Geophysical Research Abstracts
Vol. 14, EGU2012-9208, 2012
EGU General Assembly 2012

Aerosol cloud processing with the global model ECHAM5-HAM-SALSA

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Atmospheric aerosols and their interactions with clouds constitute the largest uncertainty in the radiative forcing of the Earth's atmosphere. Increasing aerosol number concentrations increases the cloud droplet concentration and droplet surface and hence the cloud albedo. This mechanism is called the aerosol indirect effect on climate. Understanding the changes in cloud droplet number concentrations and size by anthropogenic aerosols are the key factors in the study of future climate change. Therefore the aerosols' formation and growth from nanoparticles to cloud condensation nuclei (CCN) must be described accurately.

The formation and growth of aerosols are shown to be described more accurately with sectional representations than with bulk (total aerosol mass only), modal (lognormal modes describing mass and number size distribution) or moment (processes tied to different moments of particle number size distribution) approaches. Recently the sectional aerosol models have been implemented to global climate models. However, the resolution of sectional models must be optimised to reduce the computational cost. We have implemented the sectional aerosol model SALSA in ECHAM5-HAM. SALSA describes the aerosol population with 20 size sections. The dynamics are optimised for large scale applications and the model includes an improved moving center sectional method. The particulate mass consists of five compounds: sulphate, organic carbon, black carbon, sea salt and dust.

The aerosol processing has been studied extensively and there are many numerical models used to predict CCN number concentrations. However, due to computational limitations many of them are not suitable for utilisation in global climate models. Therefore in most global climate studies on aerosol activation to CCN is examined using cloud activation parameterisations. We study the aerosol cloud processing and its affect on transport of aerosols using Abdul-Razzak-Ghan aerosol cloud activation parameterisation in ECHAM5-HAM utilising the aerosol microphysical models SALSA and M7. We will present a comparison of the global particle size distributions predicted with and without cloud activation parameterisation to evaluate the effect of cloud processing on the aerosol size distribution.