Geosci. Model Dev. Discuss.,
doi:10.5194/gmd-2016-66-AC4, 2016

Geoscientific Model Development Discussions

Interactive comment on "High Resolution Model Intercomparison Project (HighResMIP)" *by* R. J. Haarsma et al.

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Received and published: 4 July 2016

Response to anonymous referee #2.

We thank the reviewer for the positive evaluation of HighResMIP and the GMD paper describing the rationale and the protocol. Below we will answer in detail the specific comments.

"Section 2: The 3 Tiers are clearly defined but it is not clear whether there is a ranking behind: are Tier 1 experiments a pre-requisite minimum to participate to HiResMIP ?"

This was indeed not specified in the protocol. It was assumed that all centers participating in HighResMIP would at least do the Tier 1 experiments, because these are considered the least demanding. We have made this now explicit, by requiring that

the Tier 1 experiments are a pre-requisite to participate to HighResMIP (page 5, line 15). The Tier 1 experiments are considered the core of HighResMIP that would benefit from an as large as possible ensemble. In addition the value of the Tier 2 coupled experiments would be strongly enhanced if they can could be compared directly with the Tier 1 uncoupled experiments.

"How HighResMIP is linked to CMIP6 (sections 2., 4.1 and 4.2) is ambiguous: since the very high resolution are not run under the DECK conditions (4.1), I guess only the standard resolution is supposed to be in CMIP6 and the very high resolution are complementary to CMIP6 but not really part of CMIP6 (in 2. It is said "linked" but in section 4.2 it says HiResMIP as one of the endorsed MIPs)? Please clarify."

Indeed, due to computational limitations, the DECK simulations will not be performed by the high resolution version. The standard resolution version, will however complete the DECK simulations and be part of CMIP6. The high resolution version is considered as a sensitivity experiment with respect to horizontal resolution. This is the overarching scientific question of HighResMIP.

"What is impact of enhanced horizontal resolution on the model characteristics?".

The standard resolution DECK simulations are considered as the entry card for HighResMIP. Because NWP centers often only can perform SST prescribed simulations, they cannot complete the DECK simulations. We still want to offer them the possibility to participate in HighResMIP. The solution as outlined in the manuscript is that they can still participate in HighResMIP but their simulations will only be visible as HighResMIP and not as CMIP6 runs. We have tried to clarify this more in the revised manuscript and hopefully make it less ambiguous by deleting the expression "linked" in sections 2, 4.1 and 4.2

"Section 2, Page 5, second paragraph on Tier 2: coupled runs are only mentioned as an opportunity to understand the role of natural variability but they are also required to investigate future climate change."

Indeed, although a large part of the focus of HighResMIP is on natural variability, the extension of simulations up to 2050 is motivated by exploring the impact of high resolution on future climate. We have added that in the manuscript (page 5, line 18-19).

"Section 2, Page 5, lines 21 to 26: the lack of tuning will most probably be more critical for coupled runs than for atmospheric alone models which are constrained by a fixed SST. This should be mentioned."

We completely agree and have mentioned that now in the manuscript (page 5, line 36-38).

"Section 2, Pages 5 and 6: For clarity I would recommend to put the sections on common forcing fields (2.1, 2.1.1, 2.1.2, 2.1.3) together with the description 3.1 of the Tier 1. For other Tiers, reference to Tier 1 is then sufficient."

Thank you for your suggestion. We prefer, however, the current structure and keep the common forcing fields in a separate section. They are common across the Tiers. Putting them in Tier 1 does not improve the clarity of the manuscript according to us. In addition it is important for the common protocol that the common forcing fields are well discussed. This warrants a separate section.

"There are some redundancies between section 4.2 on links with other MIPs, section 6 on applications and section 7 on analysis plan. I understand the need for some redundancies but I have the feeling the order of arguments could be optimised. For example, it would be clearer to first describe the analysis plan, emphasizing at the same time the related MIPs (eg CORDEX, CFMIP, GMMIP) and some applications related to analyses, and then the list of other potential applications. For the interactions with other MIPS, they could be spread among the analyses and the description of the additional experiments. A table could summarise all these interactions."

We prefer to keep a separate section on the connection with DECK and the other MIPs. This was also required by the WGNM of the WRCP. They want for the different MIPs

explicitly the connection. Incorporating them in the analysis plan would according to us dilute this too much and makes the connections less visible.

We agree with your suggestion of re-ordering the analysis plan and the potential applications and have done this. The analysis plan is now section 6 and the additional potential applications of HighResMIP simulations section 7. In addition we have removed issue 1(Extremes), 5(Scale interactions) and 8(Ocean model biases) and transferred the relevant information to the analysis plan. This reduces, according us, significantly the redundancies. In the analysis plan we have now also made clear the links with the different MIPs for the different specific topics.

