

Suggestions for revision or reasons for rejection with author comments

The authors have improved this version of the paper somewhat, but there are still a number of problems to be addressed. The most severe problem is that the workflow presented in this paper in no way represents a generalised approach for producing paleobathymetry grids, as many ad hoc fixes used in the 38 Ma reconstructions are custom-designed just for reconstructing this time, especially when it comes to mixing different vintages of rotation models, paleo-age and paleo-depth grids. The current title “A Generalised Approach to Reconstructing geographical Boundary Conditions for Palaeoclimate Modelling” is misleading. The paper would be acceptable if solely focussed on the 38 Ma reconstruction. I therefore suggest a change of the title of the paper to:

Reconstructing Geographical Boundary Conditions for Palaeoclimate Modelling at 38 Ma

AC: We thank the reviewer for his repeated comments and especially for trying to use the workflow presented in the paper. There were indeed some technical issues left, which have all been resolved in the latest version.

We disagree, however, that our approach cannot be generalised for time frames other than the late Eocene 38 Ma example we have used. At least within the Cenozoic, there are no other issues to be expected when reconstructing the palaeogeography/bathymetry.

We have redesigned part of the procedure by exporting the masks as shapefiles that can be converted into netcdf grids. The script was adjusted so that it now uses these grids, which are now more general and independent of the user platform. This also improves the reusability of the workflow, since specific masks no longer need to be saved as a set of separate files for each timeframe. A new set of starting files, scripts and an updated ReadMe will be provided.

The issues regarding rotation models, palaeo-age and palaeo-depth grids have all been addressed in our specific answers below and in the manuscript. Therefore, we have chosen to not change the title of the manuscript.

Some specific comments:

There is a mismatch between using the present-day age-grid from Seton et al. 2012, and the paleobathymetry from Muller et al. 2008, since the present-day age grid for 2012 is based on the reconstruction history/rotations of that model, which differs significantly, especially for the Pacific (Manihiki/Hikurangi breakup).

AC: There are indeed some differences between these reconstructions, but this is not necessarily problematic, especially when regarding the Cenozoic. Since oceanic plateaus and ridges are treated separately, these will always be consistent with the framework of the plate-tectonic reconstruction. This was tested for 5Ma time slices up to 65Ma and no problems were found regarding this matter. A remark on this has been added to the text.

This new workflow uses the Crosby et al. (2006) age-depth relationship, to convert the reconstructed age grid into depth. But the Muller 2008 paleobathymetry grid, which they use for filling gaps in their initial paleobathymetry reconstruction based on the Seton et al. (2012) present-day agegrid, is based on Stein and Stein's (1992) age-depth relationship, and also has sediments added. So mixing different age-depth relationships and sediment cover (vs. no sediment cover) in the Baatsen workflow certainly does not represent a sensible generic workflow for constructing paleobathymetry grids, even if this works reasonably well for 38 Ma.

AC: This potential problem was indeed not assessed before and important to consider. When comparing the different age-depth relationships, one can conclude that these are quite similar; $2527 + 336\sqrt{age}$ versus $2620 + 330\sqrt{age}$. Apart from the ridge itself (93m), the difference between these reconstructions is generally 50m or less which is small considering the uncertainties in ocean bathymetry.

AC: Sediment cover is a larger issue and does need to be corrected; one can either remove

sediments from the reconstruction or add them at locations where the Mueller (2008) bathymetry grid is not used. We have chosen not to include sediments and thus to work with the depth to basement reconstructions instead. First of all, significant sediment cover is generally only found in oceanic regions that are very deep (>5000m) so most, if not all numeric models used in paeleoclimate studies will not see any difference in their final computational grid. Furthermore, the uncertainty on these sediment covers is also rather large, so leaving the choice to the user whether to add these or not seems convenient. In contrast, a region that does need attention is the Mediterranean/Neotethyan Ocean as it holds a thick sediment cover. Since this region is treated separately, it is not an issue for this time frame (and any earlier ones) but it needs to be considered for younger reconstructions.

Both these issues are adressed and discussed in the newly revised manuscript.

Some comments by line:

Line 42: Not sure what "poorly constrained and/or in agreement" means.

AC: This was rephrased.

Line 62: "transition" in Eocene-Oligocene Transition is capitalised (earlier, line 34, it isn't).

AC: Was corrected to state Eocene-Oligocene transition throughout.

Line 69: "require" is misspelt

AC: Was corrected.

Line 87: Seton et al., 2012 isn't a Phanerozoic model.

AC: Has been changed into '200Ma to present'.

Lines 90-91: It is insufficiently justified to what extent a paleomagnetic reference frame is better suited for paleoclimate reconstructions, even if this is obvious theoretically. How different it is from other reference frames for 38 Ma in terms of paleolatitude? Is there a reference for this?

AC: A citation was added to go with this statement (Moreau, 2007). It is also not the intention of the authors to promote the paleomagnetic reference frame but only to present it as a valid possibility.

Lines 114-136: This entire paragraph is hard to follow.

AC: This part was re-written and re-ordered.

Line 133: Is there a reference for the robustness for continental shelf margins through time?

AC: This was re-phrased, also a reference is given for the late-Eocene (Somme, 2009).

Workflow – I couldn't get this to work very well – it crashed after producing Figure 5. Exporting the files exactly as needed for the matlab script is extremely tedious, and not suitable for any sort of generic workflow.

AC: There was an issue with one of the scripts used to create a plot showing specific changes with hatched regions. This script was no longer functioning in newer versions of Matlab, so it was removed and the figure is now created using only built-in code. Other changes to the script should also make it easier to use and more resilient to crashes.

Exporting files as a png. (step 1 and 2): I can now see why the authors didn't export a netcdf file directly – they are reconstructing polygons (gpml), not a grid, and GPlates can't convert polygons to grids. Nevertheless, this step would be much better completed using GMT for this

to become generic and easier to use (e.g. exporting reconstructed polygons, and using a combination of grdmask and grdmath steps).

AC: Masks are now exported as shapefiles (these are more easy to handle than GMT), which are transformed into NetCDF grids relatively easily using MatLab. An additional script to do this will be provided along with a new, updated script and ReadMe file.

For part 2., there are numerous files needed, with specific colours (from the Apple palette, which Windows users will not have!). These files seem to be specific for 38 Ma (their reconstruction time) – again this is no generic recipe.

AC: This is surely is an issue for non-Apple users, it is now fixed using a NetCDF grid.

Step 5: I don't really follow what is happening with rotating the grids here, and I found it convoluted to get this step to work.

AC: With the changes to the text, script and ReadMe this should be more clear and easier to reproduce.