



Simulation of Cloud Drop Concentration and Effective Radius over Europe

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A parameterization is developed for explicit simulation of aerosol activation, cloud drop effective radius and pH-dependent aqueous phase chemistry, and this was implemented in the global aerosol-climate model ECHAM5/HAM. The module HAM represents emissions of aerosol and aerosol precursors, chemical transformations, nucleation and condensation of aerosol species, and dry and wet removal. The cloud processing parameterization uses the simulated aerosol size distribution and chemical characteristics, together with the cloud liquid water, updraft speed and temperature, to predict the cloud drop number concentration (CDNC) due to particle activation. Subsequently, sulfate formation in the droplets due to oxidation of sulfur dioxide by ozone and hydrogen peroxide is calculated. In this study we will focus on model results obtained for Europe. We will present the simulated CDNC and the effective cloud drop radius over the continent and adjacent regions, and compare these with (remotely sensed) observations. Generally, the model underestimates CDNC especially in marine regions, but it qualitatively reproduces observed correlations between the atmospheric sulfate concentration and CDNC. The sensitivity of the simulated cloud drop radius to inaccuracies in relevant parameters, such as the updraft velocity at the cloud base, the solubility of aerosol organic matter and the in-cloud sulfate production, is also explored. Finally we will assess the role of European pollution on simulated cloud characteristics.