Aircraft and Ground-based Measurements of Cloud Condensation Nuclei (CCN) in and over the Tropical Rain Forest of Amazonia

M. L. Krüger[1], T. Klimach[1], C. Pöhlker[1], A. Afchine[2], R. Albrecht[3], M. O. Andreae[1], P. Artaxo[3], H. M. J. Barbosa[3], S. Borrmann[1], M. A. Cecchini[4], Y. Cheng[1], A. Costa[2], M. Dollner[5,6], D. Fütterer[5], A. Jefferson[7], M. Krämer[2], L. A. T. Machado[3], S. Mertes[8], D. Sauer[5,6], J. Schneider[1],C. Schulz[1], A. Spanu[5], H. Su[1], R. Thalman[9], A. Walser[5,6], J. Wang[9], B. Weinzierl[5,6], M. Wendisch[10], U.Pöschl[1]

[1] Max Planck Institute for Chemistry, Mainz, Germany, [2]Forschungszentrum Jülich, Jülich, Germany,[3] Universidade de Sao Paulo (USP), Brazil, [4]Instituto Nacional de Pesquisas Espaciais (INPE), Sao Jose dos Campos, Brazil, [5]Deutsches Zentrum für Luft- und Raumfahrt (DLR),Oberpfaffenhofen, Germany, [6]Ludwig-Maximilians-Universität, München, Germany, [7]National Oceanic and Atmospheric Administration (NOAA), USA, [8]Leibniz Institute for Tropospheric Research, 04318 Leipzig, Germany, [9]Brookhaven National Laboratory, Upton, NY; USA, [10]Universität Leipzig, Leipzig, Germany

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Presenting author email: m.kruger@mpic.de

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 and chemical 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 (HALO-CVI) inlet to sample cloud droplets, evaporate the cloud water, and analyze the residual particles.

During the campaign the two-column CCNC was operated in two configurations: measuring in parallel at both inlets (cloud profiling flight maneuvers) or at two different supersaturations (no cloud profiling flight maneuvers).

Figure 1 shows the vertical profile of CCN number concentration under clean and polluted conditions. The measurements were performed at the HASI inlet at a supersaturation(S) of (0.53±0.02) % during cloud profiling flight maneuvers and contain in cloud as well as out of cloud conditions. The red markers represent polluted air in an area south of Alta Floresta in Southern Brazil. The green markers represent the measurements in clean air around Boa Vista, north of Manaus. The CCN concentrations for polluted air are very high at low altitudes, have a minimum at 6 km asl, and then increase again above this altitude. The CCN concentration of clean air higher than 5 km asl are the same as for pollutant air. The large CCN concentration at high altitudes may be an indicator for new particle formation in the cloud. Using measurement data from the new ice experiment-cloud and aerosol particle photometer (NIXE-CAPS) we will distinguish between in-cloud and out-of-cloud conditions. The results will be compared to complementary aerosol measurement data from a condensation particle counter (CPC), a single particle soot photometer (SP2) and a compact time-of-flight aerosol mass spectrometer (C-ToF-AMS). The C-ToF-AMS data will provide quantitative chemical composition and mass concentrations of non-refractory sub-micron particles. In addition, we are planning to investigate single particles collected on impactor substrates using x-ray micro-spectroscopy.

For out-of-cloud conditions, both columns were measuring at the HASI inlet. By scanning the flow rate the CCN number concentration was measured at different S as suggested by Moore and Nenes (2009). This method together with aerosol size distribution measurements will provide us detailed information about the hygroscopicity of the particles.

In parallel with the HALO measurements, ground-based size-resolved CCN measurements were performed in the context of GoAmazon at the ATTO site, north of Manaus. The measurement period already covers 12 months and will be continued. Certain temporal variations and also a clear distinction between Aitken and accumulation mode of the measured Kappa value have been observed.

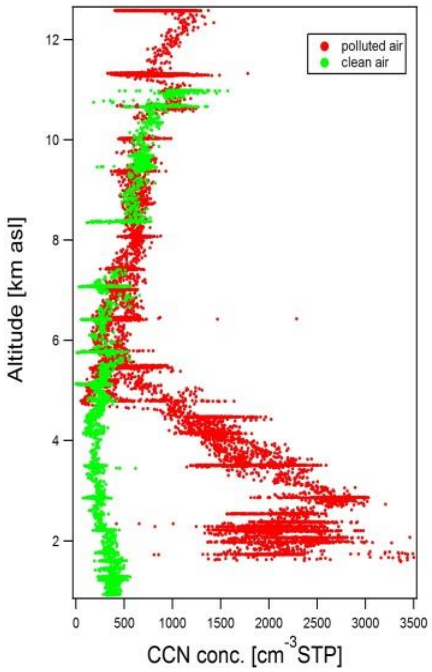

Fig. 1: Vertical profile of CCN number concentration under clean and polluted conditions.

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