We decided not to include an extra table as the topics and connections should now be clear from the text.

"Section 5, page 11, on data: In this part, it is not clear whether the plans for the list of variables to be stored is already fixed or not. Please clarify. "

The data and diagnostic plan will be finalized during the boreal summer of 2016. This is added in the text. (Section 5, line 28)

"It would also be good if an order of magnitude of the storage needed could be given."

The approximate numbers of data storage for the different CMIP6 MIP's, including HighResMIP are provided at http://clipc-services.ceda.ac.uk/dreq/tab01_3_3.html. This is now mentioned in the text. (Section 5, line 32)

"What is meant by the "design of CORDEX will be taken into account"?"

We have removed this phrase. Within HighResMIP protocol we do not describe the forcing to CORDEX. This is left to the individual centers.

"What are priorities 1, 2 and 3 ?"

The HighResMIP data request is based on answering the scientific questions we submitted to the CMIP6 panel: http://clipc-services.ceda.ac.uk/dreq/u/HighResMIP.html

We then needed to find a balance between the data needed to answer as many of these questions as possible, against the ability (and willingness) of as many modeling groups as possible to deliver these high volumes of data. This is how we have prioritized the data request – we consider it should be possible for participating groups to produce all of priority 1 data. We have attempted to organize Priority 2 and 3 data in terms of general usefulness and data volume – priority 2 as lower volume and useful for general questions, priority 3 for more specific questions with very high frequency (and possibly shorter period) output. This has been clarified now in the manuscript.

"Section 6: lines 24-25: Tier 3 experiments are also limited by using atmosphere only models."

We have added this remark in the text (page 16, line 20-21).

"Page 18, the data availability part should not be in this section but rather with section 5."

To put the data availability at the end of the manuscript is a requirement of Geoscientific Model Development. (see http://www.geoscientific-model development.net/about/code_and_data_policy.html) We first put it in section 5 as you suggested, but were requested by GMD to transfer it to the end of the article.

"Technical comments:"

"Page 4, line 11: results rather than representation ?"

Done

"Page 4, lines 30-32: should be more explicit on which resolution."

Done

"Page 5, lines 10-11: the list of model names do not correspond to the list of models used in the references: models MIROC, GFDL, SINTEX-F2 whereas in the references SINTEX-F2, GFDL, Hadley, CESM"

This has been corrected

"Page 5, line 34, please mention explicitly RCP8.5."

Done

"Section 2, Page 5, lines 41-42: the use of a delta to the climatological forcing is not clear enough."

This has been now been made more clear.

"Page 6, Figure 1: would be good to add 1, OA and A for Tiers 1, 2 and 3 respectively on the graphs."

Also in response to reviewer 3 we have extended the figure caption. The information of this figure should now be clear.

"Page 7, line 20. It would be good to add here that 3 runs are recommended but not mandatory (rather than page 8 lines 40-43)"

This is a good suggestion. We have changed the text accordingly.

"Page 7, line 36-37: unclear. Is it for detection/attribution ?"

This simply states the properties of the HadISST2 data set and the uses it can potentially be put to – using the multiple ensemble members is not part of the protocol so we could remove the last part of the sentence, but we thought it was useful to be noted.

"Page 8, line 6: what is EN4 ?"

EN4 is version 4 of the Met Office Hadley Centre “EN” series of data sets of global quality controlled ocean temperature and salinity profiles and monthly objective analyses, which covers the period 1900 to present (Good et al., 2013). This is now explained in the manuscript.

"Page 8, lines 34-38: has already been said"

We agree that we have already discussed this before but now in a different context we want to note this again. We have adapted the text to make this more clear.

"Section 3.2.1, Page 9, 3.2.4 is the use of EN4 recommended ? not fully clear"

EN4 is now stated to be the recommended method. This will make the multi-model ensemble consistent, and enable a systematic investigation of model drift from initial conditions which we think would be a valuable new contribution to CMIP.

"Page 12, line 12 the European Copernicus Climate Data Store"

Thank you. Indeed the order of the words was wrong. This has been corrected.

"Page 13, line 22: rather the air quality than the aerosol only effect on health ?"

Agree. We have changed the text accordingly.

"Page 13, line 32: very few models will use eddy-permitting ocean. This is misleading."

We agree that agree that most of the HighResMIP models will use eddy permitting ($\sim$1/4 degree) and not fully eddy-resolving ocean models. We have modified the text accordingly.

"Table 1: give a reference to “Historic” boundary conditons."

The Historic simulations are part of the DECK and are outlined in Eyering et al. 2016. The reference has been added.

"Tier 2 future add coupled."

Done

Table 9.1:

" what is the standard resolution of NorESM ?" 2 degrees "missing information for GFDL" CM3 standard is 200 km