

Interactive
Comment

Interactive comment on “Impact of spatial resolution on the modelling of the Greenland ice sheet surface mass balance between 1990–2010, using the regional climate model MAR” by B. Franco et al.

Anonymous Referee #2

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This manuscript by Franco et al. assesses the influence of spatial resolution on simulating the SMB (and its different components) of the Greenland ice sheet using the regional climate model MAR. Doing so, the authors carried out important tests that are valuable in the process of coupling ice dynamical models with climate models. They also present a downscaling technique that can be used to improve the skill of lower resolution climate fields on a higher resolution (15 km), in addition to simple interpolation. This demonstrates how climate fields on a course resolution can be used on a higher resolution, such that they are suitable as a forcing field for ice dynamical models.

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Sometimes the style of writing / choice of words is somewhat vague. For example, the section that describes the calculation of the model skill is too general, and cannot be understood on its own (see below for detailed comments).

The method used as 'intelligent' interpolation is presented as a valuable correction step within coupling of (regional) climate models and ice dynamical models. The only correction mentioned in the manuscript is topographic differences due to resolution changes. However, much larger topographic differences are to be expected when a coupled ice dynamical – climate model experiment is carried out, due to ice sheet retreat and/or expansion, in response to climate forcing. As such, can this technique also be used to correct the resulting climate fields for these topographic changes? This is relevant since it is even more computational expensive to run a regional climate model with and updated ice topography after each significant topographic change in the ice dynamical model.

When these points, and the detailed comments below are carefully revised, I would recommend accepting this manuscript for publication.

Detailed comments

Page 642, line 1-8: Inverse distance weighting is used to interpolate the coarser climate fields onto the 15 km grid. How are differences in marginal area treated between model resolutions? E.g. the 15 km ice mask contains ice over the Maniitsoq ice sheet, southwest Greenland, whereas the 50 km resolution lacks ice there. Figures of the difference of fields (e.g. Fig. 3i) do not show data here. Are these grid points not taken into account for when comparing results?

If values are calculated for grid points outside the coarser grid ice mask, problems may arise when using an interpolation technique such as inverse distance weighting. For example, run-off will generally increase towards the ice margin, hence the use of inverse distance interpolation may result in a slightly higher run off value of a target point that lies just outside the original coarse grid, compared to the nearest neighbor-

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ing (coarse) grid point. Hence, an alternative extrapolation technique might be worth considering for these grid points.

Page 642, line 24: “multi-annual observed field” probably refers to the 15 km resolution modeled result. These are not observations.

Page 642, line 24-25: “normalized it by a measure of the variability of this field” Vague wording. What kind of measure, presumably the standard deviation? Could you please specify this?

Sections 6 The method of ‘intelligent interpolation’ makes use of daily local vertical gradients within the particular climate fields. As such, is the correction then applied to the daily fields, or is a mean correction term computed over the entire period of simulation, and applied once?

It would be valuable to add a figure that illustrates the magnitude and spatial pattern of the gradients (for run-off, sublimation and evaporation).

Page 649, line 17: You refer to Helsen et al. (2012), who described a comparable method to take differences in topography into account in forcing an ice dynamical model with SMB from a regional climate model. Could you indicate how your gradients compare with theirs? Although they calculated gradients for SMB, your values for run off should be quite comparable in the ablation zone. Also for this purpose a figure showing spatial patterns of the gradients would be useful.

Page 649, line 14-15: What is meant with “common mask”?

Textual comments

Page 636, Line 25: Consider “an increase in” before precipitation.

Page 637, line 2: Surface mass balance, instead of mass balance.

Page 640, line 4: typo: development

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Page 644, line 11: compared instead of applied?

Page 647, line 7: enlarged instead of expanded

Interactive comment on The Cryosphere Discuss., 6, 635, 2012.

TCD

6, C305–C308, 2012

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