

## ***Interactive comment on “The penultimate deglaciation: protocol for PMIP4 transient numerical simulations between 140 and 127 ka” by Laurie Menviel et al.***

### **Anonymous Referee #1**

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Menviel and colleagues describe the experimental protocol for numerical climate simulations of the penultimate deglaciation (140-127 ka) in the framework of the Paleoclimate Modelling Intercomparison Project (PMIP). The manuscript gives a comprehensive overview of the planned simulations, the required input and forcing data and paleo information that will become useful for data-model comparison later in the project.

The manuscript represents an important contribution for the modelling community to describe, organise and guide climate model experiments for the penultimate deglaciation. Next to the more technical description of the experiments, the work also gives a brief but well-informed overview of the current knowledge and scientific questions for

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the climate evolution of this period. The manuscript is well written and is an interesting read for the readers of CP, even beyond the group of people directly connected to PMIP. I recommend publication of the article with minor revisions detailed below.

P1, Abstract Here you define 'thousand years before present' as 'ka', but in the rest of the text this is not used consistently. E.g. P2 L18-19 you use kyr. Consider revising for consistency.

P2 L3 Depending on the complexity of the Earth system model, some of the elements listed here as boundary conditions could be interactive components (carbon cycle, ice sheets). I suggest to make it clear that the target model configuration for these experiments are standard AOGCMs.

P2 L11 Add 'last deglaciation experiments of the' before 'PMIP4 effort'.

P2 L13 Again, clarify that this is typically O-A coupled and not including e.g. the ice sheets.

P2 L24 I can see that the earlier definition of the term 'termination' may not be very useful in the context of this effort. Nevertheless, it is not clear what the new definition really means. Maybe it is not necessary to have a precise definition, but could you try to capture the common understanding in your group. Is this e.g. from peak glacial to peak interglacial in temperature or similar?

P2 L32 While I agree that GHG and ice sheets are probably the largest factors, I am not sure other mechanisms can be excluded, like sea-ice and vegetation changes. This could be included in the sentence.

P3 L1 You could mention here how many glacial terminations have occurred in the past 450 ka.

P4 L1 Could add 'global' before CO<sub>2</sub> to avoid confusion.

P5 Reformulate to avoid confusion: Sea-level rise is not the potential cause of HS11.

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P5 L9 Specify over how many ka, or from when to when CO2 increase was sustained.

P6 L14 Is Berger (1978) the quasi-standard used by everybody in the community? Would another solution (e.g. Lasker) be accepted? Clarify.

P6 L31 Is it desired that the model configuration is the same for the proposed experiments as for the last deglaciation? Maybe this could be included as a (soft) constraint.

P7 L19 I was a bit surprised by some of the wording in the experiment description. I would e.g. interpret 'recommended' as 'other options are also OK'. I don't know if that is intended, but would suggest to carefully reconsider these formulations. I understand that on one hand the MIP cannot be too prescriptive, to not exclude specific groups or modelling approaches. On the other hand, consistent analysis across ensemble members gets very difficult when the ensemble is too diverse.

P7 L29 Will all forcing records be provided by PMIP4? I see that you have a general statement in the "Data availability" section. Maybe it could be mentioned already at an earlier state and in the main text, e.g. around here, where different records are discussed.

P8 L13 What is meant by 'Glacial geological data'? Could you give some examples?

P8 L20 Maybe 'the different' instead of 'all different'. There are not that many.

P8 L21 Also, could you be more specific on how the NHIS and GrIS are merged? How much of a difference does it make on one degree resolution to use GSM GrIS compared to what is simulated for GrIS by IclIES?

P8 L23 Be consistent with symbol GLAC1-D vs GLAC-1D.

P8 L19-29 Could you explain this better? Maybe you could start by explaining that you need TII data, but that the SL solver needs a full evolution until present day.

P8 L29 What is 'surface drainage pointer evolution'?, Explain.

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P9 L3 Is it true that the ice sheet model is run on a lat-lon grid? That was surprising to me.

P9 L7 Add 'other' before 'numerical simulations'.

P9 L10-17 This paragraph could be part of an introduction in the main section 4. Consider revising.

P10 L1-10 The level of detail in this description seems a bit unbalanced compared to the limited information given for IclIES. Maybe the IclIES description could be matched to give some similar information on ice flow, parameterisations, ...

P10 L5 Add 'and bedrock geometry' after ice if that is the case.

P10 L6 What does '\*partly\* glacial index based' mean?

P10 L14 Could move sentence 'The last 20 kyr ...' before sentence starting 'The simulation presented ...'.

P10 L18 What is 'glacial non-floating ice volume'. Is that ice grounded out on the continental shelf?

P10 L30 Not clear what is meant here. Maybe 'The maximum sea level contribution from Greenland at 123-121 ka ...'.

P11 section 5 At first view it seems a bit out of balance to have three pages of text to describe TII sea-level evolution. Is the sea-level evolution used for anything else then the land-sea mask evolution in these simulations?

P14 L20 What is meant by 'restrictions', clarify?

P14 L30 Specify (if) what is included in the simulations. A isotope tracer?

P15 L19 It is difficult for me to imagine how land-sea masks are linearly interpolated. Please clarify.

P15 L27 How and when will these files be provided? Specify.

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P16 L17 Please check and specify the units for this equation. P-E would probably be in mm/yr water equivalent, while  $dH/dt$  would probably be in ice equivalent if taken from elevation changes of the ice sheet model. What ice density is assumed in the ice sheet models? Is it consistent between IclES and GSM?

P16 L11 There are two Goelzer et al. papers from 2016. The one that would be more appropriate to cite in this context is the one on ice sheet freshwater forcing (doi:10.5194/cp-12-1721-2016)

P17 L4 Such massive input of freshwater as given in some of the scenarios may be problematic for some of the models, especially when distributed over small areas, like river mouths. You may want to consider a plan B for such cases.

P17 L20 It is not further described what should be done in cases of negative fwf. It seems important to note that the salt flux anomaly should not be applied at the same routing locations as the positive fwf would be. Probably it should be added as a global flux if conservation is required.

P18 L27 'could be assessed', P19 L2 '... should be studied in detail through sensitivity experiments', P19 L5 '... sensitivity simulations forced with different dust-flux scenarios are encouraged' Is there further guidance from PMIP on these experiments, or is it up to the participants to decide these extensions? Maybe some more details could be given that support the participants in their choices?

P24 L10 Is sea-level not needed to determine changes of the land-sea mask? If not, why is there so much emphasis on this new chronology?

P24 L24 Are climate models with interactive ice sheet components not used by any of the potential participants? If they are, how would the protocol have to be adjusted to accommodate the additional capability in the best possible way?

Table 4. The caption is very difficult to read at this font size.

Figure 2 The grey EDML line is very difficult to see.

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Figure 3 The caption suggests that the ice mask should be visible, but that is not the case. I see lowest bin colour everywhere.

Figure 5 Remove the 0.99 label from the grounding line.

The choice to show only 132 and 128 seems surprising. Why not show more snapshots including the beginning (140 ka). (the grid could be almost half the size!) .

Figure 6 Why not show also 134, 138 and 128 ka?

It seems that the x and y axis have different scale. Could this be improved (e.g. matlab axis equal)

Figure 7 Replace 'Rea' by 'Red' in first line.

Figure 9 Line e for Chinese loess is not well visible.

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