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Global Modelling of Chemistry and Aerosols: The Role of Halogen Species

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Observational and model studies have shown that halogen species chlorine, bromine and iodine play an important role in the chemistry of the troposphere. Understanding how halogens influence NOx, HOx and ozone is key to understanding the oxidative capacity of the troposphere. Furthermore, halogen interactions with atmospheric aerosols in the marine boundary layer are important for the partitioning of reactive and reservoir halogen compounds. Heterogeneous reactions on sea salt and sulphate aerosol cycle halogen reservoir species (HBr, BrNO3 and HOBr) to more reactive forms (Br and Br2).

In clean marine regions halogens may also play an important role in cloud formation processes. Gas-phase oxidation of DMS by BrO and IO and aqueous phase phase reaction of SO2 with HOCl and HOBr are thought to reduce the amount of SO2 derived from DMS. It has been suggested that reduced SO2, a precursor species to H2SO4 will ultimately reduce the formation of CCN derived from DMS. Quantification of this hypothesis will require the use of detailed coupled models of aerosols and chemistry.

In this work we have combined a detailed 3-D tropospheric chemical transport model (TOMCAT) with a detailed size-resolved aerosol microphysics scheme (GLOMAP) to produce a fully coupled aerosol/chemistry model. The chemistry scheme includes standard tropospheric gas phase chemistry for HOx-NOy-Ox-SOx-C1 to C3 NMHCs and isoprene. The aerosol microphysics scheme contains nucleation, cloud processing, dry and wet deposition, coagulation, condensation and in and below cloud scavenging Emissions of sea salt, DMS, antropogenic and volcanic SO2, dust, organic carbon, black carbon and secondary aerosols can be used. The microphysics scheme uses a two

moment sectional scheme containing 20 size bins allowing for accurate modelling of complex aerosol size distributions. The addition of a detailed chemistry scheme allows us to study halogen sulphur/aerosol interactions.

We will first show how the use of the interactive chemistry has improved the calculated aerosol distributions compared to previous GLOMAP studies using specified, monthly mean oxidants. We will then quantify the rate of release of bromine from sea salt aerosol and compare that with observations and other models. We will also compare the relative importance of assumed macroalgae sources in the model. The impact of bromine on the oxidative capacity of the atmosphere and on DMS oxidation will also be discussed.