Effects of Biomass Burning Aerosols and Land Cover Use Change on the Hydrological Cycle and Surface Fluxes in the Amazon Region

Ricardo A. Siqueira[1], Saulo R. Freitas[2], Karla M. Longo[1], Claúdio M. S. Silva[5], José Guilherme M. Santos[1], Judith Hoelzemann[1], Daniela A. França[3], Rafael S. S. Lima[2], Rafael M. Fonseca[2], Aline A. Castro[4]

[1] Earth System Science Center (CCST),
[2] Center for Weather Forecasting and Climate Studies (CPTEC),
[3] Remote Sensing Division (DSR),
[4] Space Geophysics Division (DGE),
National Institute for Space Research (INPE).
[5]Department of Theoretical and Experimental Physics,
Federal University of Rio Grande do Norte (UFRN).

The biomass burning, which occur mostly in tropical areas of the planet, are important sources of particulate matter to the atmosphere. In South America, during the Austral winter, thousands of vegetation fires occur in the forest ecosystems. These fires occur primarily in the Amazon and Central Brazil regions, however, through atmospheric transport of this emissions, they can produce a spatial distribution of smoke over an extensive area of about 4-5 millions km^2, much higher than the area where they fires took place. During the combustion process, aerosol particles are emitted into the atmosphere and they can interact efficiently with solar radiation and affect the dynamic and microphysical processes of cloud formation and air quality. Land cover use changes can affect the energy balance due modification of surface albedo and evapotranspiration capacity, which can influence the fluxes of latent heat and sensible heat emitted by surface and the hydrological cycle. In this study, we estimate emissions of biomass burning aerosols using projected scenarios of land use (correspondent to the years 2007 to 2030) and investigate the effects of land cover use change on the surface fluxes, which also affect the hydrological cycle and near surface thermodynamics properties over South America, especially in the Amazon region. This study was performed numerically with the regional circulation model CCATT-BRAMS. In this modeling system the radiation parameterization takes into account the interaction between biomass burning aerosols and short and long wave radiation. The impact of biomass burning aerosols is also computed through an auto-conversion formulation based on the cloud condensation nuclei (CCN) availability at cloud base in the convective parameterization. The surface scheme (LEAF-3) was tuned using field campaign observational data, in particular, the water extraction by vegetation using a new parameterization of root profiles. Model results showed a reduction of precipitation in the projected scenarios and a net increase of near-surface temperature. These changes are associated with an augment of sensible heat due land/cover use change as well as the effect of aerosol on the hydrological cycle.