Author's response to comments from V. Eyring (Comment 2)

Comments from CMIP Panel
The CMIP Panel is undertaking a review of the CMIP6 GMD special issue papers to ensure a level of consistency among the invited contributions, also in answering the key questions that were outlined in our request to submit a paper to all co-chairs of CMIP6- Endorsed MIPs. We very much welcome the important contribution from ISMIP6 to the CMIP6 special issue, below are a few comments:

We thanks the CMIP Panel for taking the time to review the ISMIP6 paper and for their leadership of CMIP6. We have revised our manuscript in light of these comments, and other comments that we have received.

Please consistently use the term 'CMIP6-Endorsed MIPs' when you refer to other MIPs that are endorsed by CMIP6.
We have checked the manuscript to ensure a consistent use of the term CMIP6-Endorsed MIPs.

Please ensure consistency of the experiment names and abbreviations with the CMIP6 overview paper (Eyring et al., 2016).
We have checked the manuscript to ensure a consistent use of the experiment names and abbreviations with the CMIP6 overview paper.

Please ensure that all ISMIP6 'experiment_ids' and 'sub_experiment_ids' are consistent with those used in the CMIP6 data request and experiment table, and with the CMIP6 terminology (see email exchange with Karl Taylor).
We have checked the manuscript to ensure that the use of the ISMIP6 experiment_ids and sub_experiment_ids are consistent with those used in the CMIP6 data request, experiment table and terminology, and use the ones from the email exchange with Karl Taylor.

Please ensure that the 'source_id' for the offline models is compliant with CMIP6 terminology.
We have emailed Karl Taylor for a clarification on what the source_id should be for the offline models. The response is that as we are not naming specific models, source_id is not relevant in our manuscript. We will however work with Karl Taylor to obtain source_id for the offline models that are compliant with CMIP6 terminology

p.5,l1ff. Section 3.1
• Is there a more intuitive title that actually describes what is envisaged here? Use seems vague.
We have changed the original title of section 3.1 from "Use of selected AGCM and AOGCM CMIP6 experiments" to "Analysis of experiments with climate models proposed elsewhere in CMIP6 (and not coupled to ISMs)". For consistency in the manuscript, we have also renamed section 3.2 from "Coupled AOGCM-ISM experiments" to "Experiments with climate models coupled to ISMs" and section 3.3 from "Standalone ice sheet model experiments" to "Experiments with ISMs not coupled to climate models".

• The last two paragraphs (l21ff and p6,l1ff) on the definition and explanation of the DECK, CMIP6 historical simulation, ScenarioMIP, and PMIP experiments should be deleted since they are already defined elsewhere in this special issue. It seems sufficient to simply refer to the other papers.
The last two paragraphs of this section are indeed intended to give a brief overview of CMIP,

CMIP6, ScenarioMIP and PMIP, for readers that are unfamiliar with these efforts. We do provide reference to these description papers, however, we do not want to delete these two short paragraphs, as they provide the context for the ISMIP6 experiments. In particular, the ice sheet modeling community is not always familiar with the CMIP effort, as it is the first time that there is an ice sheet component in the CMIP effort. Some of the ISMIP6 standalone experiments may appear strange for an ice sheet modeler, who does not know of the CMIP framework/history.

• Would it be possible to list some observations that could be used to assess the models (l15ff)?
The observations that could be used to assess the climate models were discussed in section 4.1. Following a comment of reviewer 2 that he expected to read something about the observations in this section, and your suggestion below that the first paragraph of section 3.1 could be merged with section 4.1, we have now moved the relevant paragraphs of section 4.1 to section 3.1. The moving of paragraphs required some tidying up of the text, which we have also done.

