Evidence for anthropogenic pollution allowing for new particle formation in the Amazon boundary layer

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Abstract:
The main goal of the GoAmazon 2014/15 experiment is to measure and understand the factors affecting aerosol particles over a tropical rain forest, especially the effects of anthropogenic pollution plume from large metropolitan areas as a perturbation to natural state of the pristine forest surrounding it. For helping the interpretation of data measured at the ground sites, we have performed HYSPLIT backward simulations, starting every 30-min from Jan-1st until Dec-31st 2014, for all the GoAmazon sites. Boundary conditions were taken every 3h at 0.5º x 0.5º resolution from the Global Data Assimilation System (GDAS) available from NOAA. An index for "in-plume" and "off-plume" events was built by selecting backward trajectories that started from T3 and passed over T2 / Manaus, and that had a CN/dCO ratio in the range of 41 to 130 # / ppbv (characterized from measurements at T2). We focus our analysis in the wet season to avoid having to disentangle the biomass burning transport. The transport time from T2 to T3 was found to be 4.5 ± 1.5 h on average. CN decreases by 45 # cm^{-3} per hour, while the mean diameter increases from 50 to 100 nm, OA mass increases by 0.7 μg m^{-3} per hour and SO4 increases by 30 ng m^{-3} per hour. By filtering the transport events by SO2 concentration at T2, we clearly identify a peak in the size distribution measured at T3, at about 30nm, which is not present in the distribution measured at T2. The peak increases with increasing concentration of SO2, a clear indication of new particle formation. During these transport events, optical properties change as following: absorption decreases from 3.73 ± 1.18 to 1.69 ± 0.58 Mm^{-1}, scattering decreases from 14.52 ± 4.08 to 8.53 ± 2.23 Mm^{-1}, while the scattering angstrom exponent increases from 1.43 to 1.82. We will discuss the possible physical mechanisms to explain these observations.

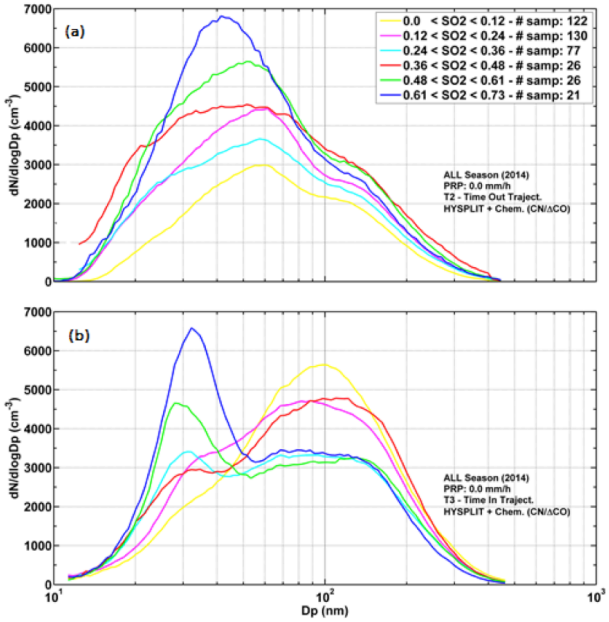

Figure – Aerosol size distributions measured at T2 and T3 during the events of downwind transport of pollution from Manaus to Mancapuru. Data is grouped by the concentration of SO2 at T2, ranging from 0 to 0.73 ppbv. Events with precipitation were excluded.