Name of research institute or organization:

Max Planck Institute for Chemistry, Biogeochemistry Department

Title of project:

Investigation of cloud condensation nuclei properties

Project leader and team:

Dr. Ulrich Pöschl, project leader
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Project description:

During the Cloud and Aerosol Characterization Experiment (CLACE-5), which took place in February and March 2006, we measured cloud condensation nuclei (CCN) concentrations and efficiencies using a CCN counter (Droplet Measurement Technologies, DMT). CCN are those particles in the atmospheric aerosol that can serve as nuclei onto which water vapor condenses to form cloud droplets at a given water vapor supersaturation. The influence of aerosol particles on clouds and precipitation is one of the central questions of current atmospheric and climate research. CCN activity and its relation to other properties of aerosol particles from different sources and regions are, however, not yet well characterized.

The CCN counter is an instrument in which aerosol particles are exposed to a defined water vapor supersaturation (typically 0.1-1.5%). Water droplets form on the particles which are activated as CCN, and their concentration is determined by an optical particle counter.

During the experiment, either total CCN concentrations (CCN concentration of polydisperse aerosol) or size resolved CCN concentrations and effiencies were measured. In the size resolved mode, in which the instrument was operated most of the time, the aerosol particles were size-segregated before entering the CCN counter, and a condensation particle counter (CPC) determined the total concentration of monodisperse particles (CN). Thus the CCN efficiency (CCN/CN) was obtained as a function of particle diameter and water vapor supersaturation (CCN efficiency spectra).

The available data comprises total CCN concentrations for the periods 22.2. 20:00 – 23.2.2006 10:00 and 21.3.2006 0:00 – 10:00, and CCN efficiency spectra for the period 23.2. 10:00 – 21.3.2006 0:00. For full processing and analysis of the CCN data (charge corrections, calculation of CCN concentrations and size distributions), aerosol particle number size distributions are required and will be provided by the project partner PSI.

Preliminary results from the beginning of the campaign (22.2. 20:00 – 23.2.2006 10:00), show that for supersaturation levels of 0.1-0.9% the total concentration of CCN was in the range of 10-200 cm^{-1}, corresponding to 1-15 % of the total aerosol particle number concentration. At the end of the campaign (21.3.2006 0:00 – 10:00), the average concentration of CCN was in the same range, although the total concentration of particles was much less (~ 500 cm^{-1}).

The diameter at which 50% of the particles are activated (D_{50}) was obtained from CCN efficiency spectra. For the supersaturation levels of 0.1, 0.3, 0.5, 0.7, 0.9% the

average values of D_{50} were 145, 78, 62, 47, and 36 nm, respectively. The D_{50} is a parameter frequently used to assess how efficiently the aerosol can form cloud droplets. The measured D_{50} values were about 30% higher than those of pure ammonium sulfate.

Key words:

aerosol, cloud condensation nuclei (CCN), activation, supersaturation

Collaborating partners/networks:

Paul Scherrer Institut, Villigen, Switzerland; Max Planck Institute for Chemistry, Particle Chemistry Department

Scientific publications and public outreach 2006:

Conference papers

Rose, D., G. P. Frank, U. Dusek, M. Gysel, E. Weingartner, S. Walter, J. Curtius, and U. Pöschl, Cloud condensation nuclei (CCN) concentrations and efficiencies on Jungfraujoch during the CLACE-5 campaign, European Geosciences Union General Assembly 2007 Vienna, Austria, 15 – 20 April 2007.

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