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Interactive comment on "Mapping technique of climate fields between GCM's and ice models" *by* T. J. Reerink et al.

Anonymous Referee #1

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This manuscript describes a method (OBLIMAP) for mapping 2D fields from GCMs (with spherical coordinates) to ice models (with rectangular coordinates) and vice versa. The mapping consists of two parts: (1) projecting grids points using an oblique stereographic projection and (2) interpolating the projected fields using either a quadrant method or a radius method. The authors test the accuracy of the method by mapping selected fields in different GCMs from a spherical grid to a rectangular grid and back, then comparing the doubly mapped field to the original field. They provide the OBLIMAP code on the GMD website. The paper is well structured, and the projection and interpolation methods are described in sufficient detail to be reproduced.

The methods and tools discussed in the paper are useful and important. Ice sheet models are critical for century-scale sea-level prediction and are beginning to be used

in fully coupled climate simulations. Since ice sheet models typically are run on regional rectangular grids, the standard mapping software available in global climate models may not be adequate for mapping fields to ice sheets. New tools are needed, and it is not immediately obvious which mapping methods are best. By describing and evaluating accurate and robust methods, the authors are providing a useful service to the climate and ice sheet modeling communities. In short, this is a suitable topic for publication in GMD.

However, I recommend that the following significant changes be made before the paper is accepted for publication:

(1) Previous work should be acknowledged and cited. Currently there is only one reference (Shephard 1968) on data interpolation, and there are no references on map projections. The standard map projections–including the oblique stereographic projection used in OBLIMAP–have been known for a long time. In fact, stereographic projections were used by ancient Greek astronomers. One comprehensive reference on map projections is that of Snyder (1987): http://pubs.er.usgs.gov/usgspubs/pp/pp1395. Snyder has a chapter (pp. 154-163) on stereographic projections, which includes several of the equations given without citation in the text. Even if the authors derived these equations independently, they should give credit to earlier work.

Also, this is not the first use of oblique stereographic projections in the ice sheet modeling community. At least one ice sheet model with which I am familiar, the Glimmer model (I.C. Rutt et al., JGR, 114, 2009), provides users with a choice of several map projections, including both polar and oblique stereographic projections.

Finally, the derivations in the appendices are fairly long and difficult to follow. I would suggest that the authors search the literature to see if simpler derivations are available.

(2) The oblique stereographic projection should be compared quantitatively to other methods. Otherwise, modelers will not know whether this is the best method, or simply one more-or-less accurate method among many. It would be straightforward to com-

pare this method to a polar (non-oblique) stereographic method. Also, I would suggest a comparison to an equal-area method (e.g., the Lambert azimuthal equal-area method, which is an option in Glimmer). Is there any reason to prefer angle-preserving projections to area-preserving projections?

(3) A related point: The authors compare the field values at specific points, but do not compare the area-integrated values. In other words, they do not discuss the conservation properties of their method. This should be done for the surface mass balance. That is, what is the total surface mass balance for the region of interest before and after the projection? Area distortions could introduce errors, especially if there is a correlation between the SMB and the area distortion. (For example, the Greenland SMB might be positive in the central regions where the projected area is too small and negative in the marginal areas where the projected area is too big.) This test would provide a useful comparison to area-preserving projections.

(4) The paper contains many errors in grammar (e.g., sentence fragments and run-on sentences), punctuation, and spelling. I would suggest that the authors seek copy-editing assistance before resubmission.

The following comments are minor:

(1) P. 936: "GCM" usually stands for "general circulation model", or sometimes for "global climate model", but generally not for "global circulation model."

(2) P. 940: Perhaps it should be made clear that the CCSM atmospheric component can be run on several different grids; the T42 grid is simply the grid chosen for this exercise.

(3) P. 941, l. 10: Typo, should be x_im = 0

(4) P. 941, l. 12: How can M' have radial coordinate R if it lies between M and the origin?

(5) P. 942, l. 15: Should be "of alpha" instead of "or alpha"? Also, "stereographic" is

misspelled.

(6) P. 944, section 2.2.4: The equations given here are quite different in form from those in Snyder (1987), pp. 158-159. Am I correct in assuming that the two formulations are equivalent? Snyder's equations are a bit simpler, and I wonder if they are easier to derive.

(7) P. 946, ll. 14-15: Is it "Shepard" or "Shephard"?

(8) P. 949, l. 20: Change "default" to "By default".

(9) P. 949, l. 23: Not sure what is meant by "suffices".

(10) P. 951, l. 6: If I understand it correctly, the averaged mapped deviation is the simple average of the error. Why was this measure chosen, instead of the root-mean-square error?

(11) P. 953, l. 15: Change "capable to perform" to "capable of performing".

(12) P. 953, l. 26: Change "significant" to "significantly" and change "relative" to "relatively".

(13) P. 953, l. 27: Why is there an "l" after the alpha?

(14) P. 954, l. 6: Change "four times" to "four or more times".

(15) P. 955, l. 18: Change "coheres with" to "is dependent on" or something similar.

(16) P. 955, l. 19: Change "yields" to "holds".

(17) P. 955, ll. 25-27: The meaning of this sentence is unclear.

(18) P. 956, l. 3: Change "then" to "than".

(19) P. 956, l. 15: Change "interset" to "intersect".

(20) P. 965, section heading: Change the first "y" to an "x".

(21) P. 971, l. 3: The word “prime” should not be spelled out.

(22) P. 976, l. 3: I am not familiar with the term “goniometic”. I think this should be “trigonometric”.

(23) P. 988, Fig. 6 caption: Change “heigth” to “height”.

(24) Pp. 990 ff: Not all of figures 7-15 are needed. For instance, it might be sufficient to plot results for one Arctic island instead of three, given that the quantitative results are shown in Table 3.

Interactive comment on Geosci. Model Dev. Discuss., 2, 935, 2009.