

Aerosol Enhancements in the Upper Troposphere Over The Amazon Forest: Do Amazonian Clouds Produce Aerosols?

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The German-Brazilian cooperative aircraft campaign ACRIDICON-CHUVA (Aerosol, Cloud, Precipitation, and Radiation Interactions and Dynamics of Convective Cloud Systems) on the German research aircraft HALO took place over the Amazon Basin in September/October 2014, with the objective of studying tropical deep convective clouds over the Amazon rainforest and their interactions with trace gases, aerosol particles, and atmospheric radiation. The aircraft was equipped with about 30 remote sensing and in-situ instruments for meteorological, trace gas, aerosol, cloud, precipitation, and solar radiation measurements. Fourteen research flights were conducted during this campaign.

Observations during ACRIDICON-CHUVA showed high aerosol concentrations in the upper troposphere (UT) over the Amazon Basin, with concentrations after normalization to standard conditions often exceeding those in the boundary layer (BL). This behavior was consistent between several aerosol metrics, including condensation nuclei (CN), cloud condensation nuclei (CCN), and chemical species mass concentrations. These UT aerosols were different in their composition and size distribution from the aerosol in the BL, making convective transport of particles unlikely as a source. The regions in the immediate outflow of deep convective clouds were found to be depleted in aerosol particles, whereas enhanced aerosol number and mass concentrations were found in UT regions that had experienced outflow from deep convection in the preceding 24–48 hours. This suggests that aerosol production takes place in the UT based on volatile and condensable material brought up by deep convection. Subsequently, downward mixing and transport of upper tropospheric aerosol may be a source of particles to the BL, where they increase in size by the condensation of biogenic volatile organic carbon (BVOC) oxidation products. This may be an important source of aerosol particles in the Amazonian BL, where aerosol nucleation and new particle formation has not been observed.