A 17 month climatology of the cloud condensation nuclei number concentration at the high alpine site Jungfraujoch

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Between May 2008 and September 2009 the cloud condensation nuclei (CCN) number concentration, N-CCN, was measured at the high alpine site Jungfraujoch, which is located in the free troposphere most of the time. Measurements at 10 different supersaturations (0.12%-1.18%) were made using a CCN counter (CCNC). The monthly median NCCN values show a distinct seasonal variability with similar to 5-12 times higher values in summer than in winter. The major part of this variation can be explained by the seasonal amplitude of total aerosol number concentration (similar to 4.5 times higher values in summer), but it is further amplified (factor of similar to 1.1-2.6) by a shift of the particle number size distribution toward slightly larger sizes in summer. In contrast to the extensive properties, the monthly median of the critical dry diameter, above which the aerosols activate as CCN, does not show a seasonal cycle (relative standard deviations of the monthly median critical dry diameters at the different supersaturations are 4-9%) or substantial variability (relative standard deviations of individual data points at the different supersaturations are less than 18-37%). The mean CCN-derived hygroscopicity of the aerosol corresponds to a value of the hygroscopicity parameter k of 0.20 (assuming a surface tension of pure water) with moderate supersaturation dependence. NCCN can be reliably predicted throughout the measurement period with knowledge of the above-mentioned averaged k value and highly time-resolved (similar to 5 min) particle number size distribution data. The predicted N-CCN was within 0.74 to 1.29 times the measured value during 80% of the time (94,499 data points in total at 10 different supersaturations).
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