Geoscientific
Model Development
Discussions

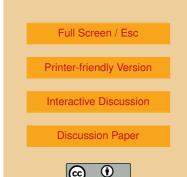## *Interactive comment on* "Pliocene Model Intercomparison Project (PlioMIP): experimental design and boundary conditions (Experiment 2)" *by* A. M. Haywood et al.

Anonymous Referee #2

The manuscript submitted by Haywood et al. entitled "Pliocene Model Intercomparison Project (PlioMIP): experimental design and boundary conditions (Experiment 2)" presents a strategy for a model intercomparison initiative that aims to simulate the mid-Pliocene warm period. The presented modeling design is the companion paper to Haywood et al. (2010) published in Geoscientific Model Development. The latter introduced the Pliocene Model Intercomparison Project (PlioMIP) and described experiment 1 of the project. The presented manuscript here summarizes the modeling strategy utilizing coupled ocean-atmosphere climate models, i.e. experiment 2. After introducing the general strategy of PlioMIP, the authors describe the experimental design before commenting on boundary conditions needed to complete experiment 2.

The fourth chapter briefly describes the logistics of data management and storage.

The manuscript presented here adds to advances in modeling science through the approach of a model intercomparison. In this respect, the outcome of the results based on the guidelines presented in the manuscript will lead to significant scientific results. The outlined approach of integrating data into numerical modeling is reasonable and scientifically reproducible. The document is written in a clear and concise way.

The authors are suggested to more closely tie the description of design and boundary conditions to PlioMIP's main scientific goals. Since this paper was not combined with the description of experiment 1, explaining how the intercomparison of coupled ocean-atmosphere model results will add to answer key scientific questions (in combination with experiment 1) will increase its value as a stand-alone publication.

I would recommend the manuscript for publication in GMD after addressing the following specific comments and minor technical corrections.

SPECIFIC COMMENTS

1 - Abstract/Introduction (1)

In the Abstract (page 446, line 5) and in chapter 4 (page 451, line 20) the authors refer to "phase 1" of PlioMIP. However, it would be beneficial for the reader to introduce phase 1 and 2 of the project in the introductory chapter. Reference to "phase 1" in Abstract could then be omitted.

2 - Abstract

Since this paper focuses on the boundary conditions, forcings, and implementation strategies for the coupled-ocean modeling, those components should be summarized and added to the Abstract. The integration of sea surface and deep ocean temperature data sets into the modeling and the benefits of using "anomaly" in combination with "alternate" strategies should be highlighted.

3 - Introduction (1)

Although the motivation and rationale of performing a model intercomparison for the mid-Pliocene project is described in Haywood et al. (2010), experiment 1, it would be helpful to introduce the reader to the mid-Pliocene warm period and the relevance of modeling it. More specifically, what particular motivational questions are there to be answered by using coupled-ocean modeling beyond than just looking at experiment 1? What are key scientific questions?

4 - Integration, atmospheric gases/aerosols, solar constant/orbital configuration (2.1)

The authors should included other available CO_2 records to define their range (page 447, line 15). For example, Pagani et al. (2010) reconstructs a possible range of Pliocene CO_2 of ∼350ppmv to ∼385ppmv for the time window presented here (3 -3.3 Ma BP). Those estimates should be included and explained in reference to the chosen 405ppmv CO_2 for the project.

5 - Integration, atmospheric gases/aerosols, solar constant/orbital configuration (2.1)

I appreciate that the authors allude to the problem that orbital configurations for present day may not be most representative for Pliocene solutions. The authors should also include a sentence or two discuss the role of changing orbits, i.e. maximum to minimum solutions in the Pliocene (glacial-interglacial cycles).

6 - Adaption/availability of a "preferred" and "alternate" experimental design (2.3)

The introduction to the "preferred" and "alternate" approach should precede the description of the "anomaly method" for topography and ocean temperatures (section 2.2).

7 - The PRISM3D data set of ocean temperatures (3.1)

This section describes the core aspect of the paper and is the main addition to the companion paper (Haywood et al. 2010). In particular, the reader would benefit if the

authors summarized and introduced the following parts of the ocean data set rather than pointing to the supplement pdf or the data paper itself (page 450, lines 14-18; page 451, lines 17-18): Since the modeling and implementation is highly dependent on the data, details on the rationale and reconstruction methods presented in Dowsett et al. (2009) should be summarized. In particular potential error bars associated with the reconstruction should be mentioned? What implications are there for the modeling part described in this manuscript?

8 - The PRISM3D data set of ocean temperatures (3.1)

Please comment on the methodology applied to convert the surface temperature anomaly to generate the PRISM3D 0 m reconstruction.

9 - The PRISM3D data set of ocean temperatures (3.1)

A figure on the global surface temperature including the 27 localities would be helpful.

10 - The PRISM3D data set of ocean temperatures (3.1)

The discussion on Pliocene deep water formation and dynamics adds value to the paper and puts emphasis on the modeling part of the project. References should be added. For example, the authors refer to "data" that suggest warmer paleo North Atlantic Deep Water expansion (page 451, lines 7-8)?

