Modelling Aerosol-cloud interactions in GCMs

Ulrike Lohmann

ETH-Zurich

Aerosols affect the climate system by changing cloud characteristics in many ways. They act as cloud condensation and ice nuclei, they may inhibit freezing and they could have an influence on the hydrological cycle. Traditionally the cloud albedo enhancement (Twomey effect) of warm stratiform clouds received most attention so far and is the only indirect aerosol forcing considered in transient climate simulations. In addition to the cloud albedo effect, the more and smaller cloud droplets in polluted stratiform clouds decrease the precipitation formation, thus, increasing cloud lifetime. Which of these two effects is more important for partly offsetting the greenhouse gas warming is not known yet. In addition, an increase in ice nuclei can result in a rapid glaciation of a supercooled liquid water cloud due to the difference in vapour pressure over ice and water. Unlike cloud droplets, these ice crystals grow in an environment of high supersaturation with respect to ice, quickly reaching precipitation size, and with that can turn a non-precipitating into a precipitating cloud (glaciation effect). In this talk, I will discuss the multitude of aerosol effects on clouds and climate.