Review of: A Last Glacial Maximum forcing dataset for ocean modelling

by Anne L. Morée and Jörg Schwinger

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The paper presents a dataset designed to compute boundary (surface) conditions for ocean general circulation model simulations of the last glacial maximum. The initial data comes from CMIP5/PMIP3 runs with coupled (ocean-atmosphere) general circulation models. The paper described the treatment made on original model outputs to derive the dataset.

This paper is well suited for the aims and scope of ESSD. The presentation is clear and fair, with the correct level of detail.

I have two main concern with this dataset. i) The rescaling method for temperature and humidity. ii) The actual interest of the dataset: the use of an average of CMIP5 ocean models to force ocean model might not be a relevant experiment protocol.

Major concerns

Computation of values @10m (t_{10m} and q_{10m})

The values at 2m height and the surface values are used to rescale the variables at 10m height. In atmospheric models, *t@2m* is not a prognostic variable. It is diagnosed with an iterative procedure (as in Large and Yeager, 2004). Input are surface values (temperature *tas*, pressure *psl*), and values at the first model level, generally between 10 to 100m height (temperature *temp[k=1]*, wind *u[k=1]*, *v[k=1]* and humidity *q[k=1]*). This computation of *t@2m* is an estimation, know to be very non precise, and not fully physically based. At least in the model it uses, or may use, the exact stability computed in the model, and the full high frequency outputs. Reapplying this procedure to recompute *t@10m* is prone to give large errors, especially because the estimated stability could be different from the one actually used in the model.

As the temperature of the first level is available in the CMIP5 database, it would be better to directly compute *t@10m* from *tas* and *temp[k=1]*. At least, the authors should check on one model than applying the procedure twice gives the same result than the direct computation.

• Which wind *u*, *v* and humidity *q* do you use for the computation ? It seems to be *u@10m*, *v@10m*, and *q@2m*, which for most model are also diagnostic variables computed with the same algorithm. This introduces an additional source of error.

• The procedure is applied on monthly mean. As the iterative procedure is highly non linear, is it justified ?

Actual interest of mean values

A procedure to force ocean models at the LGM is undoubtedly very useful. But I am very skeptical about using an average of different CMIP model outputs. The inter model spread

is very large, as mentioned in the paper. Atmospheric circulation pattern differs, and the internal coherence of a mean dataset is doubtful. It seems important that a user may evaluate the uncertainty coming from the forcing. And I can't imagine a way to build a variety of forcings from this dataset. The model spread is not relevant for this, as large values may locally and temporally come from different models. Perturbing the dataset with a fraction of the spread will generate incoherent patterns.

From the above rationale, the use of an inter model average is far from being an obvious protocol of LGM experiments. The dataset should probably include :

• Anomaly of individual models. For model that has a small ensemble, mean of ensemble could be provided if the intra ensemble spread is small (but how to define "small" ?).

• Absolute values for individual model, as applying anomalies to a given dataset is inconsistent. One may want to try the absolute values as forcing data.

Minor concerns

Water budget closure

The dataset provides precipitation anomalies. Evaporation will be computed from the CORE formula. To close the water budget, ocean modeller are missing the input from river and land ice melting. River input seems to be available for only 4 of the 5 model used in this study. Anyway, if the individual model data are given in the dataset (as suggested above), *friver* could be made available for some of them. This assume that a general interpolation procedure can be designed for all models, which maybe difficult because the variety of solution for river runoff in each model.