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Vertical profiling of droplet and ice particle residuals sampled in tropical deep convec-tive cloud systems during ACRIDICON-CHUVA

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Airborne sampling of cloud particles inside deep convective clouds was conducted during the ACRIDICON-CHUVA campaign over Amazonia in September 2014 with the German research aircraft HALO (Wendisch et al, 2016). Beside other objectives, ACRIDICON-CHUVA investigated the vertical aerosol transport (comparison cloud base and anvil) and the cloud processing of aerosol particles (comparison in- and outflow) by tropical deep convective cloud systems in clean and polluted air masses and over forested and deforested regions.
The hydrometeors (drops and ice particles) are sampled by a counterflow virtual impactor (HALO-CVI) which has to be installed in the front part of the upper fuselage of the HALO aircraft. Such an intake position implies a decreased or increased abundance of cloud particles with respect to am-bient conditions depending on cloud particle size. On the other hand, this sampling location avoids that large ice crystals which potentially bias the cloud particle sampling by shattering and break-up at the inlet shroud and tip could enter the HALO-CVI.
Interstitial particles are rejected and the condensed phase is evaporated/sublimated by the CVI, such that the residuals from cloud droplets and ice particles (CDR and IPR) can be analyzed for number concentration, size distribution and chemical composition by respective aerosol sensors located in the cabin. In addition, the cloud particle concentration and size distribution was meas-ured by different cloud probes mounted under the aircraft wings. The comparison of residual and cloud particle concentration reveals a strong enhancement of cloud particle sampling due to the location of the CVI inlet aboard HALO, which has to be taken into account for quantitative examina-tions of residual particle number and mass concentration.
Information about the chemical composition of CDR and IPR was obtained by a Compact-Time-of-Flight-Aerosol-Mass-Spectrometer (C-ToF-AMS), a Single Particle Soot Photometer (SP-2) and a Particle Soot Absorption Photometer (PSAP). CDR concentration, size distribution, and chemical composition are found to be different for convective cloud systems evolving from more clean air masses compared to systems evolving from more polluted air masses. Moreover, significant dif-ferences in the aerosol chemical features of the residuals are observed between the lower and upper part of the deep convective clouds, which gives indications about the vertical transport and cloud processing of the aerosol particles activated at cloud base.
In the lower parts of the probed convective clouds up to 6 km and at temperatures above 0°C, the mean electrical charge of droplets was inferred by means of electrometer measurements. They change from negative to positive values with height in all observed clouds in a quite constant way, which should be considered in explanations of cloud electrification.

References:
Wendisch, M., Pöschl, U., Andreae, M. O. et al. (2016), BAMS, doi:10.1175/BAMS-D-14-00255.1