The influence of biogenic aerosol particles on clouds and climate

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The reflectivity and extent of the global cloud cover is, besides meteorological parameters, depending on microphysical properties of clouds, i.e. the number and size of the cloud droplets and cloud ice particles. These depend strongly on the physical and chemical properties of the underlying particle population. Due to the release of primary biological aerosol particles (PABP, e.g. pollen, spores, and bacteria) and the emission of gases (e.g. isoprene and terpenes) that lead to the formation of so-called secondary organic aerosol (SOA), the vegetation directly influences the number, size, and chemical composition of atmospheric particles.

To date, the interactions between aerosol particles and clouds represent one major source of uncertainty of climate models (IPCC, 2013). Moreover, it is a challenge to quantify how vegetation on land will respond to climate change by altering natural emissions of particles and gases. A subsequent feedback onto cloud properties, the formation of precipitation, and atmospheric radiation may further influence climate change. Thus, the aerosol-cloud-interactions provide multiple mechanisms for ecosystem-cloud-climate feedbacks. It is unclear which ones are more important.

Treatments of emissions of primary biological particles are implemented in the global Earth System model EC-Earth (Hazeleger et al., 2012) and linked with recently implemented schemes describing the formation of secondary organic aerosol and aerosol-cloud-interactions. The EC-Earth version that is used consists of the well-known meteorological driver IFS (Integrated Forecasting System) and the atmospheric chemistry and transport model TM5 (van Noije et al., 2014). TM5 makes use of the aerosol module M7 (Vignati et al., 2004). The PBAPs are emitted in the insoluble coarse mode. The emission flux depends on 10m wind speed, relative humidity, season, and vegetation cover. Fig. 1 shows a snapshot of the bacteria number concentration during the simulation.

The model is applied for a set of sensitivity studies concerning the implemented parameterizations as well as to assess feedbacks between surface meteorological properties, PBAP emissions from vegetation, and cloud properties, both regionally and globally.

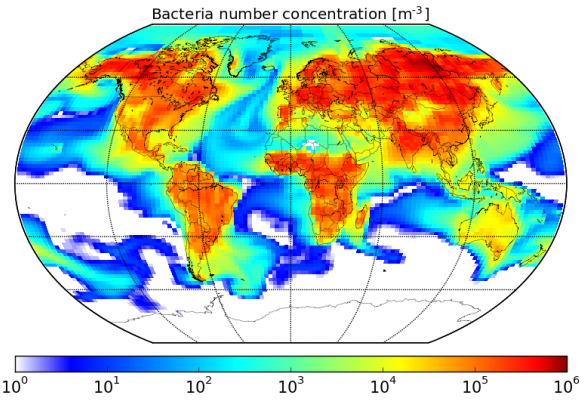

Figure 1. Modelled number concentration of bacteria.

This study is a contribution to the Swedish strategic research area ModElling the Regional and Global Earth system, MERGE.

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