11 - Chapters (3) and (4)

The description of boundary conditions and implementation strategies are written in a style that directly speaks to the participants. The author may want to choose a style/rephrase the text to more generally describe the implementation and strategy. This would be more appropriate for the publication in GMD.

12 - Conclusions (5)

How does experiment 2, i.e. the intercomparison of ocean-coupled models, add to experiment 1 and what potential key questions can be answered?

TECHNICAL CORRECTIONS

Page 446, line 4, 5, 13;, 4, 14; page 448, line 5, 11; page 449, line 21; page 450, line 10; page 451, line 20, 22, 25; 19: "PlioMIP"; and page 446, line 19: page 447, line 1; page 449, line 16; page 452, line 14: "the PlioMIP". Be consistent with using "the".

Abstract

Page 446, line 1: "Paleoclimate Modeling Intercomparison Project", introduce in Introduction (1.) below and reference.

Page 446, line 2; page 447, line 26: Haywood et al. (2010) and other studies published within PRISM define the mid-Pliocene warm period as the time window between 2.97 and 3.29 Ma BP. Here the authors use ∼3.3 to 3.0 million yr ago?

Introduction

page 446, line 18: The authors reference the use of US Geological Service PRISM data. This needs a reference. On the same note, the authors refer to the abbreviation "PRISM3D" below (page 447, line 25) without an introduction nor a reference.

Page 446, line 18; page 450, line 8: "This Special Issue..."; "... (2010; this volume)", Although this is a companion paper, it refers to a published paper elsewhere (year 2010) and is not part of the same issue nor volume? Omit references to the special issue.

Page 446, line 19; "...the PlioMIP project"; and page 451, line 21:"...the PMIP project", word "project" is redundant.

Page 447, line 3, 15; page 448, line 7; page 450, line 5: There is a wealth of abbreviations to deal with. Since it is a short paper, I suggest to shorten the list of abbreviations. For example, "mPWP".

Page 447, line 4: Omit "briefly".

Experimental Design

Page 447, line 12: "CMIP5", this abbreviation should be explained. Omit abbreviation.

Page 447, line 13: Instead of a long line of reference to a pdf on a website, please cite an appropriate paper.

Page 447, line 15: "... little more ...", rephrase.

Page 448, line 14-15: : "...(from Experiment 1) . . . (from Experiment 2) ...", (and) can be omitted.

Page 448; line 18: "PRISM_Pliocene and PRISM_Modern", this form is not directly used in equation (1) nor (2). Rephrase and describe instead of using this form of naming the data set.

Page 449, line 3: "Modern SST is projected...", change to "Modern SSTs are projected...".

Page 449, line 6, line 8: "Global_dot.v2.0", Rephrase instead of using this form of naming the data set. Delete in Table 1 accordingly (see below).

Description of Boundary Conditions

Page 449, line 11: "Levitus", needs a description and reference.

Page 450, line 12, 18 and 25, line 20: "PRISM 3-D"; "PRISM3", and "PRISM3D" elsewhere in the document. Be consistent with naming the data set.

Page 450, line 24: "0m" to "0 m" for consistency.

Page 450, line 25: "(converted to a . . . resolution)", (and) can be omitted.

Page 451, lines 7-16: There is a wealth of abbreviations to deal with. Since it is a short paper, I suggest to shorten the list of abbreviations. The following abbreviations are used only once, delete them and spell them out: "NADW", "AAB", "PDW", "AAIW".

Page 451, line 11: "Sites", to "sites".

Variables, output format, data processing/storage, planned analyses

Page 451: Shorten chapter title to "Data Management and Planned Analyses".

Page 452, line 14: The link to the website is already established above. Delete link here.

Conclusions

Page 452, line 16: Delete "detailed".

Table 1

The table description targets participants. Names of data sets, e.g "land_fraction_v1.1", are not necessary to include in the table for the publication in GMD.

References to equation (1) and (2) are necessary when mentioning "anomaly" approach in the description of the table.

REFERENCES

Dowsett, H.J., Robinson, M.M. and Foley, K.M., 2009. Pliocene three-dimensional global ocean temperature reconstruction. Climate of the Past, 5(4): 769-783.

Haywood, A. M., Dowsett, H. J., Otto-Bliesner, B., Chandler, M. A., Dolan, A. M., Hill, D. J., Lunt, D. J., Robinson, M. M., Rosenbloom, N., Salzmann, U., and Sohl, L. E. 2010: Pliocene Model Intercomparison Project (PlioMIP): experimental design and boundary conditions (Experiment 1), Geosci. Model Dev. Discuss., 2, 1215-1244, doi:10.5194/gmdd-2-1215-2009.

Pagani M, Liu Z, LaRiviere J, Ravelo AC. 2010. High Earth-system climate sensitivity determined from Pliocene carbon dioxide concentrations. Nature Geoscience 3: 27-30.

Interactive comment on Geosci. Model Dev. Discuss., 4, 445, 2011.

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