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Effect of smoke and clouds on the transmissivity of photosynthetically active radiation inside the canopy

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Abstract. Biomass burning activities emit high concentrations of aerosol particles to the atmosphere. Such particles can interact with solar radiation, decreasing the amount of light reaching the surface and increasing the fraction of diffuse radiation through scattering processes, and thus has implications for photosynthesis within plant canopies. This work reports results from photosynthetically active radiation (PAR) and aerosol optical depth (AOD) measurements conducted simultaneously at Reserva Biológica do Jaru (Rondonia State, Brazil) during LBA/SMOCC (Large-Scale Biosphere-Atmosphere Experiment in Amazonia/ Smoke, Aerosols, Clouds, Rainfall, and Climate) and RaCCI (Radiation, Cloud, and Climate Interactions in the Amazon during the Dry-to-Wet Transition Season) field experiments from 15 September to 15 November 2002. AOD values were retrieved from an AERONET (Aerosol Robotic Network) radiometer, MODIS (Moderate Resolution Spectroradiometer) and a portable sunphotometer from the United States Department of Agriculture – Forest Service. Significant reduction of PAR irradiance at the top of the canopy was observed due to the smoke aerosol particles layer. This radiation reduction affected turbulent fluxes of sensible and latent heats. The increase of AOD also enhanced the transmission of PAR inside the canopy. As a consequence, the availability of diffuse radiation was enhanced due to light scattering by the aerosol particles. A complex relationship was identified between light availability inside the canopy and net ecosystem exchange (NEE). The results showed that the increase of aerosol optical depth corresponded to an increase of CO_2 uptake by the vegetation. However, for even higher AOD values, the corresponding NEE was lower than for intermediate values. As expected, water vapor pressure deficit (VPD), retrieved at 28m height inside the canopy, can also affect photosynthesis. A decrease in NEE was observed as VPD increased. Further studies are needed to better understand these findings, which

were reported for the first time for the Amazon region under smoky conditions.

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