Aerosol physical and chemical properties in the several sites of the GoAmazon 2014/15 Experiment: From biogenic to urban air pollution

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The central region of the Amazonian forest in the wet season is a pristine region in terms of aerosol, trace gases concentrations as well as cloud properties. In the wet season, Amazon is actually one of the cleanest continental region we can observe on Earth. As part of the GoAmazon 2014/15 experiment, several aerosol and trace gas monitoring stations are being operated for at least two years (2014-2015) before and after the Manaus urban plume. The idea is to analyse the effects of urban emissions in a pristine atmosphere in terms of aerosols, trace gases and cloud properties. Three sites are being operated in pristine conditions, with atmospheric properties mostly under natural biogenic conditions. After the air masses are exposed to the Manaus plume, one site (called T2) is being operated right on the opposite side of the Negro River under the direct influence of the Manaus plume 5 Km downwind of Manaus. Finally, at about 150 Km downwind of Manaus is the T3 Manacapuru site, operated by the DoE ARM program. Aerosol chemical composition is being analysed in real time using several Aerodyne AMS and ACSM (Aerosol Chemical Speciation Monitors) instruments. Aerosol size distribution, light scattering, light absorption, CCN activity and many other properties are being continuously measured. VOCs are measured using PTR-MS at most ground sites as well as in the G1 airplane. Concentrations of CO, O3, CO2, NO2 and SO2 were measured. Raman Lidars measure the aerosol column up to 12 Km providing the vertical profile of extinction. The aerosol column was measured using AERONET sunphotometers before and after the Manaus plume. Detailed air mass trajectory and WRRF-Chem simulations was performed at each 6 hours for 2014 and shows clearly the local and regional transport pattern, and helps guide the transformation process along the Manaus plume. Large-scale aircraft sampling was also performed for the wet and dry seasons using the DoE G1 platform as well as the DLR HALO G5 plane. The instrumented aircraft allowed the analysis of cloud droplets, aerosol properties and trace gas distribution at up to 12 Km height.

For both seasons, there is a common aerosol and trace gas component for all GoAmazon sampling sites. Over this background, urban air pollution from Manaus adds mostly black carbon as well as NOx and CO (Artaxo et al., 2013).

In the wet season, organic aerosol comprises 75-85% of fine mode aerosol, and sulphate and nitrate concentrations are very low. Aerosols are dominated by biogenic primary particles as well as SOA from biogenic precursors. Black carbon in the wet season accounts for 5-9% of fine mode aerosol. Ozone in the wet season peaks at 10-12 ppb at the middle of the day, while carbon monoxide averages at 50-80 ppb. Aerosol optical thickness (AOT) is a low 0.05 to 0.1 at 550 nm in the wet season. Sahara dust transport events sporadically enhance the concentration of soil dust aerosols and black carbon (Andreae et al., 2015).

In the dry season (August-December), long range transported biomass burning alters atmospheric composition very significantly. AOT can reach values as high as 2-3 at 550 nm, and concentrations of aerosol species and trace gases are strongly enriched. Ozone concentrations can reach 50 ppb downwind of Manaus. For both seasons it is possible to observe clearly the brown carbon component that is responsible to 20% of total absorption.

Aircraft measurements shows a clear impact of Manaus plume, with enhanced production of SOA, ozone, sulfate and nitrate downwind of Manaus. A strong enhacement in aerosol absorption was also observed.

The analysis of the results aims at delineating a contrasting picture between seasons as well as the anthropogenic impact on the measurements given the distinct seasonal backgrounds. The goal is to improve the understanding of anthropogenic influences on the submicron atmospheric particle population under different regional environmental conditions. A detailed comparison of aerosol characteristics and composition for the several sites will be presented together with the evolution of aerosol and trace gases in the GoAmazon2014-2015 experiment.

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