• Possibly merge the first paragraph with Section 4.1 which is on the same subject and seems repetitive as it stands now with bits of information scattered across these two sections.
Done, see comment above.

p7,l19ff: please add to the text that both the downscaling method and the spin-up should be well documented. Also it might be good to expand a bit on the methods used for the spinup.
We have added to the text that downscaling methods and spin-up should be well documented, as you suggested. We have also expanded a little on the methods and challenges for coupled AOGCM-ISM and ISM spin-up.

p8,l8: 'then holds concentrations fixed for an additional two to four centuries.'. This is not how the 1ptCO2 experiment is defined. Note that in contrast to previous definitions, the experiment has been simplified so that the 1% CO2 increase per year is applied throughout the entire simulation rather than keeping it constant after 140 years as in CMIP5, see Section A1.4 in Eyring et al. (2016).
When working with Karl Taylor on the experiment_id (after the paper was submitted) it became clear that the version of the 1pctCO2 experiment that ISMIP6 is using is in line with the CMIP5 version and thus slightly different from the CMIP6 version after 140yrs. We have modified the manuscript to state this.

p8,l21: Here you encourage the extension of the projections until 2300 which is certainly a valid addition when it comes to the assessment of future sea level change. It is however only recommended, whereas in Table 1 this experiment is listed until 2300. Please could you make this consistent, e.g. either make it mandatory or - similar to ScenarioMIP (e.g. SSP5-8.5-Ext) - separate the two simulations in Table 1 into one that goes until 2100 and one that extends to 2300, and additionally list the Tier?
Thank you for pointing this out. We will follow ScenarioMIP and have altered the manuscript to reflect this.

p9,l5ff: Section 3.3: Could you confirm that all the output from the offline and standalone ISM experiments is conform to the output requirements of CMIP6? If ISMIP6 relaxes this requirement on output for some of its offline experiments, then those experiments should be considered not a part of CMIP6 (and therefore not listed in this paper). They could be described elsewhere. Our experience with past MIPs has been that initially the threshold effort required for standardizing data output (CMORization) is perceived as an obstacle by

many groups, but time and experience has shown that this effort is well worth it. We have found that only standardized data gets widely used by the community, and the analysis of that data, especially by researchers outside the major modeling centers, has been central to CMIP's success.
We confirm that all the outputs from the offline and standalone ISM experiments will conform to the output requirements of CMIP6. We have worked with Martin Juckes, Denis Nadeau and Karl Taylor to test that CMOR works for polar stereographic grids. ISMIP6 will also continue to provide help to ice sheet modelers to make their files compliant, a process that started with the initMIP experiments**.**

p9,l13ff: 'A key concern is that ISMIP6 assess uncertainty associated with both emission scenario and the AOGCMs' simulation of these scenarios. To this end, we anticipate identifying a subset of the CMIP6 AOGCM ensemble for use as ISM forcing which captures the full range of potential ice-sheet forcing.' This paragraph is too vague and the sentence seems contradicting - first a subset is selected and this should then be the full range? Please clarify. Please also add more explanation on how this selection process is done and why it is necessary.
ISMIP6 seeks to assess the uncertainty in sea level projections arising from both the ice sheet models and the climate forcing. For a given emission scenario, the AOGCMs simulation of these scenarios will result in a range of atmospheric and oceanic forcings. It is not possible for the standalone ice sheet models to make simulations with the forcings from all AOGCMs. A subset will therefore be selected (rather than doing them all), and the subset will be chosen to represent the range, by using metrics of the SMB and ocean forcing to investigate that range. The manuscript has been modified to explain this.

l18,p15: Data availability:
• Please delete 'the majority' in the first sentence. All CMIP6 simulations will be distributed through the ESGF and non-CMIP6 experiments shouldn't be described in this paper.
We have deleted "the majority" as suggested, and checked that all experiments described in this paper are CMIP6 experiments.

• Could you please add the following additional sentence after the first sentence? 'In order to document CMIP6's scientific impact and enable ongoing support of CMIP, users are obligated to acknowledge CMIP6, the participating modelling groups, and the ESGF centres (see details on the CMIP Panel website at http://www.wcrp-climate.org/index.php/wgcm-cmip/about-cmip).'
We have added the suggested sentence.

