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Modeling investigation of light-absorbing aerosols in the Amazon Basin during the wet season

qiaoqiao wang (1), Jorge Saturno (1), Xuguang Chi (1,11), David Walter (1), Jost Lavric (2,3), Daniel Moran-Zuloaga (1), Florian Ditas (1), Christopher Pöhlker (1), Joel Brito (4,12), Samara Carbone (4,13), Paulo Artaxo (4), and Meinrat Andreae (1)

(1) Biogeochemistry Department, Max Planck Institute for Chemistry, 55131 Mainz, Germany, (11) School of Atmospheric Sciences, Nanjing University, Jiangsu, China, (2) Department of Biogeochemical Systems, Max Planck Institute for Biogeochemistry, 07745 Jena, Germany, (3) ICOS ERIC Head Office, Helsinki, Finland, (4) Department of Applied Physics, University of São Paulo, São Paulo 05508, Brazil, (12) Laboratory for Meteorological Physics, University Blaise Pascal, Aubière, France, (13) Institute of Agrarian Sciences, Federal University of Uberlandia, Uberlandia, Brazil

We use a global chemical transport model (GEOS-Chem) to interpret observed light-absorbing aerosols in Amazonia during the wet season. Observed aerosol properties, including black carbon (BC) concentration and light absorption, at the Amazon Tall Tower Observatory (ATTO) site in the central Amazon have relatively low background levels but frequently show high peaks during the study period of January–April 2014. With daily temporal resolution for open fire emissions and modified aerosol optical properties, our model successfully captures the observed variation in fine/coarse aerosol and BC concentrations as well as aerosol light absorption and its wavelength dependence over the Amazon Basin. The source attribution in the model indicates the important influence of open fire on the observed variances of aerosol concentrations and absorption, mainly from regional sources (northern South America) and from northern Africa. The contribution of open fires from these two regions is comparable, with the latter becoming more important in the late wet season. The analysis of correlation and enhancement ratios of BC versus CO suggests transport times of < 3 days for regional fires and 11 days for African plumes arriving at ATTO during the wet season. The model performance of long-range transport of African plumes is also evaluated with observations from AERONET, MODIS, and CALIOP. Simulated absorption aerosol optical depth (AAOD) averaged over the wet season is lower than 0.0015 over the central Amazon, including the ATTO site. We find that more than 50% of total absorption at 550 nm is from BC, except for the northeastern Amazon and the Guianas, where the influence of dust becomes significant (up to 35 %). The brown carbon contribution is generally between 20 and 30 %. The distribution of absorption Ångström exponents (AAE) suggests more influence from fossil fuel combustion in the southern part of the basin (AAE $\sim$ 1) but more open fire and dust influence in the northern part (AAE $>$ 1.8). Uncertainty analysis shows that accounting for absorption due to secondary organic aerosol (SOA) and primary biogenic aerosol (PBA) particles could result in differences of < 8 and 5–40% in total absorption, respectively.