



## ***Interactive comment on “Simulations of the Mid-Pliocene Warm Period using the NASA/GISS ModelE2-R Earth System Model” by M. A. Chandler et al.***

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The key issue in the reviews is the suggestion that this simulation did not present results from a simulation that is identical to that used in the multi-model ensemble presented in Haywood et al 2012. That is absolutely true, but the changes were not those surmised by the reviewers. The run described in this manuscript was identical to the previous run (including all boundary and initial conditions, such as the land-sea mask) and differed only in that there was a correction made to the Gent-McWilliams parameterization in the ocean component of the GISS E2-R model (described in more detail below).

We were not aware of the difficulty that the inclusion of this new "corrected" experiment

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would cause others who had used the initial PlioMIP experiment in multi-model ensembles, therefore, after discussions with the PlioMIP steering committee we have agreed that it would be best to do a major revision of this manuscript (instead of the previous suggestion of minor revisions). The crux of the revision will be to add a description of a second experiment - the older GISS PlioMIP simulation used in certain multi-model ensembles. In addition to this revised manuscript we have archived the new experiment, already described here, using the CMOR protocols, to the PlioMIP archives for others to use in future multi-model ensembles.

Additional comments addressing reviewer concerns:

1) It is important for readers to understand that in the two experiments we did not change the land-sea mask or in anyway change the ocean straits. The only alteration made to straits is true for all of our GISS Pliocene coupled runs (both corrected and uncorrected): at any point, when straits are no longer sub-grid scale as a result of a resolution change or as a result of a sea level rise the flow through those straits becomes explicit. Thus, we need to remove sub-grid scale parameterizations for those straits so as not to be calculating the flow twice.

2) As to the specific nature of the correction to the GM parameterization - a coding error in the initial experiment caused an incorrect calculation of isopycnal slopes, leading to spurious diapycnal heat fluxes and, ultimately the extremely cool North Atlantic temperatures in the Pliocene experiment (relative to the control run). Fixing this calculation in the code also required the imposition of a minimum eddy diffusivity of 600 m<sup>2</sup>/s in the mesoscale diffusivities in the Visbeck et al formulation.

3) It was noted that the maps need to have the latitudes and longitudes marked. This applies to several of the figures and this change has been implemented on all maps used in the paper, including figures 2, 3, 4, and 7. In addition, we will make sure that the latitudes and longitudes are labelled in the additional maps that are part of the revised manuscript.

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4) There was a question about when the earliest Pliocene GCM runs had been done, related to our comment that such simulations had been carried out for "a couple of decades" To address this we have modified the text to cite early modeling studies and I have changed the text to "early 1990s" rather than "a couple of decades". Though we have not included citations in the abstract per instructions of the journal. At NASA we actually ran our first mid-Pliocene GCM simulations using the NASA-GISS model in the year 1990. The first mention in a GISS paper of the Pliocene work was in Rind and Chandler, 1991, but I see that that paper does not refer to our Pliocene simulations, just those of the "Mesozoic" and "Eocene". Therefore, the first time results of Pliocene GCM simulations were presented was at the spring conference of the American Geophysical Union (AGU) in 1992. There is an EOS Transactions abstract that I've cited to identify this first ever Pliocene GCM simulation. A full journal article was published in 1994 and is also cited.

5) There was also a request for us to improve clarity and accuracy of the language in the manuscript. We have corrected the first sentence and have done additional language clean up to improve clarity as requested. All authors re-read the manuscript and contributed language improvements. The major revisions forthcoming on the manuscript will undoubtedly have to be review again, but we will endeavor to be as clear as possible in our additions.

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