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Multi-wavelength aerosol light absorption measurements in the Amazon rainforest

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The most important light-absorbing aerosol is black carbon (BC), which is emitted by incomplete combustion of fossil fuels and biomass. BC is considered the second anthropogenic contributor to global warming. Beyond BC, other aerosols like some organics, dust, and primary biological aerosol particles are able to absorb radiation. In contrast to BC, the light absorption coefficient of these aerosols is wavelength dependent. Therefore, multi-wavelength measurements become important in environments where BC is not the predominant light-absorbing aerosol like in the Amazon. The Amazon Tall Tower Observatory (ATTO) site is located in the remote Amazon rainforest, one of the most pristine continental sites in the world during the wet season. In the dry season, winds coming from the southern hemisphere are loaded with biomass burning aerosol particles originated by farming-related deforestation. BC and aerosol number concentration data from the last two years indicate this is the most polluted period. Two different techniques have been implemented to measure the light absorption at different wavelengths; one of them is the 7-wavelengths Aethalometer, model AE30, an instrument that measures the light attenuation on a filter substrate and requires multiple scattering and filter-loading corrections to retrieve the light absorption coefficient. The other method is an offline technique, the Multi-Wavelength Absorbance Analysis (MWAA), which is able to measure reflectance and absorbance by aerosols collected on a filter and, by means of a radiative model, can retrieve the light absorption coefficient. Filters collected during May-September 2014, comprehending wet-to-dry transition and most of the dry season, were analyzed. The results indicate that the Absorption Ångström Exponent (AAE), a parameter that is directly proportional to the wavelength dependence of the aerosol light absorption, is close to 1.0 during the transition period and slightly decreases in the beginning of the dry season. However, during strong biomass burning episodes in the dry season, the AAE increases significantly, and reaches values higher than 1.3, indicating the presence of wavelength dependent light-absorbing aerosols like organics (brown carbon). The present study is a contribution to the understanding of the optical properties of light-absorbing aerosol particles under pristine and biomass-burning conditions.