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# *Interactive comment on* "Fast GCM – ice sheet model coupling software OBLIMAP 2.0, including on-line embeddable mapping routines" *by* Thomas Reerink and Roderik van de Wal

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**Answer to Florence Colleoni (Referee)**

First we would like to thank the referee for her compliments on the improvements of the OBLIMAP package, and for her comments on our work which improved our manuscript. You will find detailed comments and answers below. We hope that the revisions improve the quality of the paper and meet your expectations.

In this manuscript, Reerink et al. present an updated improved version of the interpolation tool OBLIMAP whose aim is to interpolate the GCM fields onto ice sheet models



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grid and vice-versa. I must say that I am myself a regular user of the first version of OBLIMAP since many years now. However, many of the ice sheets models that I use have grids projected on the ellipsoid and not on the sphere. Therefore at the time of OBLIMAP 1.0, I had to implement by myself the missing projection routines on ellipsoid grids.

We are pleased to notice that OBLIMAP has been regularly used by others as well. The final published release of OBLIMAP 1.0 actually does include the option to map on the ellipsoid. However, in OBLIMAP 2.0 all polar aspect forms for the ellipsoid projections are now included, and any ellipsoid shape can be configured from the config file now (the WGS84 is still the default).

In addition, because I also needed to interpolate ocean vertical data, or create my own ISM regional grid, I also had to implement the additional level dimension in the netcdf routine and produce a slightly modified version of the first version of OBLIMAP to create new ISM grids for boundary conditions. Recently, I needed to use the BEDMAP Antarctic topography, which comes in cartesian format already projected and the problem of re-interpolating it on a different grids surged. In this new version of OBLIMAP, all the points that I mentioned above have been fully improved and implemented, which demonstrate that those points were really the main weaknesses of the first version.

Indeed OBLIMAP 2.0 enables mapping of spatial 1D, 2D and 3D fields, all with or without a time dimension. As setting the dimensional properties got laborious for the user, we enabled an option to automatically detect the dimensional shape of the input fields in any situation in the new release.

The expressed appreciation of the remapping feature of ISM data did us realize that running this simple two step procedure should be described in the OBLIMAP User Guide. Therefore we added this as a subsection (so it is easy to find from the index) of the 'Running OBLIMAP' section in the OBLIMAP User Guide.

Several improvements that have been made in this version: it provides the geographical





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projections on ellipsoid and not only on a sphere as in the previous version. In fact, many ice sheet models have their cartesian grid projected on the ellipsoid and not on the sphere. This was a limiting aspect of the first version since one had to implement the projection on the ellipsoid by himself. the computation time performance of the scan method to interpolate from grid with numerous points has improved substantially. This was effectively a limitation. A suggestion could also be to provide a parallel version of this code for this specific loop. the re-interpolation of cartesian projected topographic or climate data sets on a defined ISM cartesian grid. Which is to me, one of the greatest improvements. it can maps 4D fields, such as ocean or winds, which is highly appreciable improvements.

We agree that with the fast scan method barriers are razed, e.g. the (re)mapping of high resolution data, like the currently available 1x1 km topographic fields for Greenland and Antarctica, was simply impossible before. Other more 'common sized' mappings, which typically took a few minutes with OBLIMAP 1.0, take less than a second now, which is also convenient. However, a parallel implementation of the scan phase would certainly be beneficial. A start has been made: A proposal to work on a parallel scan phase of OBLIMAP for the Polar Science HPC Hackathon 2016 was accepted, so I went in July 2016 to XSEDE's conference in Miami and worked with HPC experts on that. A well scalable parallel domain decomposition could be implemented for the scan phase, the results remain bitwise identical for a changing number of processors. This is work in progress. Advancing insights due to this recent work are reflected in a rewrite of the discussed proposed parallel implementation at the end of the discussion.

