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Properties of refractory BC containing particles during the ACRIDICON-CHUVA aircraft campaign in the Amazon basin

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Black carbon (BC) particles are emitted directly into the atmosphere by processes of incomplete combustion and therefore can be used as a tracer of atmospheric pollution. BC is considered one of the drivers of global warming due to its efficient absorption of solar and infra-red radiation (Bond et al., 2013). Depending on abundance and size, aerosols can also modify the characteristics of clouds and enhance or suppress precipitation (Pöschl et al., 2010).

The BC particles can gain surface coatings by condensation of low and semi-volatile compounds, coagulation, and cloud processing. The inclusion of a non-absorbing coating influences the way that BC particles act as cloud nuclei and may increase their absorption through the lensing effect (Fuller et al., 1999). These aging processes change significantly the optical, chemical and physical properties of the particles, as well as their atmospheric lifetime, making BC a source of large uncertainties in current atmospheric models.

Taking into account the complex dynamics of BC particles in the atmosphere, we are analyzing data from the ACRIDICON-CHUVA aircraft campaign, which took place in the Amazon basin, Brazil, during the dry season of 2014 (Wendisch et al., 2016). A detailed characterization of BC particles was done using the Single Particle Soot Photometer (SP2) instrument, which directly measures the mass of individual refractory BC particles (rBC). Additionally, the SP2 provides information about the size distribution of rBC cores and their associated coatings. These properties were measured covering a wide geographic area with different pollution conditions and at several levels of the atmosphere at high time resolution.

The rBC concentrations change significantly with altitude and with the source of pollution, being a few nanograms per cubic meter for altitudes higher that 5 km. In the surroundings of Manaus city, the mean BC concentration was ∼0.7 μg/m3, with core sizes peaking at 180 nm. The highest BC mass values were observed over fresh biomass burning plumes (6 μg/m3) with smaller core sizes (∼150 nm). Moreover, in a specific flight (AC19) we identified an extended layer of pollution at 4 km altitude. Backward trajectories calculated using FLEXPART suggest that this pollution layer originated in Africa and has aged few days during its travel over the Atlantic. Similarities in the properties of rBC particles within the pollution and boundary layers suggest that the long range transport of pollution from Africa can be an important source of BC to the Amazonian atmosphere. Here we present first results from our analyses that characterize the various pollution aerosols and their properties in the Amazon basin.

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