Aerosols in Amazonia: Urban impacts on a pristine atmosphere at GoAmazon 2014-15

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Keywords: Amazonia, Urban air pollution, biogenic emissions, aerosols, secondary organic aerosols.
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The central region of the Amazonian forest is a pristine region in terms of aerosol and trace gases concentrations. In the wet season, Amazonia is actually one of the cleanest continental region we can observe on Earth (Artaxo et al., 2013). As part of the GoAmazon2014 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. Three sites are being operated in pristine conditions, with atmospheric properties mostly under natural biogenic conditions. These three sites named T0 and are: ATTO (Amazon Tall Tower Observatory), (T0a) ZF2 ecological research site (T0z) and a third site called EMBRAPA (T0e). 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 at the Tiwa Hotel. Finally, at about 150 Km downwind of Manaus is the T3 Manacapuru site. Aerosol chemical composition (OC/EC and trace elements) is being analysed using filters for fine ($PM_{2.5}$) and coarse mode aerosol as well as several Aerodyne ACSM (Aerosol Chemical Speciation Monitors) instruments. VOCs are measured using PTR-MS at most ground sites as well as in the G1 airplane. CO, O3, CO_2, NO_2 and SO_2 are routinely measured. Aerosol absorption is being studied with AE33 aethalometers and MAAP (Multi Angle Absorption Photometers). Aerosol light scattering are being measured at several wavelengths using TSI and Ecotech nephelometers. Aerosol size distribution is determined using scanning mobility particle sizers at each site. Lidars measure the aerosol column up to 12 Km providing the vertical profile of extinction. The aerosol column is measures using AERONET sunphotometers before and after the Manaus plume, as well as several Lidar systems. Al sites are measuring dry aerosol properties. Two intensive operation periods (IOPs) took place in the wet season (February 1 – March 30) and in the dry season (August 15-October 15).

The three sites before the Manaus plume show remarkable similar variability in aerosol concentrations and optical properties. This pattern is very different at the T2 site, with large aerosol concentrations enhancing aerosol absorption and scattering significantly. The aerosol is quite oxidized before being exposed to the Manaus plume, and this pattern changes for T2 and T3 sites, with a much higher presence of less oxidized aerosol. Typical ozone concentrations in the wet season at mid-day before Manaus plume is a low 10-12 ppb, value that changes to 50-70 ppb for air masses suffering the influence of Manaus plume. Analysis by AMS shows that in both seasons, the organic species are dominant (70-85% in PM1 mass), followed by sulfate. In the wet season, the PM_1 mass concentration had typical values on order of 1 to 2 $\mu g/m^3$, whereas in the dry season mass concentrations were on average a factor of eight higher. Mass spectral features indicate a larger relative contribution of biomass burning derived compounds in the dry season.

Detailed air mass trajectory was performed each 6 hours for 2014 and shows clearly the local and regional transport pattern, and helps guide the transformation process along the Manaus plume. Additionally, high resolution WRF-Chem regional simulations helps to understand the processes related to secondary organic aerosol production and understand the sulphate aerosol formation from the SO_2 emissions from the Manaus city. Large scale aircraft sampling was performed for the wet and dry seasons using the DoE G1 platform.

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 air mass trajectories following the evolution of aerosol and trace gases in the GoAmazon2014-2015 experiment.

This work was supported by FAPESP grants 2013/05014-0, and 2013/50510-5. We also acknowledge support from CNPq grant 475735/2012-2 and the INCT – Global Change project from MCTI.

Artaxo, P., et al., Atmospheric aerosols in Amazonia and land use change: from natural biogenic to biomass burning conditions. Faraday Discussions, DOI:10.1039/C3FD00052D, 2013.