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Seasonal aerosol characteristics in the Amazon rain forest

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For the first time in Amazonia, continuous measurements of the vertical aerosol structure were carried out in the framework of EUCAARI (European Integrated Project on Aerosol, Cloud, Climate, Air Quality Interactions) and AMAZE-08 (Amazonian Aerosol Characterization Experiment). The observations were performed 60 km north of Manaus, Brazil (at 2° 35.5' S and 60° 2.3' W) in the central northern part of the Amazon rain forest from January to November 2008 with the automated multi-wavelength-Raman-polarization-lidar PollyXT. With this instrument, vertical profiles of the particle backscatter coefficient at 355, 532, and 1064 nm, of the particle extinction coefficient at 355 and 532 nm, and of the particle linear depolarization ratio at 355 nm can be determined. During the 10-months observational period, measurements were performed on 211 days resulting in more than 2500 hours of tropospheric aerosol and cloud profile observations.

The analysis of the long-term data set revealed strong differences in the aerosol characteristics between the wet and the dry season. In the wet season, very clean atmospheric conditions occurred in ca. 50% of all observation cases. During these clean conditions, the aerosol optical depth (AOD) at 532 nm was less than 0.05 and the aerosol was trapped in the lowermost 2 km of the troposphere. However, also intrusions of Saharan dust and African biomass-burning aerosol (BBA) - characterized by a significantly increased AOD and particle depolarization ratio - were observed in about one third (32%) of all lidar observations. These African aerosol plumes extended usually from the surface up to about 3.5 km agl.

During the dry season, BBA from fires on the South American continent was the dominant aerosol species. The mean AOD of the dry season was found to be a factor of 3 higher than the mean AOD of the wet season (0.26 compared to 0.08 at 532 nm). This is due to the high BBA concentration in the atmosphere. Maximum AOD values were less than 0.55 and hence show that the lidar location was not in the direct vicinity of fire events. An AOD below 0.1 was observed in only 7% of all cases in the dry season 2008. Significantly different geometrical, optical, and microphysical properties of BBA (e.g., vertical layering, extinction-to-backscatter ratio, Ångström exponent, effective radius, single-scattering albedo) were observed in dependence of the burning conditions, transport time, etc. The measurements also revealed that BBA can easily mix up to 3-5 km height and thus has the potential to affect cloud microphysics.