Flavio Justino
Universidade Federal de Vicosa
PH Rolfs S/N
Vicosa, MG
Brazil
fjustino@ufv.br

To the Editor Climate of the Past (CP):

Our paper, "**Oceanic response to changes in the WAIS and astronomical forcing during the MIS31 superinterglacial**" is reviewed.

Please find enclosed point-by-point replies to the reviewer comments and suggestions. We greatly appreciate all comments and careful evaluation done by the anonymous reviewers, which will substantially improve the manuscript.

Sincerely,
Flavio Justino

Reviewer #2

The main comment raised by the reviewer concerns the possibility of comparing our MIS31 simulation with similar experiments of MIS1 and 5e. We recognize that seeing our MIS31 experiments in relation to these two other interglacials would add to the manuscript value. However, this will require another set of experiments specifically 6 additional runs. We regret that at this stage is not feasible to proceed as suggested by the reviewer, as new modeling experiments could not be conducted in due time. Because an AOGCM is used, demanding computational time and complexity in interpreting global results make this task un-attainable. In fact, it is for the first time that such experiments have been performed with a full rather than a slab oceasn model. We will leave this interesting comparison to a potential follow up publication. However, all other comments by this reviewer are addressed.

We will modify the introductory section to better define the manuscript focus. Also we will emphasize clearer that our study is an improvement of previous ones conducted with slab ocean models. Indeed, this is the first study conducted with an AOGCM to evaluate the MIS31 interglacial, performed to disentangle individual climate responses to astronomical and WAIS topography forcings.

We will add the suggested references, and their main findings in the Introduction.

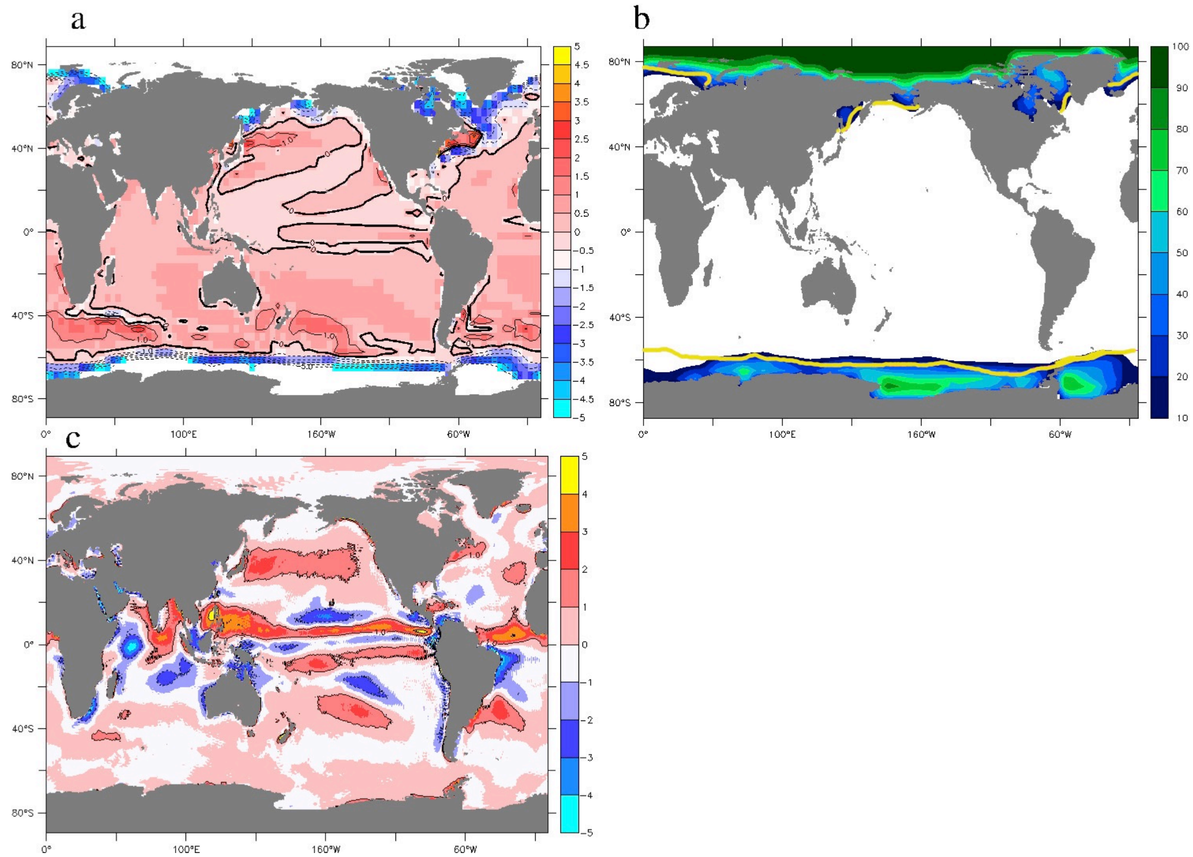
We will include a paragraph on the CO2 uncertainties during MIS31, and their potential impact on our results which assume present day CO2.

