THE CLOSE LINKS BETWEEN BIOLOGY AND THE CHEMISTRY OF PARTICLES AND TRACE GASES IN AMAZONIA

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Amazonia is a place where the biology of the forest and atmospheric chemistry are very well coupled. Feedbacks are very strong between ecosystem functioning, trace gases and aerosol emissions, cloud cover, precipitation, radiation balance and other key issues. In the wet season, a large portion of the Amazon region constitutes one of the most pristine continental areas, with very low concentrations of atmospheric trace gases and aerosol particles. However, land use change modifies the biosphere-atmosphere interactions in such a way that key processes that maintain the functioning of Amazonia are substantially altered. This study presents long term aerosol and trace gases observations at a preserved forest site in Central Amazonia (TT34 North of Manaus), with observations from 2008 to 2013. Amazonian aerosols were characterized in detail, including aerosol size distributions, aerosol light absorption and scattering, optical depth and aerosol inorganic and organic composition, among others properties. Trace gases analyzed includes VOCs, ozone and CO. The central Amazonia site showed low aerosol concentrations ($PM_{2.5}$ of 1.3±0.7 $\mu g\ m^{-3}$ and 3.4±2.0 $\mu g\ m^{-3}$ in the wet and dry seasons, respectively), with a median particle number concentration of 220 cm^{-3} in the wet season and 2,200 cm^{-3} in the dry season. An aerosol chemical speciation monitor (ACSM) shows that organic aerosol accounts to 81% to the non-refractory PM1 aerosol loading. The trace elements associated with natural biogenic aerosols were K, P, Zn, and organic carbon. Aerosol light scattering and absorption coefficients were very low during the wet season, increasing by a factor of 5, approximately, in the dry season due to long range transport of biomass burning aerosols reaching the forest site in the dry season. Aerosol single scattering albedo (SSA) ranged from 0.84 in the wet season up to 0.91 in the dry. Using remote sensing techniques and MODIS and CERES data it was possible to calculate the mean direct radiative forcing of aerosols at the top of the atmosphere (TOA) during the dry season, and it was a significant −5.6±1.7 Wm^{-2}, averaged over the Amazon Basin. For high AOD (larger than 1) the maximum daily direct aerosol radiative forcing at the TOA was as high as −20 Wm^{-2} locally. This change in the radiation balance caused increases in the diffuse radiation flux, with an increase of Net Ecosystem Exchange (NEE) of 18-29% for relatively high AOD. From this analysis, it is clear that land use change in Amazonia shows alterations of many atmospheric properties, and these changes are affecting the functioning of the Amazonian ecosystem in significant ways.