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Heterogeneous uptake of HO_2 by aerosols: Quantifying the chemical indirect effect of aerosols on climate

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Aerosols can impact the global atmosphere in various ways. One of these is by providing a surface on which reactions between adsorbed gas-phase components may occur. These reactions perturb chemical processing in the atmosphere, leading to changes in the concentrations of climate-relevant species, such as methane (CH_4) and carbon dioxide (CO_2). This can be regarded as a chemical indirect effect of aerosols on climate. Quantifying the impact of this effect is one of the current challenges facing climate science.

Heterogeneous chemistry has been included in models for well over a decade. Much of the focus on reactive uptake is on nitrogen species, such as N_2O_5, NO_2, and NO. HO_2 is also taken up by aerosol. The rate of uptake of gas-phase species to aerosol is usually represented in models by the parameter gamma (γ), which is defined as 'the probability that a molecule impacting the surface of the aerosol undergoes a reaction'. The first modelling studies to include uptake of HO_2 used a gamma HO_2 value of 0.2, a value based on recommendations from a review.

Recently, more lab data for uptake of HO_2 has become available, including uptake information for different aerosol types, and some information on how uptake varies with temperature and humidity. This new lab data has been used to create a more detailed parameterisation for uptake of HO_2 by aerosol.

The GEOS-Chem chemistry transport model has been used to investigate the impact of the new parameterisation for uptake of HO_2. The global mean gamma for HO_2 is found to be 0.03, much smaller than assumed previously. Large regional changes in atmospheric oxidants are associated with this reduced uptake. Subsequent impacts on lifetimes of relevant climate gases are discussed.