Table 1: The table lists experiments that are defined by ISMIP6 and experiments that are already defined elsewhere in CMIP6, this is confusing.
• Suggest to remove all experiments that are already defined elsewhere from this table (i.e., please remove the entire row for amip, abrupt-4xCO2, historical, ssp5-8.5, and lig127k).
• The titles of each category could be more specific by for example saying 'ISMIP6 DECK experiments' or something similar.
• Please could you also add a column that shows the Tier for each experiment?
• There could be another category that lists the ISMIP6 offline experiments from Section 3.3 if they are proposed to be part of CMIP6 (in which case the output has to be compliant with CMIP6 standards, see above).
We have removed the rows corresponding to experiments that have already been defined in the CMIP6 description paper or MIP-Endorsed description papers of this special issue, and placed

them in a new Table (now Table 1). We feel that this information is important in our manuscript, as it allows readers that are not familiar with CMIP6 to avoid having to read many additional papers to find relevant information.

The new Table 2 now only contains experiments that are ISMIP6 experiments. This table includes your suggested changes: more specific titles, the Tier for each experiments, and the experiments that had been omitted from the original table (and described in the original section 3.3)

Table 2:
• is it possible to add a column with some specifics on the ice sheet models used and a reference if available?
• GFDL and MPI-ESM were two more models that initially indicated interest in participating but are not listed?
• Except for CanESM that only participates in the diagnostic part of ISMIP6, are all other models listed using fully coupled ice sheet models, or are some of the models listed only contributing with standalone ice sheet models? Maybe this is not fully decided yet?
• Maybe it would be good to also list in a similar manner the standalone ice sheet models?

The new Table 3 now includes the ice sheet models used. We have also added MPI-ESM (the omission had been a mistake on our part). However, GFDL informed us that they no longer wish to take part in ISMIP6 and have asked to be removed.

With the exception of CanESM, all the models listed in Table 3 are planning to participate using fully coupled ice sheet models.

The manuscript now includes a new Table (Table 4) that lists the standalone ice sheet models taking part in ISMIP6 (and their institution).

Tables A1-A3: This is a very helpful overview of the variables requested by ISMIP6 but it would be good to clarify either in the caption or in a separate column from which CMIP6 experiments these variables are requested.
The caption now indicates from which CMIP6 experiments these variables are requested.

Table A2: Some additional information from the models is required to regrid the ocean data to standard grids. OMIP is proposing a weights file that model groups should provide to enable regridding from the native grid to one or two CMIP6 standard grids. Please refer to Griffies et al. (2016) and follow the same procedure for the ISMIP6 Omon requests if regridding is required.
We have modified the manuscript as suggested.

Reference:
Eyring, V., Bony, S., Meehl, G. A., Senior, C. A., Stevens, B., Stouffer, R. J., and Taylor, K. E.: Overview of the Coupled Model Intercomparison Project Phase 6 (CMIP6) experimental design and organization, Geosci. Model Dev., 9, 1937-1958, doi:10.5194/gmd-9-1937-2016, 2016.

Griffies, S. M., Danabasoglu, G., Durack, P. J., Adcroft, A. J., Balaji, V., Böning, C. W., Chassignet, E. P., Curchitser, E., Deshayes, J., Drange, H., Fox-Kemper, B., Gleckler, P. J., Gregory, J. M., Haak, H., Hallberg, R. W., Hewitt, H. T., Holland, D. M., Ilyina, T., Jungclaus, J. H., Komuro, Y., Krasting, J. P., Large, W. G., Marsland, S. J., Masina, S.,

McDougall, T. J., Nurser, A. J. G., Orr, J. C., Pirani, A., Qiao, F., Stouffer, R. J., Taylor, K. E., Treguier, A. M., Tsujino, H., Uotila, P., Valdivieso, M., Winton, M., and Yeager, S. G.: Experimental and diagnostic protocol for the physical component of the CMIP6 Ocean Model Intercomparison Project (OMIP), Geosci. Model Dev. Discuss.,doi:10.5194/gmd-2016-77, in review, 2016.

With many thanks for your ongoing efforts in the CMIP6 process.

The CMIP Panel