

Interactive comment on “Experimental and diagnostic protocol for the physical component of the CMIP6 Ocean Model Intercomparison Project (OMIP)” by Stephen M. Griffies et al.

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We sincerely thank the CMIP panel, as represented by Cath Senior, for their comments and encouragement. Here are our responses.

Reviewer comment:

We very much welcome the OMIP contribution and the hugely valuable detailing of the diagnostic output that you currently cover in sections 3-8. OMIP is clearly providing leadership on the ocean diagnostics that will provide an important protocol for CMIP6. However we would like to suggest that for consistency with the other papers these sections (3-8) are documented in an appendix rather than in the main body of the

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paper.

Author response:

Many thanks for your encouraging remarks. We agree to move the diagnostics details (located in Sections 3 through 11 rather than 3 through 8) into appendices. We have done so in the revised draft. Note that doing so has made it impossible for us to generate a marked-up draft that clearly identifies differences between the original and revised draft. A "diff" now identifies nearly all text as having changed. The editor is aware of this situation, and has agreed to allow us to skip submitting a marked up new draft.

Reviewer comment:

Additionally, we would like to see some more detail on some of the issues raised above, notably;

1. More discussion on the goal of OMIP in CMIP6 and what science gaps it is attempting to fill. Currently you do not mention the 3 science questions or the WCRP grand-challenges around which CMIP6 is organised. It would seem clear that OMIP is focussed on "understanding systematic biases" and hence would be good to include this and also discuss what OMIP is hoping to achieve that is new.

Author response:

→Agree. These points are now discussed in the abstract and in the introduction. In particular, we now state:

OMIP addresses CMIP6 science questions investigating the origins and consequences of systematic model biases. It does so by providing a framework for evaluating (including assessment of systematic biases), understanding, and improving ocean, sea ice, tracer, and biogeochemical components of climate and earth system models contributing to CMIP6. Among the WCRP Grand Challenge in climate science (GCs), OMIP primarily contributes to the regional sea-level rise and near-term (climate / decadal)

prediction GCs.

Reviewer comment:

2. The discussion of the CORE II experiments is not framed in terms of the CMIP6 ideas of MIPs having tiered experiments. Again for consistency it would be good to include this in section 2.2

Author response:

→Agree. These points are now discussed. Namely, the present paper focuses on a Tier 1 physical experimental protocol. The companion paper from Orr et al (2016) discusses the inert chemistry and the biogeochemical elements of OMIP, and propose a Tier 1 and a Tier 2 simulation.

Reviewer comment:

3. All MIPs have been asked to demonstrate connectivity to the DECK experiments and the CMIP6 historical simulations as one of the 10 endorsement criteria (see Table 1 in Eyring et al., 2016). Please document this for OMIP.

Author response:

→We now more clearly make note of the connection of OMIP to CMIP6 goals in the abstract and introduction, where we now state:

OMIP addresses CMIP6 science questions investigating the origins and consequences of systematic model biases. It does so by providing a framework for evaluating (including assessment of systematic biases), understanding, and improving ocean, sea ice, tracer, and biogeochemical components of climate and earth system models contributing to CMIP6. Among the WCRP Grand Challenge in climate science (GCs), OMIP primarily contributes to the regional sea-level rise and near-term (climate / decadal) prediction GCs.

Reviewer comment:

4. You have not provided an analysis plan for the science community engaged in OMIP. How are you going to use the experiments and diagnostics? Are you committing to analyse all the data that you are requesting (or can you point to other MIPs that will do so)?

Author response:

→In Section 3.2 of the revised draft, we detail areas of ocean and climate science having effected the design of the diagnostics. We here list five CMIP6 sanctioned MIPs (OMIP, FAFMIP, C4MIP, HighResMIP, DCP) that have either proposed diagnostics, or have indicated their needs. We also list five science communities (GSOP, AMOC, Southern Ocean Regional Panel, Ecosystem community, Ocean Mixing) that have representatives on the author list of this paper, each having expressed the need for various diagnostics to further their science research using CMIP6 ocean fields.

More generally, our aim is to design a diagnostic protocol that enables a wide suite of ocean related research to emerge from CMIP6. Analysis plans for this research take various shapes, from detailed projects ongoing by various OMIP authors, to an understanding that some of the best science from CMIP6 will emerge from questions that have yet to be asked. We trust that if these diagnostics are archived for CMIP6, there will be extensive science enabled in the coming years.

Reviewer comment:

5. You make a strong argument about the potential to compare the modelling data with new observations. Can you highlight diagnostics that will enable this comparison – do they make any particular demand on the model outputs? Are/Could the new observations you describe in section 1.1 be made easily available to the modelling community (e.g. through Obs4MIPs?)

Author response:

→We do comment on this point in the introduction. Most notably, improvements to

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the measurement of ocean heat enable a huge suite of key research into the energy balance of the climate system. These observations are being made available to the modelling community through the development of databases and their analyses. Obs4MIPS is aware of this work and is endeavoring to bring the data into the hands of modellers (note, Peter Gleckler and Karl Taylor are co-authors of this OMIP document, and leads on Obs4MIPs).

Reviewer comment:

- The first sentence in the data availability section seems wrong “The model output from the DECK and CMIP6 historical simulations described in this paper will be distributed through the Earth System Grid Federation (ESGF) with digital object identifiers (DOIs) assigned.” This paper is not describing the DECK and CMIP6 historical simulations. Please change. The data availability section could also be shortened. The details on the WIP contribution seems unnecessary here.

Author response:

→Yes, we agree and have edited the text.

Reviewer comment:

-Somewhere at the beginning of the manuscript it should say that this is one of the 21 CMIP6-Endorsed MIPs.

Author response: →Agree and done.

Reviewer comment:

- For the diagnostic sections (3-8), what is the link to the CMIP6 data request? Perhaps you need to clarify where is the definitive documentation of what is actually being output from the models (e.g. via a link to the actual data request) and to reference the GMD paper by Martin Jukes?

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→We are working closely with Martin Jukes. His data request spreadsheets include all of the diagnostics requested in the OMIP manuscript. We indicate such to be the case in the revised version (start of Section 3). However, he has informed us that there is no Jukes et al. manuscript yet to cite, so we cannot do so at this time. Instead, we cite "Martin Jukes, personal communication".

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