

## **Anonymous Referee #1**

We thank the valuable comments, whose responses follow:

**1. The model BESM-OA2.5 is an Earth System Model. However, there is no evaluation of model about cloud-aerosol-chemistry or dynamic carbon cycle processes. The unique characters highly related with Earth System Model should be introduced, and some results should be also evaluated.**

Reply:

The model used in this work is an ocean-atmosphere-biosphere coupled model, indicated in its name BESM-OA version 2.5. Therefore, it is not at this version a full Earth System Model, as disclaimed in the manuscript (Page 3 Lines L19-L23). We acknowledge that an Earth System Model is a comprehensive model that includes all Earth system components, including biogeochemical cycles (e.g. dynamic carbon cycle processes) and cloud-aerosol-chemistry processes. Although the main aim of our group is to build up such a model, at the moment the model is a coupled ocean-atmosphere climate model, without the representation of either biogeochemical cycles or cloud-aerosol-chemistry processes. Nonetheless, the name Brazilian Earth System Model was chosen in order to avoid a future change of the model's name on its transition from an ocean-atmosphere coupled model to an Earth System model. For this reason, in the acronym BESM was always added the letters OA, which stand for ocean-atmosphere coupled model. Therefore, at the moment, there is any evaluation of the biogeochemical cycles and their interaction with other Earth system components.

**2. The bias of the double ITCZ is taken as the long standing problems from CMIP3 to CMIP5. As for CMIP6, some model groups illustrated the encouraging progresses to mitigation these biases. How about BESM-OA2.5? Annual mean SST and precipitation should be also given.**

Reply:

As well as other global coupled climate model groups, the BESM development group is working on understanding the causes for the recurrent double ITCZ problem in global coupled models. From the research on cloud physics parameterization we are currently working on, we have detected that the double ITCZ coupled problems emerges in part due to incorrect distribution of upper air sources of mass along the equator. This research is in progress, and part of its results was submitted to Climate Dynamics (Bottino and Nobre, pers. comm.) and is currently under review.

As you have suggested, the figures for the mean fields of SST and precipitation for BESM-OA2.5 and Reanalysis have been included in the manuscript. The annual mean precipitation figure is included on Page 56 and the annual mean SST is included on Page 64.

**3. As a documentation of BESM-OA2.5, the behaviors of the subseasonal variability (e.g. MJO) and diurnal cycle are highly suggested to be given.**

Reply:

All outputs of the simulation were previously defined to be given in daily time scale, therefore it would not be possible to analyze the diurnal cycle. In the case of subseasonal variability, the Madden-Julian Oscillation (MJO) is computed and added to the revised manuscript as a topic of Tropical Variability subchapter (Page 25-27 Lines L16-L2). The MJO figure is presented on Page 80.

**4. Fig5: there are some uncertainties raised from the observation/reanalysis products, therefore, CMAP or the last global precipitation datasets of stations should be added to present the differences.**

Reply:

Thank you for your advice. The difference between BESM-OA2.5 and the CMAP precipitation reanalysis has been computed and is shown below (Fig. 1). The global model's mean biases are similar for GPCP ( $0.3 \text{ mm day}^{-1}$ ) and CMAP ( $0.4 \text{ mm day}^{-1}$ ). In the case of the global model's RMSE biases, they are also similar for GPCP ( $1.4 \text{ mm day}^{-1}$ ) and CMAP ( $1.5 \text{ mm day}^{-1}$ ). This description has been added to the revised manuscript (Page 13, Lines L13-L16).

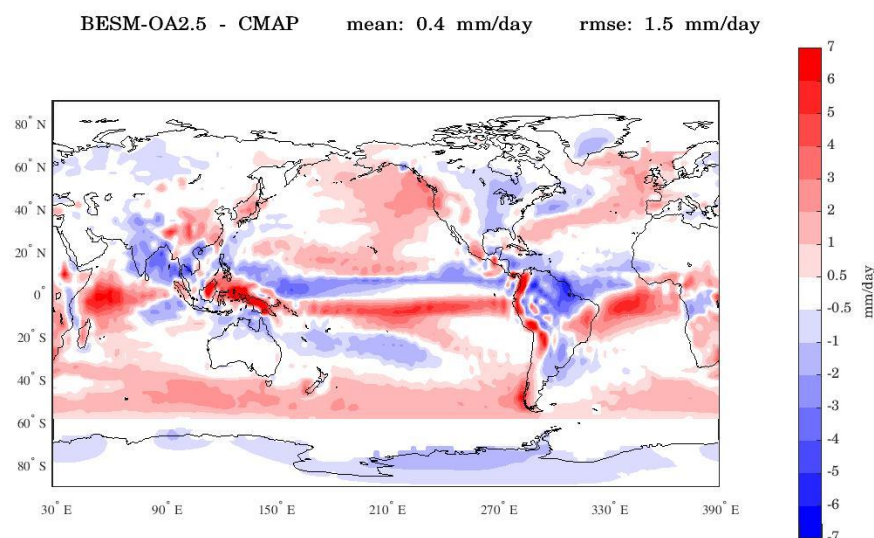


Figure 1 – Spatial map of annual mean precipitation bias of BESM-OA2.5 relative to CMAP. The averages values are computed over the periods 1971–2000 and 1979–2008, for BESM-OA2.5 and CMAP, respectively. Units are in  $\text{mm day}^{-1}$ .

**5. The plans of BESM-OA2.5 for CMIP6 participation are also highly expected.**

Reply:

The plans for the BESM-OA2.8 CMIP6 participation consists, in addition to the DEC characterization runs, the Scenario Model Intercomparison Project (ScenarioMIP;

O'Neill et al., 2016), Decadal Climate Prediction Project (DCPP; Boer et al., 2016), and supercomputer time available at CPTEC, the High Resolution Model Intercomparison Project (HighResMIPv1.0; Haarsma et al., 2016).

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