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What are the Microphysical Properties of Clouds in an Atmosphere without Human-Induced Pollution?

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The composition of the atmosphere without any man-made emissions is controlled by biogenic and volcanic emissions and wind-driven particle emissions from the pedosphere and the ocean. Biogenic sources include phytoplankton, emission of volatile organic carbon (VOC) compounds by plants and reduced sulfur emissions from vegetation and soils. Besides mineral dust and biomass burning emissions, organics formed from biogenic VOC was likely the dominating aerosol over continents. The different chemical composition of present-day and past climate aerosol loading might affect the subset of aerosols acting as cloud condensation nuclei and subsequently the microphysical properties of clouds.

We will present some exploratory model simulations contrasting the climate system in the absence of human-induced aerosol and VOC emissions with that in the presence of such emissions. In particular, cloud properties will be simulated for present-day emissions and contrasted to a scenario where anthropogenic emissions are switched off.
The atmospheric general circulation model ECHAM5 used for this study includes the aerosol model HAM and has been extended by an emission model and a module for secondary organic aerosol (SOA). The updated model treats SOA formed from the anthropogenic precursors toluene, xylene and benzene and from the biogenic precursors isoprene and monoterpenes. SOA-specific modelled processes are precursor emissions, gas-phase formation of SOA and gas-aerosol phase partitioning of SOA. Aerosol microphysical and sink processes (dry and wet removal) are treated with minor modifications to the existing model. The VOC emissions from plants are calculated dependent on surface temperature and photosynthetically active radiation flux.