Geophysical Research Abstracts,
Vol. 11, EGU2009-8649-1, 2009
EGU General Assembly 2009

A modelling study on the role of dust and salt aerosol particles in cloud

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Natural born aerosols have profound impacts on the thermodynamic and radiative energy budgets of the Earth. They change the optical properties of the atmosphere and redistribute the radiation fluxes between earth and sun while they can also serve as efficient Cloud Condensation Nuclei (CCN) and Ice Nuclei (IN) changing the microphysical and radiative properties of the clouds. However there is still significant amount of uncertainty regarding the aerosol – weather interaction mechanisms. In an attempt to examine such interactions, the Nenes and Seinfeld cloud droplet nucleation parameterization has been implemented in the Integrated Community Limited Area Modeling System (ICLAMS). ICLAMS is an enhanced version of the Regional Atmospheric Modeling System - RAMS6.0. Apart from all standard RAMS features (explicit microphysics, high resolution two-way nesting etc.) ICLAMS also includes soil dust, sea salt, gas and aqueous phase chemistry, gas to particle conversion and heterogeneous processes. These new parameterizations describe the cycle of airborne and natural particles in the atmosphere, their feedbacks and interactions with clouds, radiation and water cycle.

Soil dust and sea spray aerosol particles are considered to fit into lognormal size distributions . However, due to size dependent deposition mechanisms, the properties of these distributions are expected to change throughout the transportation paths. Since these parameters (number mean diameter and geometric dispersion) are important for the CCN nucleation process they are explicitly calculated at every model grid point and timestep. Also, the chemical properties of dust particles are associated to the origin of the particles as well as to the various chemical transformations that occur along the transportation paths. Aged dust clouds may include particles that are coated with sea salt or sulfates thus having increased CCN efficiency. On the other hand, insoluble mineral dust is an efficient ice nucleus (IN) participating in heterogeneous ice nucleation processes. ICLAMS has the capability to explicitly resolve both the chemical and size properties of aerosol on cloud-scale grid resolution.

In this presentation the effects of aerosol size distribution and chemical composition on the formation and development of clouds and precipitation is discussed. More specifically, an event recorded over the Eastern Mediterranean during the MEIDEX experiment is analyzed. During this event, a frontal system moving from Crete towards the Middle-East coast produced heavy precipitation over the sea and some coastal areas. On the same time significant amounts of dust and sea spray particles were recorded over the region. Various model simulations regarding different sets of aerosol composition characteristics were performed and the results are discussed and compared to available ground and satellite measurements.