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Optical and physical properties of aerosols in the boundary layer and free troposphere over the Amazon Basin during the biomass burning season

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Abstract. As part of the Large Scale Biosphere-Atmosphere Experiment in Amazonia – Smoke, Aerosols, Clouds, Rainfall and Climate (LBA-SMOCC) campaign, detailed surface and airborne aerosol measurements were performed over the Amazon Basin during the dry to wet season from 16 September to 14 November 2002. Optical and physical properties of aerosols at the surface, and in the boundary layer (BL) and free troposphere (FT) during the dry season are discussed in this article. Carbon monoxide (CO) is used as a tracer for biomass burning emissions. At the surface, good correlation among the light scattering coefficient (σ_s at 545 nm), PM2.5, and CO indicates that biomass burning is the main source of aerosols. Accumulation of haze during some of the large-scale biomass burning events led to high PM2.5 (225 μg m^{-3}), σ_s (1435 Mm^{-1}), aerosol optical depth at 500 nm (3.0), and CO (3000 ppb). A few rainy episodes reduced the PM2.5, number concentration (CN) and CO concentration by two orders of magnitude. The correlation analysis between σ_s and aerosol optical thickness shows that most of the optically active aerosols are confined to a layer with a scale height of 1617 m during the burning season. This is confirmed by aircraft profiles. The average mass scattering and absorption efficiencies (545 nm) for small particles (diameter D_p<1.5 μm) at surface level are found to be 5.0 and 0.33 m^2 g^{-1}, respectively, when relating the aerosol optical properties to PM2.5 aerosols. The observed mean single scattering albedo (ω_o at 545 nm) for submicron aerosols at the surface is 0.92±0.02. The light scattering by particles ($\Delta\sigma_s/\Delta$ CN) increase 2–10 times from the surface to the FT, most probably due to the combined affects of coagulation and condensation.

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