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Interactive comment on "What glaciers are telling us about Earth's changing climate" *by* W. Tangborn and M. Mosteller

C. Rye

cameron.rye@cantab.net

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This is an interesting paper, and I am very pleased to see alternative approaches being used for the calibration of glacier mass balance models (rather than the traditional trial-and-error method). I have several comments regarding the implementation of the Nelder and Mead (1965) downhill simplex algorithm. The authors need to provide greater detail on the exact methodology they have used, and discuss the limitations of the downhill simplex approach. My comments on the calibration method are below.

The author's description of the Nelder and Mead (1965) optimisation method is incorrect. The method is called "downhill simplex", not "simplex". It is also a "nonlinear" method, not a "linear" method. It is important to avoid confusion with Dantzig's simplex algorithm used for solving problems of linear optimisation.

It is also not correct to state that the calibration method "resembles Monte Carlo simulation" (section 3.3). Downhill simplex uses the results from the previous steps to inform the direction of the subsequent step. It is therefore not a purely random sampling technique like Monte Carlo. I suggest the authors remove this analogy to avoid confusion for the reader.

It would be useful for the reader if a brief description of the Nelder and Mead (1965) method was provided. For example, details of how the method converges on a solution from an initial point in the parameter space would be beneficial. It may also be worthwhile to reference previous glaciological studies that have used this approach (e.g., Rye et. al., 2010).

The authors need to provide further details on how they have implemented the downhill simplex method. A table of the parameters used in the optimisation and their initial values would be very useful. How did the authors decide on the initial values of these parameters? Was the downhill simplex algorithm bounded? (i.e., if the algorithm went outside feasible parameter values, was it stopped from doing so?). How did the authors define the lambda (scale length) for the downhill simplex algorithm? Was the method applied to each individual glacier in the same way, using the same parameters and initial values? What were the final parameter values that the algorithm converged on? Are these realistic?

Please can the authors provide an equation describing the objective function they minimised during the calibration? The description in Section 3.2 seems to suggest the objective function used was the coefficient of determination for observed vs modelled annual mass balance. Please make this explicit. Was the same objective function used for all glaciers? Why was this objective function chosen? Do the authors think that other objective functions could produce different results?

A well-known problem with the downhill simplex algorithm is that it will often become stuck in local minima (i.e., it will not find the global optimal solution). One way of

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overcoming this is to run the algorithm multiple times from different (random) starting positions within the parameter space (see e.g., Rye et al., 2010). Have the authors done this? If not, I suggest they re-run their analysis to ensure the solution is global, not local. A calibration error of ∼40% seems rather large for an optimisation algorithm (Figure 2), so I suspect it could be stuck in a local optima. The authors should also discuss the limitations of the downhill simplex method in their article.

Interactive comment on The Cryosphere Discuss., 8, 3475, 2014.