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Detailed simulation of CDNC and aqueous chemistry in a global climate model: first results

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We adapted and extended a cloud processing parameterization that enables simulation of the cloud drop number concentration (cdnc), cloud drop radius and pH-dependent aqueous phase chemistry in large scale models. The parameterization is implemented in the global climate model ECHAM5 that is coupled to an aerosol dynamical module (HAM). ECHAM5-HAM calculates emissions of aerosol and aerosol precursors, chemical transformations, nucleation and condensation of aerosol species, atmospheric transport of aerosol, and dry and wet removal. The core of the aerosol module is M7 which represents four soluble and three unsoluble aerosol modes. The cloud processing parameterization is currently restricted to the simulation of large scale clouds. Calculation of cdnc is based on estimation of the maximum supersaturation at the cloud base using the bulk liquid water content, updraft speed, temperature, and aerosol modal parameters (particle number concentration, average dry size, standard deviation, chemical composition) as input. Further, aqueous phase formation of sulfate through oxidation of dissolved SO_2 by ozone and hydrogen peroxide is evaluated while distinguishing between relatively diluted and polluted cloud drops. We will present the simulated spatial and seasonal global distribution of cdnc and the effective radius, and compare them qualitatively and quantitatively with (remotely sensed) observations. The sensitivity of the simulated cloud microphysics and chemistry to, e.g., the updraft velocity, the solubility of organic matter, sulfur emissions and the abundance of oxidants, will be discussed.