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

W. Tangborn and M. Mosteller

wendell@hymet.com

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Jakub Malecki raised some important questions that I will attempt to answer. There is no doubt that the paper needs to explain how the PTAA model works much more clearly. Consequently, we are currently rewriting the sections Model Description and Model Calibration.

One new finding the model introduces is a capability to use routine meteorological observations and the area-altitude distribution of the glacier to calculate both the accumulation and the ablation balances (and consequently the net balance), daily and for each altitude interval of the glacier. Another new finding is demonstrating a significant correlation between the calculated ablation of the Wrangell Range glaciers in Alaska and temperature anomalies averaged for 7000 stations in the Northern Hemisphere by

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the Hadley Climate Center. In other words, ablation calculated for a few glaciers by the PTAA model, predicts earth's average temperature.

It should be noted that temperatures at the two stations used in the PTAA model to calculate Wrangell glacier ablation (McKinley and Big Delta)do not correlate with global temperatures, indicating that Wrangell glacier ablation determined with the PTAA model is more sensitive to climate change than are observed temperatures.

Another important question is with regard to the temperature lapse rate determined by the model. The average global lapse rate is -0.68 degrees C per 100 meters. The PTAA model uses the daily temperature range and mean temperature to calculate lapse rates the range from about -0.20 to -0.90 C per 100 meters. These lapse rates appear to agree with theoretical lapse rates for different climatic conditions (the average -1.00 lapse rate that Mr. Malecki found in Svalbard seems excessively negative - unless climate conditions there are greatly different from most of the earth.

I agree that more validation of the model comparing PTAA and measured annual balances is needed. There is considerable difficulty in obtaining area-altitude distributions and daily weather observations for the model throughout the world, but finding records of annual field measured balances is even more difficult. For the six glaciers with adequate records that are currently compared, there is a total of 308 balance years.

Regarding Mr.Malecki's comments on Graham Cogley's review in which the PTAA model is criticized as showing poor correlation between measured and simulated balance: I am not aware that there is another glacier balance model in existence which independently produces annual balances from weather observations for long time periods and for several glaciers. The correlations we show are not large, but they are greater than anything else produced by other balance models. Regarding the criticism that the PTAA model is not too parsimonious - it has too many coefficients that can be adjusted to improve the fit between model and measured balances: the 15 coefficients that are determined automatically by regressing calculated balance parameters

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are applied for each day and each altitude interval. Thus for a glacier with 150 altitude intervals that has the balance calculated daily for 50 years, the identical 15 coefficients are used 2,737,500 times - thus the coefficients are not exactly what would be called overdetermined.

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