OBLIMAP is a really useful tool for those who carry out ice sheet simulations and the difficulty of interpolating on cartesian grids can be understood only when facing this problem. On the coupling process, I would definitely say that OBLIMAP should be embedded in ice sheet models rather than in the coupler of coupled climate models. Given the variety of existing climate couplers, and sometimes their complexity (e.g. the NCAR model), it is much easier to host OBLIMAP within the ice sheet models. As I





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mentioned again in the Major comments below, the GLIMMER ice sheet model and I think also the CISM model (derived from GLIMMER), the TARAH ice sheet model (Pollar ad Deconto) already embed the projection of the climate fields onto the ice sheet grid within the ice sheet code itself, and by experience with both ice sheet and climate models, I would also recommend to put OBLIMAP in the ISM code.

We once more thank for the compliments on the achievements which are realized with OBLIMAP's second release, and for summarizing the milestones from a regular user's perspective. We comment on the embedding issue in one of the next points.

Based my comments above, except minor typos or reformulations, I recommend the publication of the manuscript in its current shape. Florence Colleoni

**Major comments**

Maybe a stand-alone version, as for the first version could also be useful, not everybody uses coupled system. Or maybe this version is stand-alone but this is not clear and should be clarified with a sentence or so in manuscript.

Sure there is a stand-alone version of OBLIMAP 2.0. The stand-alone version has already been mentioned in the abstract, introduction (twice), in the caption of Fig. 1 and in the text reference to Fig. 1 in Sec. 2. However, we added:"Its stand-alone version can be installed and compiled within a couple of minutes on any platform." to the last paragraph of the conclusion, in order to emphasize once more OBLIMAP's stand-alone version and to emphasis its user friendly install.

Line 50-55: after using OBLIMAP very often, I would say that perhaps hosting OBLIMAP in the ice sheet model is the most easiest way to deal with it. OBLIMAP is a small coupler model and very simple in its use, therefore, it is easily implemented in an ISM, as for example GLIMMER does, rather than embedded in a GCM. But this is only my opinion of user. In addition the climate coupler are built to interpolate on lon-lat grids most of the time.





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There might be certainly some exploration on this theme. We think that with OBLIMAP's new version OBLIMAP itself is suited for several strategies: embedding OBLIMAP in the ISM, in the GCM or in another coupler. Because OBLIMAP is subdivided in the standard components: 'Initialize', 'Run' (map or inverse map) and 'Finalize', this allows direct embedding. Note that the mapping routines pass on all fields as an argument, which makes embedding of OBLIMAP low intrusive. The strategy might depend on the specific GCM – ISM combination as well on the coupling approach: one way or two way on-line coupling. In case of a two way on-line coupling we expect that embedding the ISM in the GCM might be easier because aside of embedding OBLIMAP, the ISM has to be embedded as well in the GCM which means that the ISM needs to be recoded in an Initialize-Run-Finalize form. While vice versa the GCM has to be embedded in the ISM which probably requires recoding of the GCM in such an Initialize-Run-Finalize form which might be much more challenging due to the complexity of GCMs. Changes have been made to Sec. 3.3 and Sec. 4.3 in order to clarify our view on embedding strategies and to include the suggestion of referee 1 to add OBLIMAP's API in Sec. 3.3.

**Minor comments**

line 45: substitute "albedo changes" by "ice sheet distribution" because an ISM does not provide albedo changes, it only provides ice distribution which affect albedo within the atmosphere model. A regional atmospheric model as RACMO on the contrary provides albedo changes, but this is not an ISM.

Done

line 48: "surface mass balance" put a space between "mass" and "balance"

Done

line 52: substitute "ocean surface temperatures" by "ocean temperatures.". Most of the basal melting methods uses vertical ocean temperature and salinity distribution







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(Holland and Jenkins 1999, Pollard and Deconto 2012, Martin et al., 2011).

Done

line 63: substitute by "any regional energy balance model (e.g. RACMO or MAR)"

Done

Figure 7: "surface mass balance" put a space between "mass" and "balance"

Done

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Done

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