5.112 Impact of tropospheric halogen chemistry on tropospheric composition. .

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Abstract:

Historically the impact of halogens (Cl, Br, I) on the composition of the troposphere has been considered insignificant outside of the polar springtime and so has not been included in climate or air quality models. However, over the last decade it has become increasingly evident that they may play a important role. To provide some insight into this role we have included halogen (Cl, Br, I) chemistry within both the global and regional version of the GEOSChem model. Emissions of anthropogenic and biogenic halocarbons (CH_3X, CH_2X_2, CHX_3), ocean sourced inorganic iodine compounds (I_2, HOI), sea-salt source of Br_y and Cl_y (IX, $ClNO_3$) together with stratospheric sources are included. We have a moderately detailed gas phase chemistry together with a simplified representation of heterogeneous / aerosol phase chemistry.
We find a range of effects of halogens on the composition of the global troposphere. Globally, we find that I and Br play a role in determining the global ozone budget, constituting around ~20% of the chemical sink. They also alter OH sources and its cycling, leading to 5.5% decrease in mean OH concentrations. Iodine also provides a source of aerosol material in the remote tropical oceans. Chlorine chemistry plays a minor role in methane oxidation but appears to play a much more significant role in the budget of other hydrocarbons and oxygenates (notable ethane, propane and acetone). Simulated halogen emissions are lower in the preindustrial due to reduced anthropogenic emissions resulting in less active chemistry. Thus halogens chemistry has mitigated the anthropogenic increase in tropospheric ozone over the last centuries. We calcualte that this has reduced the radiative forcing of tropospheric ozone significantly.