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Physical, chemical and optical properties of mixed aerosols on Djougou (Northern Benin) during the AMMA dry season experiment (SOP-0). Effect on the local direct radiative forcing

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Aerosol physical, chemical and optical properties, associated with vertical profiles and radiative effects have been investigated over Djougou (Northern Benin) during the AMMA SOP-0 dry season experiment. During this period, Sun-photometric measurements indicate a rather turbid atmosphere with a mean Aerosol Optical Depth (AOD), for the overall period, about 0.78 ± 0.24 (at 440 nm). Surface observations indicate a mean aerosol absorption (scattering) coefficient at the surface about 15.2 ± 10.6 Mm-1 (145 Mm-1 ± 59 Mm-1) at 520 nm, leading to a Single Scattering Albedo (SSA) comprised between 0.81 and 0.98 at 520 nm (average value of 0.91 ± 0.05), depending on the contribution of each aerosol (smoke and mineral dust).

Associated micropulse lidar measurements indicate the presence of two distinct aerosol layers, with a first one located between the surface and 1 km and a second one (smoke layer) located above 1.5-4.0 km. In parallel, physical properties of fresh carbonaceous aerosols have been used to calculate Black Carbon (BC) and Organic Carbon (OC) optical properties, by using mass size distributions associated with refractive indexes. Optical computations indicate dry mass extinction efficiencies of 7.3 m2g-1 for BC and 2.3 m2g-1 for OC (at 550nm), associated with SSA of 0.45 and 0.95, for BC and OC, respectively.

Finally, on the basis of surface and aircraft observations, sunphotometer measurements, lidar profiles, and MODIS sensor, an estimation of the daily clear sky direct radiative forcing has been estimated for the 17–24 January 2006 period. Simulations indicate that aerosols reduce significantly the solar energy reaching the surface (mean [U+F044]FBOA = 61.5 W/m2) by reflection to space (mean [U+F044]FTOA = 18.4 W/m2) but predominantly by absorption of the solar radiation into the atmosphere (mean [U+F044]FATM = +43.1 W/m2). The mean heating rate at the surface and within the elevated biomass burning layer is considerably enhanced by 1.50 and 1.90 K by day, respectively.