

Interactive comment on “Are paleoclimate model ensembles consistent with the MARGO data synthesis?” by J. C. Hargreaves et al.

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General comments:

In the paper entitled "Are paleoclimate model ensembles consistent with the MARGO data synthesis?", authors Hargreaves et al. evaluate existing climate model ensembles simulating Last Glacial Maximum (LGM) climate against the state-of-the-art MARGO multi-proxy reconstruction of sea surface temperatures (SSTs) during the LGM chronozone. The paper addresses the performance and biases of two generations of coupled climate models in simulating paleoclimates using relatively simple, though innovative statistics. In particular, they draw conclusions on the consistency between simulated LGM ocean conditions the Paleoclimate Modelling Intercomparison Project ensembles (from phases 1 and 2) as well as a one model - multiple parameterisation ensemble

(JUMP), and the MARGO SST database using statistical reliability.

Their major conclusions are that: (1) dynamic ocean models in coupled climate circulation models improve simulated North Atlantic SSTs by calculating the oceanic meridional heat transport; (2) their inclusion in coupled models does not increase spread in simulated LGM SST anomalies; (3) Too warm SST anomalies in the unreliable JUMP ensemble suggests that a high (modelled) climate sensitivity of about 4°C decreases consistency between simulated and reconstructed LGM climate as compared to lower, canonical sensitivities, implying a potentially lower reliability in future climate projections based on models with high climate sensitivities.

In General, the manuscript is well focused, clear in terms of text, tables and figures, and of fair relevance to the climate modelling community by clarifying the need of constraining climate models used for future projections against paleo-data. However, modest, but necessary improvements need be made before publication. I therefore recommend the paper for publication in *Climate of the Past*, subject to minor revision.

Specific comments:

1. References:

One concern for the overall quality of the manuscript is the frequent self-referencing to either papers that have been submitted to – but are not yet accepted for publication in – peer reviewed journals (i.e. Annan and Hargreaves, submitted, 2010b; Yoshimori et al., in revision, 2011) or papers that are published in journals that are not peer reviewed or of which the status is not clear to me (i.e. Annan et al., 2005b; Hargreaves, 2010). Combined with the self-referencing of papers in peer reviewed journals, this practice appears somewhat inappropriate. Since, however, the present manuscript does not draw much on the conclusions of the referenced papers, the authors should reconsider whether those references are at all needed and delete them where not.

2. p777 l8 and elsewhere:

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The authors should avoid the use of 'epochs' which in geochronological terms refers to intervals of a typical duration of millions of years (thus far with the exception of the Holocene). The Last Glacial Maximum, however, is not considered an epoch in geochronology. Rather, Mix et al. (2003) define the LGM chronozone as the interval ~23-19ka BP.

3. p777 l12: ... carbon dioxide level[s] substantially...

'substantially' is a matter of choice. Perhaps better would be less than half of today's (or 2011) values.

4. p781 l18: The authors should include a brief justification of the use of both AOGCMs and AOVGCMs. In my opinion, one of the strengths of PMIP2 in this is its diversity of coupled model types.

5. p782 l8: control model run

In terms of control run, the authors should specify which conditions are meant with 'modern'. Do they mean pre-industrial or present-day.

6. p784 l9-11: T21 MIROC grid

Since the T21 spectral resolution corresponds to ~5.625° horizontal grid resolution, which is slightly lower than the MARGO 5° horizontal resolution, should that not increase the error of the re-interpolated MARGO SST estimates? If so, then the MARGO SST constraints are less tight for MIROC evaluation.

7. p785 l17: effective dimension of 5

The authors should explain what is meant by effective dimension and why 5 is a fair assumption (without referring to the as yet unpublished Annan and Hargreaves 2010b paper).

8. p786 l24-27: add reference to underpin the important conjecture that 'prominence to the North Atlantic may not be unreasonable', since it affects the interpretation of the

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results.

9. p788 l24-26: the authors should better argue the use and presentation of the JUMP ensemble, since up to this point in the text it remains unclear. Moreover, the rationale of using a slab ocean version of MIROC is unclear.

10. Table 2 caption: it is unclear to me which values are associated with a statistically different from uniform distribution. Also, the use of bold type face denoting 'unreliability' should be explained.

Editorial comments:

1. p776 l2 ensembles of [climate] models
2. p776 l17 ... CMIP3 ensemble [of global climate models] (Meehl ...)
3. p776 l19 ... the the ... remove the
4. p777 l23 define ASGCM
5. p781 l6 define AOGCM
6. p781 l24 AOVG[C]M
7. p782 l23-24 The MARGO acronym has already been defined. Delete definition.
8. p783 l25 ... the expert opinion [of] the MARGO ...
9. p785 l1-3 We conclude that ...

this sentence repeats what has been mentioned on p780 l20-228

10. p787 l3-4 Combine the first two sentences of this paragraph into one topical sentence

11. p787 l17 Split up the paragraph after 'occur.' since the remainder discusses a different topic than the 307 MARGO data points.

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12. p788 I20 Split up the paragraph after 'model.'

References:

Mix A (2003) Chilled out in the ice-age Atlantic. *Nature* 425: 32-33

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7, C393–C397, 2011

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