There are unfortunately no observations of global OHT as presented in the MS, we have therefore, compared with indirect estimations. This point was raised also by reviewer #1, and in our reply to her/him we explain in some more detail why we will refrain from including such a comparison.

Regarding the paleo-model inter-comparison shown in Figure 2c, we will argue that the MIS31 interval lacks extensive reconstructions, and those available do not provide magnitudes, but rather in general express whether the climate state was cooler or warmer than the present climate. This is our reason for showing red squares (warming) and blue squares (cooling) together with modeled temperature anomalies.

* Regarding to CO_2, CH_4 and N_2O concentration.

It has been proposed by Hoenisch et al. (2009) that the MIS31 has the highest partial pressure of CO_2 of the mid-Pleistocene, by about 325 ppm. However, according to their Figure 1, the CO2 concentration could vary between 300 and 350 ppm during the MIS31, due to propagated error of the individual pH, SST, salinity, and alkalinity. The uncertainty in the atmospheric composition may lead to overestimation in the NH warming as simulated in our study. Changes in CO_2 by about +50 ppm may be associated with +0.3K change in globally averaged surface temperature. In fact, this alteration in temperature is within the uncertainties of the climate sensitivity (Bindoff et al. 2013). The CH_4 (800 ppb, Loulergue et al. 2008) and N_2O (288 ppb, Schilt et al. 2010) concentrations are similar to Coletii et al. (2015).



(a) Surface temperature differences (!C) between the CTR and the NOAA-OI-surface temperature-V2 . The white shading indicates surface temperatures -1.8!C. (b) Sea-ice cover in the CTR (shaded in %) and the sea ice (yellow line)based on HadISST. (c) Time-averaged E - P flux differences (mm day−1) between the control simulation and the ERAI.

