

Regine Hock, 31 August 2012

Review of “Past and future sea-level change from the surface mass balance of glaciers” by B. Marzeion et al.

Cryosphere

The paper computes the surface mass balance of all glaciers other than the Greenland and Antarctic ice sheets for the period 1850 to 2300. The study is highly relevant for the upcoming IPCC. The authors use a simple temperature index model driven by monthly CRU Temperature and precipitation data and use 15 GCMs forced by various emission scenarios to make mass change projections.

This is an excellent highly informative paper. It is very well written, and the methods appear sound. I strongly recommend accepting this paper for publication, and I only have a few minor comments/suggestions for the authors to consider.

General

- 1.) The authors model the surface mass balance, and seem to neglect refreezing, a component that is large in some regions. Or is refreezing included in their ‘surface mass balance’, and hence it is the ‘climatic mass balance’ (according to Cogley et al., 2011). The description of the model seems to suggest that it is only surface mass balance. This is fine, however, as for calving, some discussion should be included about the possible impact of re-freezing. In any case it should be made clear whether or not re-freezing is included or not.

2.) Structure

Although overall the paper is very well structured, I suggest that a data chapter is added, where all data sets are explained. Currently the datasets are ‘hidden’ in chapters where the model parameterizations are explained, however, it would be easier to read if model description and model application (including the use of the datasets used in this specific application of the model) are clearly separated. The structure is especially awkward in chapter 6, which claims to be RESULTS, but starts with description of data gaps and the GCM data. These subchapters under 6 seem mislabeled and should better be

combined in a Data chapter together with the CRU and other relevant data sets to force the model.

- 3.) Related to 2.) a little more information should be given about the climate scenarios. What is the difference between the different RCPs? How where the GCM results downscaled?

Detailed comments:

1.) Abstract

a) It would be good if a little bit more information about the modeling was included here, for example that the model was forced with monthly T/P data from CRU, and how many GCMs were used.

b) line 2: add: "... individual glaciers (excluding the ice sheets)" to make clear that this paper is not about ALL glaciers in the world but all except for the ice sheets. It is clarified in a foot note, but should preferably be made clear in the abstract as well to avoid confusion.

2.) Page 4, L4, 'amount' should be replaced by 'number'

3.) Line 19: glaciated should be glacierized (according to Cogley et al., 2011)

4.) Line 19: 'ice shields' should be 'ice sheets'

5.) Line 25-26: I would omit the first part of that statement because this can not be generalized. Changes of the ice sheets could in principle affect more people if the changes were to raise the sea-level sufficiently.

6.) Page 6 (MB model)

For the symbol of surface mass balance, "MB" is unfortunate because in an equation it suggests that MB means $M \cdot B$, rather than a mathematical/algebraic entity. The authors may consider to adopt the terminology/symbols of Cogley et al., 2011.

7.) Page 6 Equation 1

Units should be added here. Specific units can be in m w.e. or kg/m^2 . Units are important here because depending on the units used in the paper Equation 7 needs to include the density

- of water. I assume that units are in kg/m^2 , but it would be good to say that.
- 8.) Page 8, 2.1.3
Since the RGI inventory is not well known, I suggest that you add a sentence what it is, including the total area.
 - 9.) Page 8, L10
Please explain how you identified ice caps in the RGI as this is not part of the RGI. How many ice caps did you find?
 - 10.) Page 22
Structure needs adjustment (see above). Part of what is described here is not Results but datasets and methods.
 - 11.) Page 28, L10
Why overestimated? Since calving is not included the actual mass loss should be underestimated by your model. Whatever is calved off (always a mass loss) needs to be added to the surface mass loss?
 - 12.) The mass balance model computes specific balances, however, results are presented in mm SLE. Please explain how you convert, specifically which ocean area you assume.
 - 13.) Figures 17 and 19
It will not be possible that all y-scales are the same, however, I suggest that the authors attempt to use as few scales as possible (using the volume % scale). Currently comparability is difficult because every single subplot has a different scale. A number of regions have rather similar % volume losses and could be plotted with one and the same scale.
 - 14.) Table 1
What is SS? I assume stand. Deviation. The caption should include the symbols/abbreviations used in the table. Also sigma would be more appropriate?
 - 15.) RCP is sometimes written with capital letters, sometimes not. This should be consistent (see e.g. Fig. 22). I think it is usually written RCP.
 - 16.) Table 2 should be combined with one of the others listing all regions. For example, Table 1 and 2 can be combined.