The impact of anthropogenic emissions on the otherwise pristine Amazonian rainforest: Insights on aerosol dynamics as observed during GoAmazon2014/5

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The Amazon Basin during the wet season has one of the lowest aerosol concentrations worldwide, with air masses with negligible human impact covering thousands of kilometers of pristine forest. The atmosphere in such regions is strongly coupled with the biosphere through primary biological aerosols, biogenic salts, and secondary aerosols from oxidation of biogenic VOCs. The natural environment is strongly modified near urbanized areas, in particular Manaus, a city of nearly two million people. The urban pollution plume has high concentrations of oxides of nitrogen and sulfur, carbon monoxide, particle concentrations, and soot, among other pollutants, strongly contrasting with the clean air masses reaching the city. This unique location provides the ideal laboratory to study isolated urban emissions as well the pristine environment by perturbing it in a relatively known fashion. The GoAmazon experiment was designed with these questions in mind, combining remote sensing, in situ, and airborne measurements. This manuscript describes the measurements taken at the site upwind of Manaus, at the T0 site (the Amazonian Tall Tower Observatory, ATTO site), at the T2 site, near Manaus, frequently impacted by relatively fresh emissions from the city and at T3, some 60 km downwind of Manaus. This work relates the aerosol dynamics of the mixture of anthropogenic emissions from Manaus and the biogenic air masses, and how it evolves from T2 to T3 under different atmospheric conditions. Focus is on the aerosol size distribution, supported by aerosol mass spectrometry and gas-phase composition, in particular at the T2 site.

At T0, the aerosol number concentration has been observed to increase from an average of 380 cm^{-3} to 1750 cm^{-3} from the wet to the dry season. The mean geometric diameter increased as well, from 95 nm to 145 nm. Interestingly, at the T2 site no significant difference was observed in number concentration between wet and dry seasons (approximately 4300 cm^{-3}) with an average diameter of 60 nm during the former and 97 nm in the latter. At the T3 site, on the other hand, the aerosol number concentration during the dry season was nearly twice that observed during the wet season (1600 cm^{-3} versus 3000 cm^{-3}), however with similar geometric mean diameter as T2 during the wet season (60 nm) and higher during the dry season (120 nm). Further analyses include the use of chemical markers to identify periods of predominance of the Manaus plume and the study of aerosol evolution under different atmospheric conditions. Such measurements provide a unique dataset to understand the aerosol life cycle and the impact of urban emissions in the heart of the Amazon Forest.

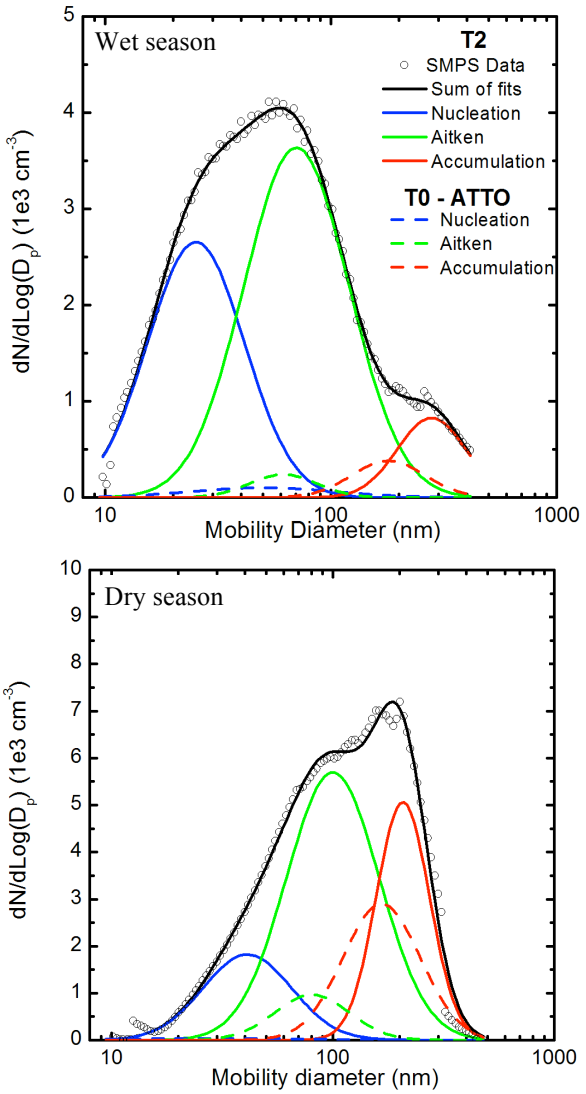

Figure 1. Average size distribution at T0 and T2 during wet (top) and dry seasons (bottom).