlit conditions is found in mid- to high-latitudes, with the level of BrO depending not only on total BrX but also on other factors such as ozone and solar irradiance. The addition of bromine chemistry to the model gives a reduction in tropospheric zonal mean ozone by 3-10% in the NH and 4-28% in the SH depending on both latitude and seasons. The hydrolysis reaction of bromine nitrate, which occurs on cloud and aerosol surfaces, (BrONO2 + H2O(aq) —HOBr + HNO3) has a significant influence on ozone chemistry through reducing tropospheric NOx and increasing the proportion of BrX available as Br and BrO.