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Geoscientific Model Development Discussions

Interactive comment on "The Scenario Model Intercomparison Project (ScenarioMIP) for CMIP6" *by* Brian C. O'Neill et al.

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We appreciate the reviewer's comments, which have led to an improved manuscript.

Comment:

General comments

This paper presents the rationale and experimental design of the internationally coordinated experiments of the intercomparison project ScenarioMIP proposed within the framework of the WCRP CMIP6 experiments.

This set of experiments aims at investigating future climate projections under different scenarios of emissions of greenhouse gases and aerosols as well as of land-use changes. The paper presents the new framework, which aims at better integrating

climate projections with the IAM and IAV communities. It clearly describes the associated objectives and scientific questions. The paper also describes the eight different scenarios organised in two tiers, as well as their rationale. The relation with other CMIP6-endorsed MIPS is also well done and emphasizes the importance of ScenarioMIP. The overall number of experiments is quite heavy (8 plus extensions) and it is crucial to indeed have 2 tiers but also well clearly show what they will allow so that groups can decide their strategy.

The overall paper is crucial for CMIP6 and certainly deserves publication. It results from a strong collaboration between IAM and Climate modelling communities. The paper is very well written even if some few elements might be improved (see specific comments). It is important that the paper clearly emphasizes why it is needed to have new scenarios, how much they differ from previous RCP scenarios and what they will allow to investigate.

Specific comments

Part 2.2 describes the ScenarioMIP objectives. They are well described and fully relevant. Their role for policy advice on mitigation and adaptation could nevertheless be also mentioned, eg. Page 5, line 17, according to the importance they play on this aspect. It is only mentioned in Table 1 and in abstract.

Response:

We have edited the text of the objectives in section 2.2 to reflect this relevance (see also response to reviewer RC1).

Comment:

In part 2.3, it would be good to have few sentences explaining what are the main characteristics of the 5 SSPs (e.g. page 6, line 3). The concept is important but not that well known from climate modelers that will contribute to ScenarioMIP. They are shortly characterised in Figures 1 and 2 but never really described in the paper. This

is missing even if references to papers are given. Moreover, the Riahi paper that gives an overview is submitted but not yet available.

Response:

We have added a short description of the SSPs to section 2.3. Also, the Riahi et al paper has now been accepted and is available (information updated in the reference list).

Comment:

Part 2.3 explains the new framework but I think it could be a bit more explicit about why it is needed to update the RCPs to the SSPx-y scenarios. Updated emissions and landuse scenarios are mentioned. The main reason however appears to be for consistency with SSPs and that it will allow integrated studies. However, if the consistency with SSPs is described, not much is said about integrated studies.

Response:

As explained in the paper, there are important reasons to ensure consistency with the RCPs, but still provide updated model runs (among others the long time period between the CMIP rounds). The update allows some important advantages over the original RCPs: - A more thoughtful design of air pollutant and land-use scenarios (given the option to develop consistent scenarios) - The consistency between SSP/RCPs. While we believe that it is possible to use the forcing scenarios for different SSPs – there are also advantages of fully consistent scenarios. We expect these to be used in ScenarioMIP but possibly also in research. Some assessments may also choose to use these scenarios (The World in 2050; IPBES).

Comment:

Part 2.4 explains the main scientific questions to be addressed by ScenarioMIP. They are all important. However, I am missing a paragraph that would also remind the key scientific questions that scenarios can address such as how climate extremes are af-

fected by the scenarios, how these scenarios will allow to address climate impacts, but also issue the questions behind the long-runs : : : In particular, none of the mentioned scientific objectives can only be addressed with Tier 1 whereas several to many groups may only perform Tier 1 simulations. Moreover, it is surprising to have as a first question, one that requires additional experiments that the 2 Tiers already quite demanding.

Response:

We have added text to the start of section 2.4 reminding the reader that the highest priority objective for ScenarioMIP is to facilitate a large number of studies addressing a wide range of questions regarding climate change impacts and response options. We have also added an explicit scientific question on this topic to be addressed by ScenarioMIP simulations (see response to Reviewer RC1 on this topic). Climate extremes, together with other topics having to do with the manifestation of forcing effects on the physical climate system are listed among the WCRP Grand Challenges that our experiments will help address. The section then goes on to describe additional climate science questions that will be able to be addressed with these simulations.

Comment:

Part 3.3.2 would it be possible to be a bit more explicit on the underlying marker scenarios which are behind each SSPx-y ?

Response:

This comment does not seem relevant to section 3.3.2 (on the relation to CMIP5). We guess that it may be relevant to section 3.2.2, which describes the scenarios to be run in ScenarioMIP. Some detail on the scenario inputs to ScenarioMIP simulations are given in section 4. Decisions on specific marker scenarios (and associated IAM models on which they are based) have not been finalized, so we do not report them here.

Comment:

Part 3.3.2 clearly states that these new scenarios will differ from the ones used in CMIP5. However, this could be made more explicit using Figure 3 which represents both the old and new scenarios but with no comments in the text. Moreover, it would be good to better emphasize how much they will differ with regards to land-use change.

Response:

We agree that being more explicit about differences in land use change would be useful, and so we have created a new figure (now figure 4) showing changes in land use in the scenarios in the ScenarioMIP design compared to those in the four RCPs. We have added reference to this figure, and to figure 3 showing the emissions, concentration and forcing pathways, to the text in section 3.3.2 as well as to section 3.2.2 in the introduction to the description of each scenario.

Technical comments

Comment:

Page 2, line 11: AR4 and not AR5

Response:

Fixed.

Comment:

Page 16, line 11, the title is misleading and should not mention CO2 since in the text it is clearly said that scenarios will be concentration driven for long-lived greenhouse gases.

Response:

We removed the reference to CO2 specifically.

Comment:

Page 17, line 25: the forcing harmonization is not clear. What it aims at should be explained and a reference given.

Response:

References are not yet available for historical land use and emissions or for the harmonization process. We have added text to describe that harmonization means modifications to the IAM scenarios to make them consistent in the base year across models and with historical land use and emissions data.

Comment:

Page 20, line 24, please add the reference for the data request

Response:

This reference is not yet available, but will eventually be part of the special issue, so we can only retain the description of this paper in the text without providing a specific citation.

Comment:

Page 20, lines 15 to 19: Specifications for the natural forcing differ from CMIP5, which should be made more explicit.

Response:

Text added to make this explicit.

Comment:

Page 20, I have not found a mention to the initial year of the scenarios. Page 20 mentions end of the historical period 2015 but Figure 3 seems to show 2005 as for previous RCPs ? At least it should be mentioned clearly.

Response:

We have clarified in the first paragraph of section 4 that the start year is 2015.

Comment:

Page 21 the paragraph on data availability would rather better fit at the end of part 4.

Response:

This format was requested by the editors of the special issue.

Comment:

Page 27, line 27, this reference is mentioned 2015 in the text not 2016. Please check. If 2016, it will important to specify 2016 a and b

Response:

We have updated the reference list and the text to 2016a and 2016b.

Comment:

Table 2 is a very good idea. However, some links may be missing concerning the overshoot experiments as mentioned in the text but not in the table ?

Response:

The overshoot scenario (SSP5-3.4-OS) is listed in Table 2.

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