Introduction — During the Austral winter, vegetation fires severely affect the tropical forest and savannah-type biomes in the South American (SA) and African (AF) continents. Biomass burning (BB) aerosols interact with solar radiation and affect the cloud microphysics properties. Therefore, changing the radiation budget, hydrological cycle and global circulation patterns over disturbed areas. This study aimed to evaluate the impact of the lack of more realistic BB emissions on the performance of the sub-seasonal climate forecasting of the Goddard Observing System global circulation model (GEOS-52, Rienecker et al., 2008) over the South American (SA) and African (AF) continents.

Model experiments configuration — Model experiments included emissions for dust, sea salt, anthropogenic, and BB aerosols (Darmenov & da Silva, 2015) (Fig. 1), and accounted explicitly for aerosol interactions with clouds (2-moment cloud scheme, Barahona et al., 2014), and radiation (RRTMG rad. scheme, Morcrette et al., 2008).

Climate forecast skill for 2-meter temperature (T2M) — The GEOS-52 T2M from both experiments fairly represented the global pattern of the MERRA2 reanalysis (Fig. 6). The BB emissions perturbation caused small, both positive and negative, scattered changes on the T2M biases. However, there was a notable reduction of the T2M bias on the South Pole. The GEOS-52 skills for T2M over land were especially high over SA and AF areas, where the correlation index values were typically above 0.6 (Fig. 7). There were small, both positive and negative, scattered changes on the skills for T2M. More expressive, we observed the deterioration of the T2M results for the AERO_CTL experiment over the Eastern US, Eastern Europe, and West Asia. On the other side, there was an enhancement of model skills for the AERO_CLM experiment over the South Pole.

The GEOS-52 skills in predicting AOD were higher for the AERO_CTL experiment compared to AERO_CLM, except over land for the AF region. Although, it is worth noting that AERO_CTL had better skills over the ocean for the same region (Fig. 5).

Highlights
- A proper representation of the BB emissions, instead of the climatology, improved the GEOS-52 AOD climate forecast, particularly for SA.
- For AF, the GEOS-52's ability to predict the AOD decreased over land as it increased over the ocean with the use of QFED daily emissions. These results suggest that climatology may reasonably represent the AF emissions, but the representation of aerosols in the region is highly sensitive to other processes that are more dependent on meteorology, such as aerosol removal.
- There was a significant impact of the BB emissions on the GEOS-52 prediction of T2M (and other meteorological variables, not shown) in the North Hemisphere and the South Pole, which need to be further investigated.