Review of „What glaciers are telling us about Earth's changing climate"
by "W. Tangborn and M. Mosteller"
(doi:10.5194/tcd-8-3475-2014)

In the present study, W. Tangborn and M. Mosteller, try to model and document the 160000 mountain glaciers worldwide, to demonstrate the link to climate change and to assess impacts of changing glaciers to the society. Documenting and modeling the mass and volume change of mountain glaciers, detecting the climatic drivers of the change and investigating the impacts of melting glaciers e.g. on sea level is a cutting-edge topic in cryospheric science and addressed in several recent publications (e.g. Gardner et al., 2013; Giesen & Oerlemans, 2013; Marzeion et al., 2012; Radić & Hock, 2011; Radić et al., 2013). Unfortunately, the presented study suffers from several fundamental deficits and therefore cannot be seen as a useful contribution.

General Comments/Deficits:

1. The indirect question in the title is answered without presenting any novel ideas to the community. I assume that it is clear to every glaciologist that glaciers are sensitive to meteorological parameters like temperature or precipitation (as stated in the conclusions). Furthermore I agree that changing glaciers (as accessible e.g. from historic moraines) can be useful as a proxy for the climate in the past (before meteorological monitoring networks were established) or for regional climate in the few remote areas without data records. If meteorological records are available it makes little sense to try to reconstruct the global climate by observing glaciers – weather stations are way more precise to track the individual meteorological parameters. So the relevant question for non-paleo work is: "How do glaciers respond to Earth's changing climate?"

2. The introduction (Section 1) misses any information on related scientific work on glacier observations and modeling on a global scale (see citations in the introduction paragraph). You should also precisely explain the advantage of your model approach compared to commonly used temperature based approaches for global scale modeling that require fewer calibration parameters (for examples see literature cited above). You write that your model "does not require manual balances for calibration" which is not clear to me (see also Point 4.b). Beyond that, you definitely need manual balances for model validation.

3. Section 2 ("mass balance measurements") reads like another introduction but I would expect information on mass balance measurements that are used within the present study.

4. The title of Section 3 is unsuitable. It could for example read: “Mass balance modeling approach” and contain detailed information on the model, the calibration and validation methods. Such information is currently either incomplete or incomprehensible:

    a. There is no clear model description in Subsection 3.1 (“Model description”). Even if the model has been published before (e.g. Tangborn, 1999, 2013), the basics of the model used for this study can and need to be presented here. In the present form it is laboriously and confusing to collect together all information required to understand the model.

    b. I do not understand the model calibration method (Subsection 3.2). In the current manuscript, this is because the description is insufficient; but also when considering Tangborn (1999 and 2013), it is nearly impossible for me to understand how and for which site the 15 values of the mass balance coefficients (Table 2) are initially defined and then optimized. Which measurements from which site(s) are used for optimizing the regression parameters by minimizing the objective function? I might not have understood your approach right, but I also wonder why you minimize $1\text{-}R^2$ and not the errors between modeled and measured mass balance (as done in Rye et al. 2010, Section 4.3.2). Please also consider the points listed in the short comments of Cameron Rye which have not been fully answered in your first reply.

    c. The manuscript does not benefit from the attempt of a comparison with a Monte Carlo optimization approach (Subsection 3.3) because the comparison is far from complete and off-topic. I would remove this section.

    d. In Subsection 3.4 you compare modeled and measured annual mass balances for 5 glaciers in Alaska and the Alps. First, why should this be enough for demonstrating that your model yields reliable mass balance results for all 160000 glaciers worldwide? Did the measured mass balances enter the model calibration? Second, some R^2 are very low, suggesting low model skill (e.g. for Kesselwandferner). Third, you need to present further parameters concerning model skill like root mean square error or mean percentage error (e.g. MacDougall & Flowers, 2011, Section 4) that yield more useful information on uncertainties of modeled mass balance values. Fourth, I appreciate scatter plots between modeled and measured annual mass balances (as shown on your website) but please make sure that the axis are equal and plot the 45° line. Fifth, you need to present much more results of your model evaluation in the present study, not only on your website.

    Overall, the descriptions of the model, the calibration and validation need to be understandable for the reader.

5. In Section 4, could you please also calculate and show the correlation between the temperature anomalies from your "model input stations" (McKinley Park and Big Delta) and from the 7000 Northern Hemisphere stations? This may offer an explanation for the high correlation between glacier ablation in the Wrangell Range and Northern Hemisphere temperature anomalies.
   The conclusions in the last paragraph of Section 4 are not meaningful, as ablation is a function of temperature. It could be interesting if regional temperatures/glaciers are better connected to global (or Northern Hemisphere?) temperature trends than others but this is not shown here.

6. In Section 5 you state: "The main goal of the PTAAGMB project is to analyze glacier mass balance results to understand and predict climate change". I come back on my first point: I think in general there are better ways to understand the ongoing climate change than by trying to extract climate information from glaciers. Furthermore, glaciers exhibit a certain response time to shifts in climate before they approach a new equilibrium (with the changed climate forcing). So you can partly estimate earlier climate conditions from current mass and volume changes (even though it might be impossible to separate between different meteorological parameters) but how do you want predict climate change from glaciers?

At the current state I have no specific comments as too many major details are missing. I hope you can follow my arguments and understand that in my opinion the manuscript in the present form does not fulfill the criterions to be published in a peer-reviewed journal.

Sincerely,
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Literature

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