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Climate of the Past Discussions

Interactive comment on "Southern Hemisphere orbital forcing and its effects on CO_2 and tropical Pacific climate" *by* K. Tachikawa et al.

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The main concern of Referee 1 is the decoupling between proxy-based SST reconstruction for the equatorial Pacific and discussion focused on mechanisms of CO2 release from the Southern Ocean sea ice coverage and Ekman pumping.

We agree with Referee 1 that the paper contains too many topics. Consequently, we decided to concentrate on the processes affecting the western Pacific warm pool (WPWP) SST on orbital timescales by data-model comparison. The part corresponding to the sea ice and Ekman pumping efficiency on orbital timescales will be presented elsewhere as an independent paper.

The Referee 1 mentioned that the data and modelling parts are not really connected.

We believe that this concern is only on the southern hemisphere forcing hypothesis. About the local effects on the WPWP SST, the data-model comparison is certainly connected to identify the influence of wind-driven surface current that have an impact on the SST at the studied site (Figure 5). The influence of seasonal foraminiferal production on the SST is also evaluated by data-model comparison (Figure S6). Detailed studies distinguishing global and local/regional effects on high-resolution SST reconstruction from the tropical ocean are still scarce. We discuss this point using an exceptional SST reconstruction in light of model simulations.

The model used in this study are a simplification to the complex Earth System, but for the discussed mechanisms are the state-of-the-art modelling tools when it comes to simulating full glacial cycles over 100ka and longer (Timm et al., 2008;Timmermann et al., 2009). Here, our objective is not to precisely reproduce SST variability, but to clarify the processes influencing the WPWP SST and its sensitivity to individual forcings and processes in the ocean-atmosphere system.

Referee 1 questioned the choice of the model setup. Indeed, it would be interesting to use the carbon cycle part in Menviel et al. (2012) (we suppose that Menviel et al., 2012 QSR not 2011) but this aspect will be treated in future works. Since the hypothesis of the southern hemisphere forcing will be shown elsewhere, we answer to the comments concerning other points. About SST data-model comparison, the glacial/interglacial SST amplitude of TR400 smaller than proxy SST record is not model-specific but rather general feature observed for various models (Figure 3). Both unknown bias of SST proxy and missing feedbacks in the model (e.g. from clouds, vertical distribution of long-wave radiation, shortwave radiation fluxes, lapse-rate effects) could contribute to creating the difference. Our contribution to this issue is to report the present mismatch (i.e. neither local/regional environmental parameters nor ecological foraminiferal responses can explain the observed biases, at least for the studied site). As suggested by the Referee 1, we will develop the discussion on this issue in the revised version.

We will correct salinity unit in the revised version.

References Menviel, L., Joos, F., and Ritz, S. P.: Simulating atmospheric CO2, 13C and the marine carbon cycle during the Last Glacial-Interglacial cycle: possible role for a deepening of the mean remineralization depth and an increase in the oceanic nutrient inventory, Quat. Sci. Rev., 56, 46-68, 2012. Timm, O., Timmermann, A., Abe-Ouchi, A., Saito, F., and Segawa, T.: On the definition of seasons in paleoclimate simulations with orbital forcing, Paleoceanography, 23, PA2221, 10.1029/2007pa001461, 2008. Timmermann, A., Timm, O., Stott, L., and Menviel, L.: The roles of CO2 and orbital forcing in driving southern hemispheric temperature variations during the last 21 000 yr, J. Clim., 22, 1626-1640, 10.1175/2008jcli2161.1, 2009.

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