Geophysical Research Abstracts, Vol. 9, 05268, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-05268

Aerosol Partitioning in Mixed-Phase Clouds

E. Weingartner (1), B. Verheggen (1,2), U. Lohmann (2), J. Cozic (1), M. Gysel (1), U. Baltensperger (1), S. Mertes (3), K.N. Bower (4), P. Connolly (4), M. Flynn (4), J. Crosier (4), M. Gallagher (4), H. Coe (4), T. Choularton (4), S. Walter (5), J. Schneider (5), J. Curtius (6), S. Borrmann (5,6), A. Petzold (7), M. Ebert (8), A. Worringen (8), S. Weinbruch (8)

(1) Paul Scherrer Institut, Laboratory of Atmospheric Chemistry, Villigen PSI, Switzerland, (2) Institute of Atmospheric and Climate Sciences, ETH Zurich, Switzerland, (3) Leibniz-Institute for Tropospheric Research, Leipzig, Germany, (4) University of Manchester, Manchester, United Kingdom, (5) Max Planck Institute for Chemistry, Mainz, Germany, (6) Johannes Gutenberg University, Mainz, Germany, (7) German Aerospace Centre, Wessling, Germany, (8) Technical University Darmstadt, Darmstadt, Germany (Contact: ernest.weingartner@psi.ch)

Intensive measurement campaigns have been conducted at the high alpine research station Jungfraujoch (JFJ, 3580 m asl; 46.55^{o}N, 7.98^{o}E) in Switzerland. These Cloud and Aerosol Characterization Experiments (CLACE) are designed to investigate the chemical composition of aerosol particles, their hygroscopic properties and their interaction with clouds. A main focus is the investigation of the aerosol-cloud interaction processes in mixed-phase clouds. The results are expected to contribute to a better understanding of the indirect effect of aerosols on climate.

The campaigns take advantage of the outstanding feature of the high altitude research station Jungfraujoch allowing for ground-based in situ sampling of mixed phase clouds. State-of-the-art instrumentation was employed to characterize the aerosol size distribution (SMPS, OPC), size segregated chemical composition (AMS), cloud microphysics (PVM, FSSP, CPI, ADA), and particle morphology (ESEM). Different inlets are used for these instruments: A heated inlet (25 deg C) designed to evaporate cloud constituents at an early stage of sampling (i.e. sampling both cloud residual and interstitial particles), an interstitial inlet operated with a PM2 cyclone impactor and an ICE-CVI (Counterflow Virtual Impactor) inlet designed to sample residual particles of small ice crystals. Differencing the response downstream of the different inlets provides insight in the fractionation of the aerosol particles to these phases.

A major result from the latest CLACE campaigns is that in mixed phase clouds the activated fraction of aerosol particles is strongly dependent on the relative fraction of ice in the cloud. This is explained by the Bergeron-Findeisen process, which describes the effect of a water vapour flux from liquid droplets to ice crystals. The lower the ambient temperature, the more liquid droplets evaporate and a higher fraction of CCN is released back to the interstitial aerosol phase. This has important implications for our understanding of weather and climate, since the presence of a few ice crystals affects the cloud microphysical and radiative properties. Mineral dust and soot particles were found to be enriched in the ice phase residual samples indicating that these particles are potential ice nuclei. We used the observed partitioning to predict the ice crystal number concentration in a General Circulation Model. These observations lead to an enhanced ice phase with increased precipitation, resulting in a larger net aerosol indirect effect due to enhanced longwave cooling.