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

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Author comment in response to short comment by Cameron Rye.

Thank you for commenting on this paper. I started using the simplex program found in Nelder and Mead about 35 years ago. It was first applied to simultaneously calculate coefficient values in a dozen equations for a streamflow forecasting model that uses routine weather observations rather than snow surveys. With this model we were able to produce real-time forecasts of Columbia River runoff with half the error of NWS forecasts (see www.hymet.com). Ten subroutines in the Fortran computer program are used in algorithms that perform various functions that minimized the streamflow forecast error using a split sample approach (half the data was used to calibrate the model, the other half was used to verify the results). The same basic program has been

applied to optimize coefficients in computer programs that were used in numerous climate and glacier studies during the past thirty years. I'll have to admit I do not understand many of the concepts you introduced, such as "downhill" or Dantzigs's simplex. I am not a mathematician. My main concern is producing accurate solutions that can be verified and by whatever means are available. The simplex I developed is not too elegant and is extremely inefficient – but it works. The fact that comparisons of measured and PTAA annual balances agree reasonably well (Table 1) signifies that the simplex independently produces credible mass balances. We plan to place the PTAA model and program files on a website so that they can be examined and downloaded by anyone interested.

In the PTAA model, there is a similarity to Monte Carlo simulation in that it uses repeated random sampling of coefficients that are used to convert observed temperature and precipitation to ablation and snow accumulation. A Monte Carlo system uses computational algorithms that rely on repeated random sampling to obtain numerical results, so it seemed okay to say it is similar. How this simplex converges to a solution is best illustrated in Figures 1 and 2. Figure 1 shows the mean annual balance averaged for the 1951-2012 period calculated with the PTAA model. The first 15 coefficients used to calculate the balance are preset estimates. The mean balance fluctuates between -0.5 mwe to +0.6 mwe. After 15 iterations the simplex controls the coefficient values and closes after about 200 iterations with a final value of -0.6 mwe. Figure 2 shows how the mean annual balance is dependent on the calibration error. When the calibration error reaches a minimum of about 43 %, the mean annual balance is approximately –0.6 mwe. The objective function is the calibration error which is the average rmse (x 100) of all the regressions that are run. The size of the average calibration error (about 43 %) is not relevant to the final balance error as some of the regressions that are run have large errors but make only a small contribution to the final mean balance. The objective function is definitely not the coefficient of determination for measured versus modeled annual balances.

The question of whether the simplex algorithm can get stuck in a local minima and will not find the global optimum solution is not easily answered. However, the balances produced for each iteration of an unconstrained simplex, as shown in Figures 1 and 2, suggest a global and not a local solution.

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