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First validation of the new aerosol dynamics and thermodynamics model GM7/EQSAM3: a comparison with observations

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Computer models of atmospheric aerosol particles are important tools for the examination of the effect of aerosols on climate. Considerable progress has been made in the past decade in the further development of aerosol models, but one area that has only recently been addressed is the treatment of aerosol ionic composition in global models. Aerosol models typically carry "lumped" aerosol components; they have a generic "sea-salt" or "mineral dust" tracer rather than considering the individual ions that make up the aerosol. This limits the accuracy with which aerosol hygroscopic growth can be calculated, which has important implications for the calculation of direct radiative forcing.

The coupled aerosol microphysics and thermodynamics model GM7/EQSAM2 has been developed to address this problem. The model considers distributions of primary black and organic carbon and various inorganic and organic compounds. It treats major cations and anions, including $NH4^{+}$, $NO3^{-}$, Cl^{-}, K^{+}, Na^{+}, Mg^{+} and $SO4^{2-}$, formate, acetate, oxalate citrate in order to explicitly determine the gas/liquid/solid partitioning and hygroscopic growth of the corresponding salt compounds. The model will be described in more detail in a companion paper (Metzger: Introducing the GM7/EQSAM3 aerodynamics and thermodynamics model).

In this paper we present an initial validation of the model, including a comparison with the observational datasets of EMEP (Europe) and CASTNET (North America). We show that the model is capable of capturing key features of the observed aerosol

distribution. The model also compares well with models submitted to the AeroCom model inter-comparison project. Results from GM7/EQSAM will be compared to detailed aerosol compositional data collected during the ACE-Asia field campaign. This model validation work allows us to identify the strengths and weakness in the setup of this new aerosol thermodynamics model and target areas for future research.