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Tropospheric aerosol size distributions simulated by three online global aerosol models using the M7 microphysics module

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The LIAM aerosol module developed at the LASG laboratory in Beijing and the HAM module of the Max Planck Institute of Meteorology are both designed for research on aerosol-climate interaction. They share the same schemes for aerosol microphysics, but differ in other aspects such as mobilization of sea salt and dust, sulfur chemistry and dry/wet deposition. In this study we couple LIAM to two AGCMs (i.e., GAMIL and CAM3), and compare the simulated tropospheric aerosol size distribution with the ECHAM5-HAM system and against observations.

One of the major findings is that in the ECHAM5-HAM system conversion of particles from the soluble Aitken and accumulation mode to the soluble coarse mode is significantly stronger than in the other two models, resulting in lower number concentrations in the two modes of smaller size and higher value in the coarse mode. This is possibly because in the ECHAM5-HAM system, larger dimethyl sulfide (DMS) emission, stronger oxidation of SO_2 by OH, and weaker dry deposition of SO_2 lead to a larger total production of gaseous sulfuric acid and thus stronger condensation on existing particles.

Number concentrations of the nucleation mode simulated by the three models also differ significantly. This is closely related to discrepancies in the relative humidity resulting from different transport properties and algorithms for humidity calculation.