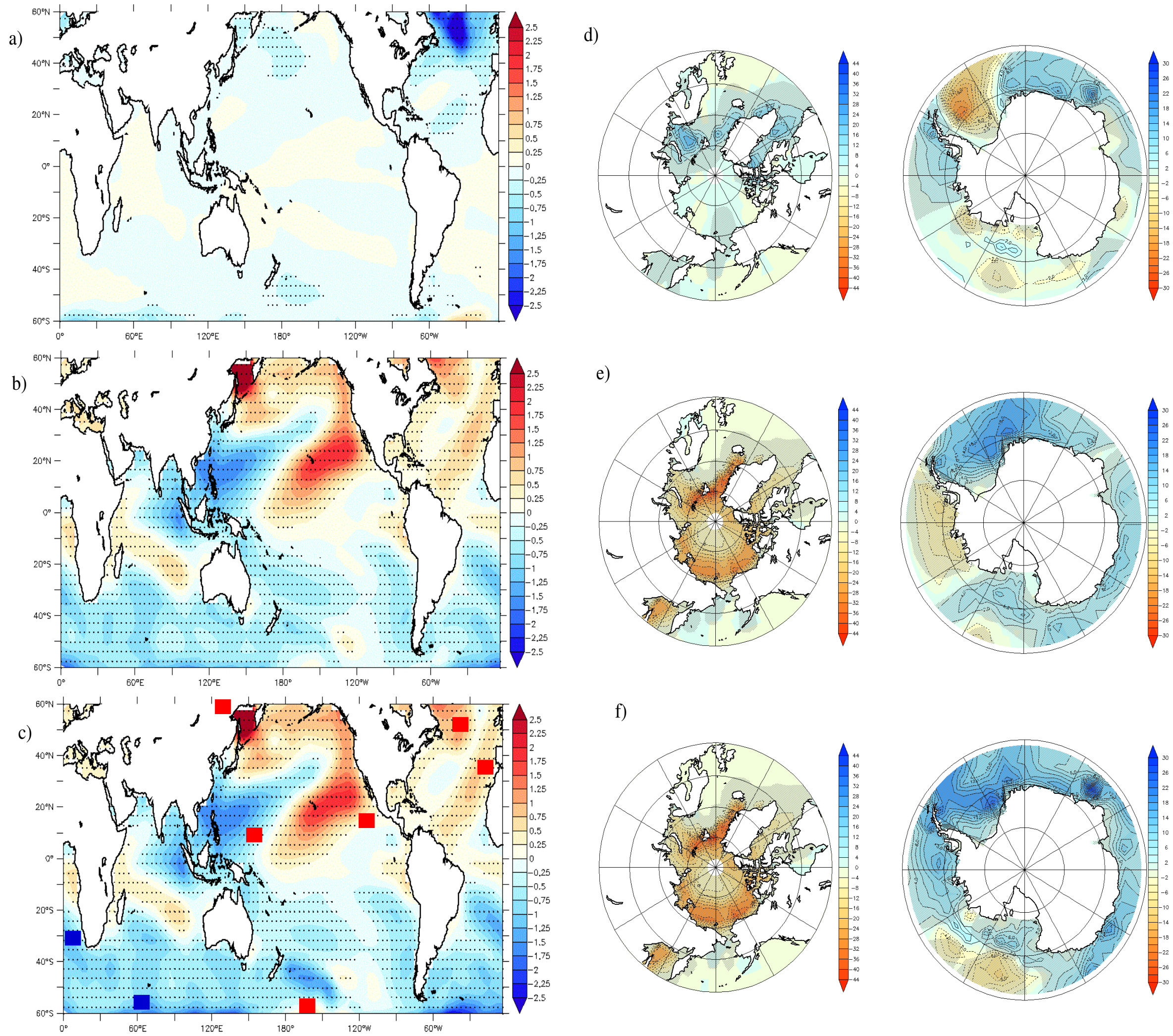


Figure 2. Surface temperature differences (C) between (a) TOPO, (b) AST, and (c) MIS31 compared to the CTR. Sea-ice differences (%) between the runs (d, e, f) Land-ocean reconstructions are shown as red squares (warmer MIS31 conditions) and blue squares (colder MIS31 conditions) as compared to CTR simulation. Dotted areas are significant at 95% based on t-test statistics.

