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The influence of ice on the partitioning of aerosol particles in mixed-phase clouds

B. Verheggen (1,2), J. Cozic (1), E. Weingartner (1), U. Baltensperger (1), S. Mertes (3), K.N. Bower (4), I.M. Flynn (4), P. Connolly (4), M. Gallagher (4), S. Walter (5), J. Schneider (5), J. Curtius (6), A. Petzold (7)

(1) Paul Scherrer Institute, Villigen PSI, Switzerland, (2) Energy Research Centre of the Netherlands ECN, Petten, the Netherlands, (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. (verheggen@ecn.nl)

Mixed phase clouds have been investigated during several Cloud and Aerosol Characterization Experiments (CLACE) at the Jungfraujoch in the Swiss Alps (3580 m). Ambient air was sampled using different inlets in order to determine the fraction of aerosol particles and of black carbon (BC) that has been incorporated into cloud droplets and ice crystals.

This scavenged fraction was found to decrease with increasing cloud ice mass fraction and with decreasing temperature from 0 to -25˚C. This can be explained by the Wegener-Bergeron-Findeisen process, which describes the effect of a water vapour flux from liquid droplets to ice crystals, thus releasing the formerly activated particles back into the interstitial phase. The presence of ice could also have prevented additional particles from activating. BC was found to be scavenged into the cloud phase to the same extent as the bulk aerosol, which suggests that BC was covered with soluble material through aging processes, rendering it more hygroscopic. However, BC was found to be enriched in small ice crystals compared to the bulk aerosol, suggesting that BC containing particles preferentially act as ice nuclei. If this finding is representative, it would mean that in addition to an indirect effect on liquid cloud formation, there is an indirect aerosol effect via glaciation of clouds.