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Activation Behaviour of Aerosol Particles and Black Carbon in mixed phase Clouds

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The interaction of aerosol particles with mixed phase clouds has been investigated during the latest Cloud and Aerosol Characterization Experiments (CLACE) during winter and summer 2004 and winter 2005 at the Jungfraujoch high alpine site. The site is located on an exposed mountain col (3580 m asl) in the Swiss Alps, offering the opportunity to sample clouds from a ground based platform.

Air is sampled via three different inlets: A total inlet, heated to 25 deg C designed to evaporate cloud particles, an interstitial inlet operated with a PM2 cyclone impactor to remove cloud particles and an ICE-CVI (Counterflow Virtual Impactor) inlet designed to sample residual particles of small ice crystals. A wide variety of physical and chemical parameters was determined downstream of these inlets and complemented by in-situ measurements of cloud microphysical parameters. The focus of this work is on the fractionation of aerosol particles (based on SMPS analysis) and Black Carbon (based on MAAP analysis) between the cloud phase and the interstitial phase by differencing the response downstream of the inlets.

The activated fraction of aerosol particles is found to decrease with increasing cloud ice fraction and with decreasing temperature from 0 to -25 deg C. This can be explained by the relative scarcity of ice nuclei as compared to cloud condensation nuclei, and by the Bergeron-Findeisen process, which describes the effect of a water vapour flux from liquid droplets to ice crystals, thus releasing the CCN back into the interstitial phase. The activation of Black Carbon (BC) shows a very similar dependency on

these parameters as the total particle volume, suggesting that BC is internally mixed into the aerosol. Other variables influencing the activated fraction include the total water content and the total number of aerosol particles, but only for those cases where these variables are a limiting factor for activation.