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Evaluation of turbulent and CO_2 fluxes modification as function of the aerosol optical depth in the Bananal Island, Tocantins, Brazil

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This work presents the climatic variation, energy and CO_2 fluxes on the surface and the respective influence of aerosols, on a micrometeorological tower in Bananal Island - TO, Brazil, between October 2003 and December 2008. The aerosol optical depth (AOD) data were obtained from the MODIS sensor aboard the Terra and Aqua satellites, with passages in the morning (∼10:30 LT) and afternoon (∼14:30 LT), respectively. The local climate has well defined rainy season (October-April), and has a higher global solar irradiance incident on the surface in the dry season (May to September). The higher mean values of AOD occur between August and November, which coincides with the season of fires in the region. The increasing of 1,0 in the AOD values at 670 nm shows a reduction of $\sim$ 10% in surface irradiance of the spectral region of photosynthetically active radiation (PAR, 400-700 nm). By analyzing the effects of the AOD increase in the solar spectral region (400 to 1000 nm), it is noticeable a smaller reduction compared to the PAR spectral region, with less significant differences between morning and afternoon, and a decrease in the system available energy (Rn). The net radiation components (sensible heat flux (H) and latent heat flux (LE)) respond differently to the increase in AOD. While H responds positively to the increase in the integrated aerosol layer, LE decreases, also with significant differences between morning and afternoon periods. The positive response in H, with an increase in AOD, is due to the fact that the temperature (T) also increases ($\sim$ 4%) by absorption and reemission of radiation by aerosols, which heats the layer. The T growth above the canopy leads to the increase of internal and external temperature difference, and H is directly proportional to this difference. The increase in vapor pressure (e) with the AOD in $\sim$ 11% - due to the fact that aerosols function as condensation nuclei - decreases the humidity difference between the inner part and the outside of the canopy and LE is proportional to this difference. The CO_2 flux (FCO_2) is a measure that most directly quantifies the photosynthetic rate of plants and has different responses to the increase in AOD values, to different time periods. In the morning, FCO_2 is more negative with the increase in AOD and in the afternoon, more positive. FCO_2 more negative indicates higher photosynthetic rates. The optical path (s) to be crossed by the radiation in the morning is higher than in the afternoon. Probably, there is more scattering of radiation in this period, which penetrates more efficiently in the canopy. On the other hand, in the afternoon, the absorption is dominant and there is a reduction in the amount of incident available energy for photosynthesis.