Optical properties of aerosol particles over the Amazon rain forest: From background to biomass burning conditions

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Atmospheric aerosols over the Amazon rainforest are strongly influenced by biomass burning activities in the southern regions of the Amazon Basin between July and October. This implies a complete change of the physical and chemical aerosol properties from the wet season, which is dominated by Primary Biological Aerosol Particles (PBAP) and biogenic secondary organic aerosols.

Biomass burning emissions are highly loaded with light-absorbing aerosols, like black and brown carbon (BC and BrC, respectively). The latter one consists of a fraction of organic carbon that is able to absorb visible radiation (Andreae and Gelencsér, 2006). BrC is a strong absorber at near-UV to UV wavelengths. Therefore, light absorption by this component is wavelength dependent. This wavelength dependency, expressed as the absorption Ångström exponent (AAE), has been used as a parameter to estimate the influence of biomass burning aerosols to total aerosol light absorption. However, the biogenic BrC contribution remains to be studied and could be significant under pristine conditions.

The measurements presented here were carried out at the Amazon Tall Tower Observatory (ATTO), located 150 km NE of the city of Manaus, in the Uatumã Sustainable Development Reserve in Amazonas State, Brazil. The aerosol inlet (60 m high, 2.5 cm diameter) is installed on an 81-m triangular mast. The measurement period, from June to September 2014, includes the wet-to-dry transition season (June-July) and part of the dry season (August and beginning of September). The optical properties were measured online by different instruments: 3-wavelengths nephelometer, Multi-Angle Absorption Photometer (MAAP), Single Particle Soot Photometer (SP2) and a 7-wavelength Aethalometer. Additionally, MAAP filter samples were analyzed by the Multi-Wavelength Absorbance Analyzer (MWAA) (Massabò et al, 2013), as well as levoglucosan analysis was carried out for filters collected between 18-22 August 2014. The average light absorption coefficient at 637 nm was 1.0 ± 0.6 Mm^{-1} and 5.5 ± 3.9 Mm^{-1}, during the wet-to-dry transition and the dry season, respectively.

Here we concentrate on measurements during 18-22 August 2014 (Figure 1) when a high absorption coefficient was measured at 637 nm, averaging 10 ± 3 Mm^{-1}. The AAE calculated from MWAA measurements increased from less than 1.0 to values higher than 1.4, indicating the presence of BrC aerosol particles. This period is characterized by a long-range transport of biomass burning aerosol (confirmed by backward trajectory analysis). Levoglucosan analysis reveals significantly increased concentration but is still relatively low compared to measurements close to the source (Graham *et al*, 2002). Nevertheless, AAE and levoglucosan concentration show a significant correlation ($r^2 > 0.9$).

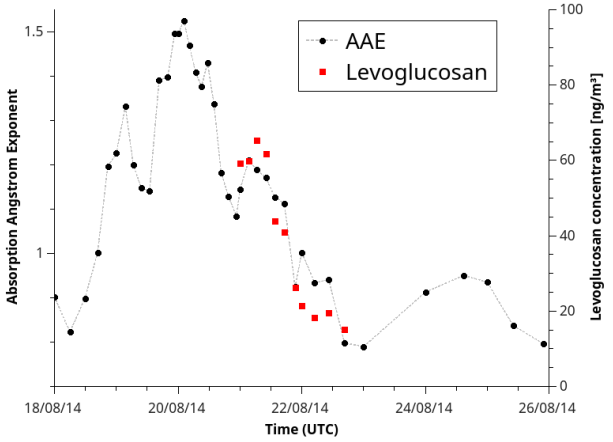

Figure 1. Levoglucosan and absorption Ångström exponent time series.

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