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Assessing the biomass burning aerosols impacts on the seasonal climate prediction over South America

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During the Austral winter, vegetation fires severely affect the tropical forest and savannah-type biomes in South America (SA), mostly associated with deforestation and agricultural/pasture land management. During the biomass burning (BB) season, there is an increase of about at least 90% of the total aerosol optical depth (AOD) in the visible spectrum associated with the BB aerosols over an area that can reach about 5 million km2 over SA. BB aerosol also act as cloud condensation nuclei affecting cloud microphysics properties. Therefore, changing the radiation budget, hydrological cycle and global circulation patterns over disturbed areas. Aiming to evaluate the impact of the BB aerosol over South America, we used the Goddard Earth Observing System global circulation model, sub-seasonal to seasonal system (GEOS-S2S). We designed two numerical experiments with GEOS-S2S, accounting explicitly for the aerosols interaction with cloud and radiation, to assess the BB aerosol direct and indirect radiative forcing (ARF and AIF) on the seasonal scale. For both experiments, we accounted for dust, sea salt, and anthropogenic aerosols sources in the same way, and only biomass burning emissions differentiate them. The GEOS-S2S system ran with a nominal spatial resolution of 56 km from June to November spanning over the years 2000 to 2015, each experiment consisting of 4 members. We analyzed the difference of the shortwave radiation fluxes both in clear-sky and cloudy conditions over SA, both at the top of the atmosphere (TOA) and at the surface from the two experiments. During September, the peak of BB aerosol emissions in SA, the ARF at the surface reached about -30 Wm-2, indicating a decreasing of the radiative budget due to the scattering and absorption of the solar radiation by the aerosols. While at the TOA, the ARF was about -12 Wm-2, indicating a loss of radiation to the space associated with the higher albedo of the aerosol layer. Including the BB aerosols in the seasonal climate forecasting significantly changed the radiative budget over SA, which in turn improved the model ability to predict meteorological variables that depend of this forcing. For example, the model skills for the 2-meter temperature increased of up to 0.3 over some areas. The model results for the AIF and the impact on variables such as precipitation and circulation will also be are being analyzed and will be discussed. This work contributes to highlight the importance of accounting for the aerosol-radiation-clouds interaction in the seasonal climate forecasting models.