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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

Anonymous Referee #1

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Reerink and van de Wal describe an updated version of their OBLIMAP mapping tool. This tool is designed for mapping fields between coarse-resolution GCM grids and fine-resolution ice sheet grids. The authors described OBLIMAP v. 1 in a 2010 GMD paper; this new paper describes updates made in v. 2 of this tool. Major new features include (1) a “fast scan” method that significantly improves the performance of the initial mapping step; (2) handling masked fields in the mapping; and (3) the capability to embed this tool within a GCM.

Based on citations of the original paper, it appears that v. 1 of this tool has proven to be quite useful to their research group. Indeed, it does sound like a useful tool, and it seems that v. 2 makes the tool even more convenient and generally useful, such

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as through robust handling of masked fields. I read this paper with interest because I am currently struggling with issues surrounding conservative online regridding of fields passed between a GCM and ice sheet model. However, in the end I was not convinced that OBLIMAP v. 2 has sufficient novelty or improvements relative to alternatives to warrant its publication in GMD.

It is hard for me to tell how much this is a real issue vs. simply a presentation issue. In particular, the authors do not spend much time comparing this tool to other alternatives, so it was hard for me to tell what practical improvements it provides over alternatives. They briefly compare it with the OASIS coupler (p. 17, L. 7-14), although not in enough detail to convince me of its advantages. For example, what are the practical advantages of the additional projection step in OBLIMAP (p. 17, L. 8-9)? I would also like to see comparisons with other tools that serve a similar purpose, such as ESMF's regridding tools (<https://www.earthsystemcog.org/projects/regridweightgen/>, https://www.earthsystemcog.org/projects/esmf/regridding_esmf_6_3_0rp1), and tools that have been written on top of those in NCL and python.

The fast scan method was the most intellectually interesting component of this paper. I am not familiar enough with mapping tools and techniques to know if this is a novel contribution to the field, and/or if it might be generally applicable to other mapping tools. If it is, then this aspect could make the paper worth publishing. However, I was left with a feeling of uncertainty about the conditions under which the fast scan was guaranteed to give identical results to the full scan, the conditions under which it would "likely" give identical results, and the conditions under which it is not expected to give identical results. I got the impression that the authors themselves are not confident of the situations under which it is guaranteed to work correctly, based on vague statements like, "Even if the additional dynamic block size method is omitted, the *majority* of the fast scan mappings yield identical results with the full scan method. However, including it *appears to be very effective* in obtaining identical results for the exceptional cases." (p. 7, L 19-21; emphasis mine). If this is published, then I would like to see these con-

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ditions made more clear. For example, is it guaranteed to work for regionally-refined grids? And is the tool able to detect when the fast scan will or won't work, or is the burden on the user to determine this? Also, in order for this technique to be more reproducible, I would like to see more precise descriptions in place of some of the vague statements such as, "an ample rounded b is taken" (p. 7, L. 1-2).

I was especially interested in the new capabilities of this tool for online coupling between a GCM and an ice sheet model. However, again, I was not convinced of the suitability of OBLIMAP for this purpose. As a GCM developer, I would need to be convinced that OBLIMAP provides enough benefits over the GCM's existing coupling technologies (e.g., Valcke et al. 2012) that it's worth using this additional package for regridding to/from the ice sheet grid. The authors did not convince me that this is the case. Again, it's hard to tell how much of this is merely a presentation issue: I would reconsider this paper for publication if the authors provided more detailed discussions of OBLIMAP's advantages. However, it does not appear that OBLIMAP provides the capability to handle either of the two major challenges that we are currently struggling with in ice sheet coupling: (1) regridding from coarse to high resolution grids in a conservative but relatively smooth fashion, and (2) handling multiple elevation classes in the GCM – i.e., including vertical as well as horizontal remapping. Regarding (1), the authors state that the scheme is "close to conservative" (p. 2, L. 22), but do not quantify this. For coupled model simulations, a fully conservative mapping scheme is needed.

In terms of the actual mapping algorithms implemented by OBLIMAP, my sense is that "quadrant" interpolation is similar to bilinear interpolation, and "radius" interpolation is a blend between bilinear and area-conservative interpolation. However, it was hard for me to tell for sure. The authors should provide an overview of these two interpolation methods, and a brief comparison with other commonly-used interpolation methods. It was unclear to me why OBLIMAP uses these methods.

Additional specific comments follow:

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1. The Introduction gets into too many details on projections, etc. Instead, I would want the Introduction to provide a high-level introduction to the problem, including a wider survey of other tools that serve a similar purpose. There could then be a separate section describing the details and limitations of OBLIMAP v. 1, which would include some of these details on projections.
2. p 9 L 1-5: It would be helpful if the API of OBLIMAP were laid out more explicitly here – what does the code interface look like in detail? This isn't absolutely necessary, but would help GCM developers evaluate whether they want to include OBLIMAP in their system.
3. It would also be helpful if an example were given of how to configure OBLIMAP for offline regridding (e.g., an example configuration file and/or command-line usage). Again, this isn't necessary, but would help people decide if this is something they want to use.
4. Section 4.2 and associated figures could be trimmed substantially. It seems that, relative to OBLIMAP v. 1, the main addition here is the masking, which could be illustrated with a single figure
5. Section 4.2 should be expanded to add metrics on area-integrated sums, to help judge conservation. My sense is that these schemes are fundamentally non-conservative, which would be a problem for incorporating them in a GCM.
6. p. 15 L 21-22: “The weaker second condition . . .”: I don't understand this; the authors should reword to make this more clear.
7. There are numerous typos and grammatical errors. Just a few examples are:
 - a. p 1 L 7: “frequent” should be “frequency”
 - b. p 2 L 5: “constrains” should be “constraints”
 - c. There should not be an apostrophe in GCMs or ISMs

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References

Valcke, S., Balaji, V., Craig, A., DeLuca, C., Dunlap, R., Ford, R. W., Jacob, R., Larson, J., O'Kuinghttons, R., Riley, G. D., and Vertenstein, M.: Coupling technologies for Earth System Modelling, *Geosci. Model Dev.*, 5, 1589–1596, doi:10.5194/gmd-5-1589-2012, 2012.

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