

Interactive comment on “Tipping the ENSO into a permanent El Niño can trigger state transitions in global terrestrial ecosystems” by Mateo Duque-Villegas et al.

Anonymous Referee #1

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Recommendation: Accepted after major revisions

The authors present a thorough study in an intermediate complex global model (PlaSim) about the impact that a permanent ENSO state might have in the global energy and water balances and also in the global atmospheric circulation and terrestrial ecosystems. The results in the manuscript and in the supplementary material are generally very well presented. However, there are some main issues that must be revised.

1 - Despite the utility of this kind of simulations, there is no proof that a permanent ENSO could be a climatic equilibrium state, consistent with the present CO₂ concentrations. Both in CTL and PEN simulations, CO₂ is kept constant at 360 ppm, near the

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global mean value of 1995, whereas the present (2018-19) mean value is around 416 ppm. Authors agree that ENSO is becoming reinforced under a larger radiative (CO₂) forcing. Therefore, why have not the authors set the CO₂ concentrations to 2018 values. The fact that CO₂ is kept at the 1995 values introduces an inconsistency. Authors shall present the impact (at least in the water deficit) of changing simultaneously SST and CO₂ forcing. There is evidence that some Permanent El Niño-Like Conditions have occurred During the Pliocene Warm Period (Wara et al. 2005). Authors shall compare the forcing of PEN simulations with those of Pliocene.

2 – The model bias given by the difference CTL minus observations is of the same order of that of some GCMs. However, the mean difference between PEN and CTL simulations is much lower in amplitude for certain fields (e.g. land surface temperature and precipitation) and locations, thus raising duties about the significance of the ENSO impact. Conclusions are only valid under the hypothesis that model bias is the same, both in climatological SST conditions and ENSO conditions. The confidence in the impact results is only valid by assessing the model bias under ENSO conditions. It is quite simple to do so through the difference PEN minus composite mean observations under ENSO (by choosing the set of larger ENSO events).

3 – Authors refer the sensitivity of model climatology to initial conditions by considering 3 perturbed initial condition fields. However, the results of that sensitivity and the t-Student tests are not explicitly presented.

4 – Quantitative diagnostics of the Walker circulation (bias and impact) shall be included.

Reference

Wara, MW.; Ravelo, AC., Delaney, ML. 2005. Permanent El Niño-Like Conditions During the Pliocene Warm Period. *Science* 29 Jul 2005: Vol. 309, Issue 5735, pp. 758-761, DOI: 10.1126/science.1112596

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