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Climate of the Past Discussions

Interactive comment on "Cold tongue/Warm pool and ENSO dynamics in the Pliocene" *by* A. S. von der Heydt et al.

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We thank the referee for the thorough reading of the manuscript and the constructive and positive comments. In the revised manuscript we have included all suggested changes. Please find below our detailed answers to the comments.

- *Review: The authors attempt to describe the permanent El Nino concept for the Pliocene but in doing so they also fall into its ambiguity trap to a degree. The term permanent El Nino-like should not be confused with a permanent El Nino state. El Nino-like should convey nothing more than a warming in the EEP and a lower SST gradient between the EEP and WEP as is displayed by the US Geological Survey PRISM3 SST data set and the coupled climate modelling studies of Haywood et*

al. (2007) and Bonham et al. (2009). In that sense all the studies above show an El Nino-like condition, but what the data and models are now showing with greater and greater clarity is that this does not, by any means, imply a that permanent or perennial El Nino state existed during the Pliocene. The author's investigation is still perfectly valid since Federov and co-authors have extrapolated a perennial El Nino from an El Nino-like condition (e.g. Fedorov et al. 2010 and 2006).
Answer: We fully agree with the referee, and the crucial point here is, that our model - though idealized - is not an anomaly model but a fully-coupled model where both the climate mean state and the variability are computed for different parameters. From our simulations, it turns out that (i) it is not easy to create a mean climate state with a weak zonal SST gradient, and (ii) most of the simulated mean states show ENSO variability. We make this more clear in the revised manuscript.

- *Review: From the description of the model it would appear that a number of attributes of the model of central importance to the models prediction of ENSO are explicitly given rather than being emergent properties of the model itself. The degree to which the authors feel that the behaviour of such a simplified model is constrained by the explicit values given to the model warrants some further discussion. Of course there are plenty of prescribed values in an ocean GCM but then again there are more emergent properties too. Could this have affected the ability of their model to predict something out of the box for the Pliocene? Would a perturbed physics ensemble have been useful and justifiable here?*
Answer: The idealized model used here is still a set of partial differential equations and hence constitutes a dynamical system with a large number of degrees of freedom. The forcing and the parameters do not impose themselves any preferred climate mean state or variability (note that the forcing is steady) and hence both the pattern of the mean state as well as the ENSO variability are all emergent properties of the model. We have mentioned this in the revised manuscript.

- *Review: The authors should include discussion around two new studies that have very recently been published in Nature and Paleoceanography*
  Answer: We agree and we done so in the revised manuscript.

Interactive comment on Clim. Past Discuss., 7, 997, 2011.