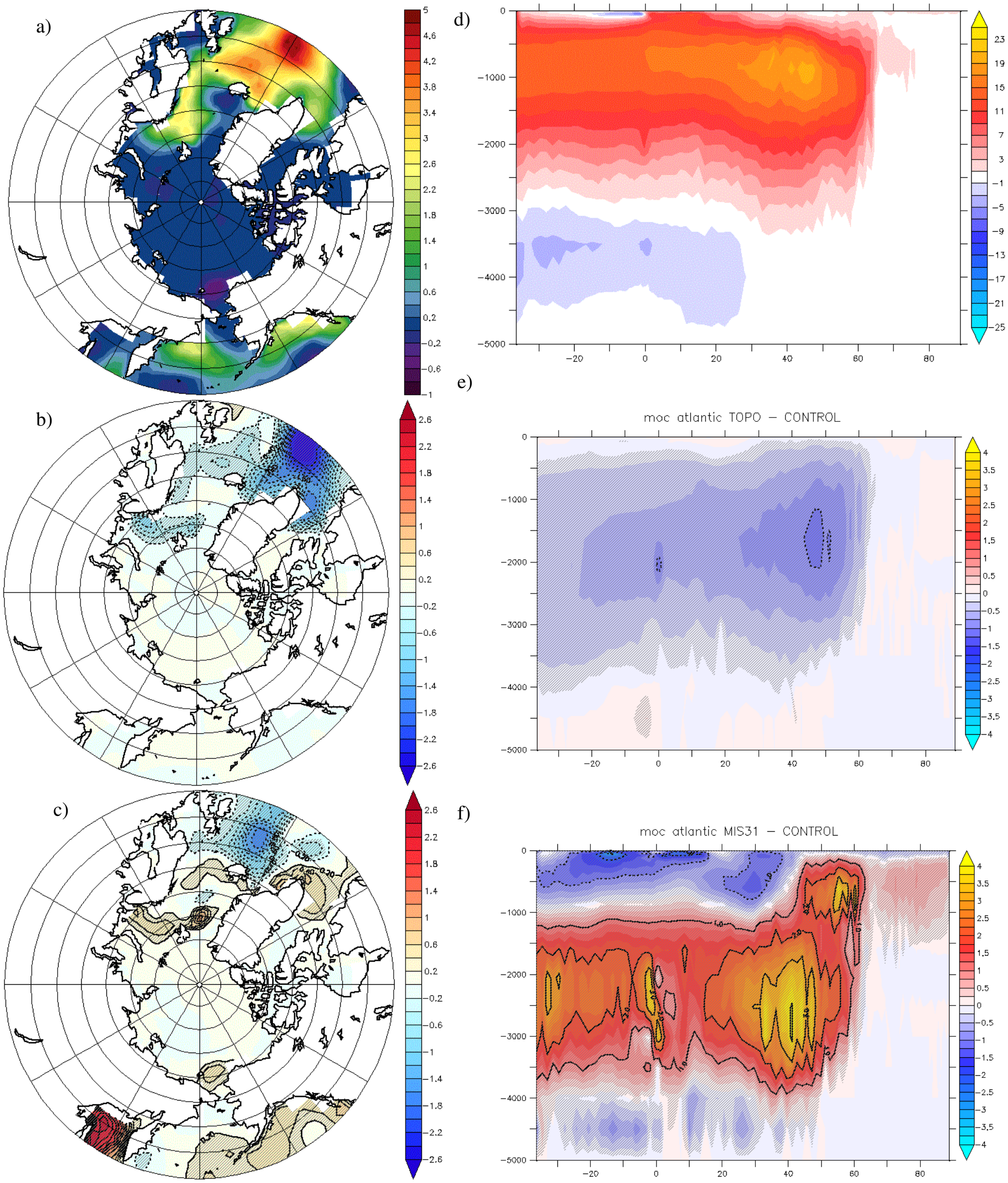


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Figure 3. Density flux for CTR (a, 10^{-6} kg m^{-2} s^{-1}) and differences between the sensitivity experiments and CTR (b) TOPO, (c) MIS31.(d) Time-averaged MOC (Sv) in the CTR and differences between the CTR and (e) TOPO and (f) MIS31. Hatched areas are significant at 95% based on t-test statistics.

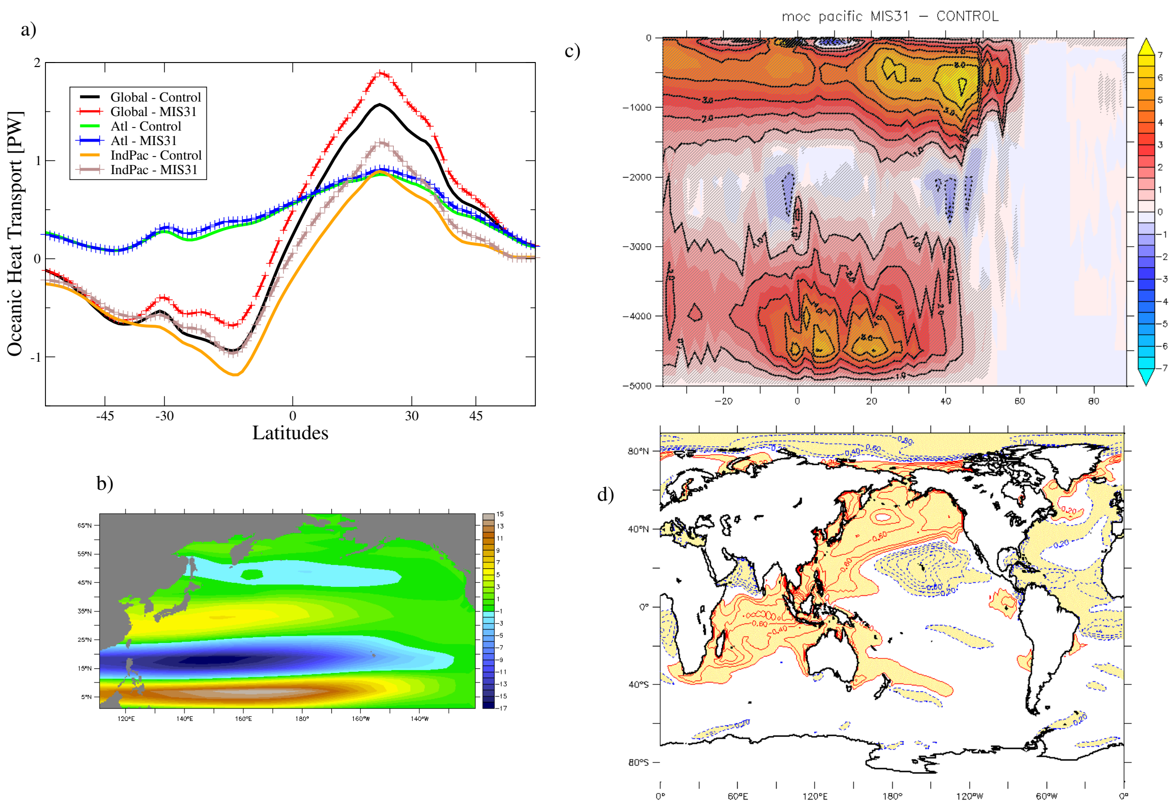

Figure 4. (a) OHT (PW) for CTR (solid line) and MIS31 (dashed-crossed line). (b) Sverdrup transport differences (Sv) between the MIS31 and CTR. (c) Differences between the MIS31 and CTR MOC in the Pacific ocean (shaded, Sv), and contour shows the Pacific MOC in CTR. (d) Surface salinity differences between MIS31 and CTR. Hatched (Yellow) areas are significant at 95% based on t-test statistics in c (d).