The cloud condensation nuclei (CCN) rack on board of the HALO aircraft during ACRIDICON-CHUVA – Current state of data analysis

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We have employed a cloud condensation nuclei counter (CCNC) on board the research aircraft HALO during ACRIDICON-CHUVA, which has been conducted in September 2014 in Brazil. The scientific objective is to analyze the physical properties of aerosol particles as cloud droplet precursors and residuals. For this purpose, we used two different inlet systems in front of the CCNC for aerosol sampling: the HALO Aerosol Submicrometer Inlet (HASI) for the aerosol particles and the Counterflow Virtual Impactor (CVI) inlet to sample cloud droplets, evaporate the cloud water, and analyze the residual particles.

The CCN was measured by a two- column continuous-flow longitudinal thermal-gradient instrument (CCN-200) manufactured by DMT (Roberts and Nenes, 2005). It measures the CCN number concentration as a function of water vapor supersaturation (S), at a time resolution of 1 Hz. The instrument has been calibrated following Rose et al. (2008).

During the campaign the system was operated in two configurations: measuring in parallel at both inlets or at two different supersaturations at the same inlet. During cloud profiling flight maneuvers, Column B was measuring at the CVI inlet and Column A at the HASI inlet with supersaturations S(Column A)= $0.63\% \pm 0.07\%$ and $S(\text{Column B})=0.68\% \pm 0.07\%$. During in-cloud conditions only particles that have not been activated into cloud droplets (interstitial aerosol) can pass the HASI inlet (interstitial inlet). These measurements will be used to calculate the upper bound of the cloud peak supersaturation (Shigh) following Russell et al. (2013). Figure 1 shows the vertical profile of CCN number concentration under clean and polluted conditions. The red markers represent polluted air in an area south of Alta Floresta in Southern Brazil (flights AC12 18 Sept. 2014 and AC13 19 Sept. 2014). The CCN concentrations for polluted air are very high at low altitudes, have a minimum at 6 km, and then increase again above this altitude. The green markers represent the measurements in clean air around Boa Vista, north of Manaus, (flight AC09 11 Sept. 2014). The CCN concentrations for clean air have a minimum at 4 kilometers asl. and increase with the altitude. The large CCN concentration at high altitudes might be an indication for aerosol nucleation in the clouds. Based on data from the new ice experiment-cloud and aerosol

particle photometer (NIXE-CAPS) measurements, we will distinguish between in and out of cloud cases. The results will be compared with the measurements of the condensation particle counter (CPC), the single particle soot photometer (SP2), the Compact-Time-of-Flight-Aerosol-Mass-Spectrometer (C-ToF-AMS), as well as microspectroscopic analysis of aerosol samples. The C-ToF-AMS will provide quantitative measurements of chemical composition and the mass concentration of sub-micron non-refractory particles.

For out-of-cloud conditions, both columns were measuring at the HASI inlet, which acts as a total aerosol inlet for those conditions. By scanning the flow rate at Column A, the CCN number concentration was measured at different *S* from 0.22% \pm 0.07% to 0.68% \pm 0.07% Moore and Nenes (2009), Column B was measuring the CCN number concentration at one fixed *S*=0.66% \pm 0.10%, as a baseline CCN monitoring.

In parallel with the HALO measurements, groundbased aerosol measurements (i.e., size-resolved CCN studies) were performed in the context of GoAmazon at the remote ATTO site (T0 site). The measurement period covers about 11 months and will be continued. Figure 2 shows the preliminary results of the calculated kappa value for different diameters and the number size distribution at the ATTO site for September 2014. Kappa shows certain temporal variations and also a clear distinction between Aitken and accumulation mode.

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Fig. 1: Vertical profile of CCN number concentration under clean and polluted conditions (all at the HASI inlet).



Fig. 2: Time series of the number size distributions and the size-resolved kappa values at the ATTO site for Sept. 2014.

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