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Interactive comment on "Transient climate simulations of the deglaciation 21–9 thousand years before present; PMIP4 Core experiment design and boundary conditions" *by* R. F. Ivanovic et al.

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Summary This manuscript describes the scientific motivation and technical specifications for a community model experiment simulating the deglaciation (26 or 21 ka until 9 ka BP) in climate models of differing complexities. The experiments are designed so that both fully- coupled Earth system models and a variety of reduced models can take part. There is a nice blend of flexibility in the model design – with specified boundary conditions for the main climate forcings and their temporal variability, but some user discretion on implementation. The balance seems appropriate. This is nicely presented

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and explained, overall. The summary of deglacial climate dynamics and some of the paleoclimatic enigmas during this period makes for a lovely review, and the experiments that are described will certainly be interesting. Most of what one needs from this manuscript is encapsulated in Tables 1 and 2, so at first it seemed unnecessarily long, but the narrative is nicely written and a pleasure to read, offering some helpful insights about the approach to be adopted in the intercomparison. I am a bit surprised that the 'focussed' experiments are not described or prescribed in detail at this point. I understand that perhaps these need to be reactionary to the results of the core experiment. It seems unfortunate though, as it would be helpful to have this information together in a single document. I am sure lots of ideas are already in place for the spinoff or focussed experiments, and it would not have taken too much extra work to have these set out here. But this is not necessary, and it is probably helpful to keep these flexible and as subsets of the main modelling exercise. My only substantive feedback or suggestion involves the meltwater treatment. Several thoughts related to this are made below, in the specific comments. Overall, it seems inconsistent to have specified, time-varying ice sheet volume on the continents but not honour this global water conservation when it comes to the ocean freshwater and salinity budget. I appreciate the desire to control for meltwater runoff, but it makes one wonder if the core experiment, as described, is meaningful since it does not do a physically sensible job of representing the basic ocean state through deglaciation. At least as I understand the model design. Things like preconditioning and ocean mixing surely depend on the mean salinity and its structure. I appreciate that this design is intentional, to eliminate some of the complexity and model dispersion associated with when/where to put the meltwater. And models are dealing with meltwater routing and runoff internally, in some cases. But since the specification is to violate water balance and neglect runoff processes, it would not be unreasonable to honour water balance while neglecting runoff processes. That is, the ice sheet ïĄĎV, as specified through the Peltier or Tarasov reconstructions, can be converted to eustatic water equivalent and restored to the nearest ocean in a specified way for all model experiments. This could be considered for the Core experiment as some-

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thing a bit more realistic, while saving some of the detailed questions about meltwater runoff and iceberg discharge for the focussed experiments. It would require a bit of extra work to define the timing and location of freshwater runoff, which everyone would follow, but this can be straightforward I think. Just don't inject the water all at once every 1000 years, when the ice geometry changes. Rather than shock the system, one could, for example, take the 1000-year ïĄĎV in each major river catchment and divide by 1000 to give the average runoff in m3/yr (or convert to Sv), in a way that respects water balance. If one wants to avoid some of the detailed questions concerning paleo-river routing, the appropriate amount of water could just be spread over the large-scale basin (e.g. North Atlantic, Southern Ocean, etc.). I would leave it to the authors to consider what is best here, but I do recommend considering a treatment like this within the core experiment design.

Specific comments p.9047, ll.12-14, "A choice of two ice sheet reconstructions is given, but no ice sheet or iceberg meltwater should be prescribed in the Core simulation." – this is confusing, are ice sheets to be prescribed or internally modelled? I understood what the authors meant by the end of the manuscript, i.e. don't put any ice sheet meltwater into the oceans, but this seems contradictory to prescribe ice sheets but not put the prescribed change in water volume back into the oceans.

p.9048, l. 26, "majority of its ice melting" – not really the majority of the Antarctic Ice Sheet melting; rather, much of the excess LGM ice that was out on the shelf, and the thicker ice that covered WAIS; but overall, it was closer to a 20% loss of the ice in Antarctica through this period

p.9050, l.4, the idea of mid-latitude N.Atlantic warming during H1. This is not really compatible with the preservation of Hudson Strait icebergs in a swath at 40-55 N across to Portugal. Is it more of a subtropical warming that has been proposed? Else it is perhaps worthwhile to note this incompatibility.

p.9050, l.15, suggest deleting 'older', it conveys a bias against these studies, i.e. a

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potential lack of objectivity, whereas many of the studies cited below in favour of a northern source are in fact older

p.9062, Section 2.1. I wonder about a prescription for oceanic or surface ocean d18O and dD as well, for those that will explore isotopic cycles through the deglaciation.

p.9062, ll.7-9, discussion of the freshwater budget. Just to be clear here, the experiments should prescribe/force all precipitation to return to the oceans annually then, i.e. equilibrium mass balance conditions on the ice sheets? This is fair for present purposes, but I guess that it will not occur naturally in any of the models, so this sounds tricky. I wonder if more explicit directions here would be helpful, as to how the freshwater routing/flux adjustments should be prescribed. For instance, should an LGM catchment map be prescribed, so that everyone is using the same one, based on the ice sheet configuration? Then everyone forces all precipitation within the catchment to return via a prescribed river outlet/coastal grid cell.

p.9064, ll.23, 27. I think with Tarasov as an author, you don't have to list this as 'personal communication' – also on the next page

p.9067, Section 2.5, freshwater fluxes during the deglaciation. It does seem odd but also sensible to have controlled experiments that examine non-meltwater forced climate change during the deglaciation. Although given the important role that ocean circulation simply had to have played in the Bolling and YD, this seems limiting. i.e., orbital forcing and CO2 clearly cannot explain these features of the deglaciation. A reference experiment is nonetheless important and useful. I wonder if it is the best reference though, given that the ice sheets did melt away and ocean salinity did decrease through this period. Is it possible to have prescribed changes in mean ocean salinity through the deglaciation and/or prescribed runoff as a second core experiment? The latter could be done based on the 1000-yr ice sheet updates to at least have the correct global water cycle (conservation). I appreciate the arguments and intricacies concerning when and where to put the meltwater. Some hypothesis-driven

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experiments here seem sensible, as additional experiments.

Please also note the supplement to this comment:
http://www.geosci-model-dev-discuss.net/8/C3782/2016/gmdd-8-C3782-2016-supplement.pdf

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Interactive comment on Geosci. Model Dev. Discuss., 8, 9045, 2015.

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