

Interactive comment on “What glaciers are telling us about Earth’s changing climate” by W. Tangborn and M. Mosteller

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These constructive and encouraging comments from Roger Braithwaite are much appreciated. We have received similar criticisms from others regarding the clarity and completeness of the Cryosphere article. In response we have extensively revised the model description and calibration sections and added new figures and tables.

The PTAA model approach to determining glacier mass balances is significantly different from all other balance models, so much so that it is difficult to compare them.

The main attributes of the PTAA model are:

1. Input to the model are daily observations of temperature and precipitation collected at mostly low elevation stations that tend to have more accurate data than those at

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higher elevations.

2. Input also includes area-altitude distributions of the glacier surface in as finely divided intervals as can be obtained (a 5 or 10 meter interval is preferable to 50 or 100 meters).

3. Fifteen coefficients are used to convert daily temperature and precipitation observations to snow accumulation and snow and ice ablation, for each day of the period (1952-2012) and for each elevation interval.

4. The coefficients are simultaneously and automatically calculated using a modified simplex program from Nelder and Mead (1965). The same coefficients are used regardless of the day, year, or elevation. Thus for a 60 year period with 150 elevation intervals in the area altitude distribution, the identical set of coefficients is used 3,285,000 times for the calibration.

The initial coefficient values are based on reasonable estimates. The mean balances for these initial coefficients vary widely at first but after a few dozen iterations of the simplex settle down to a value that usually agrees with balances calculated manually or by geodetic means. The Bering glacier article (Tangborn, 2013) demonstrates a successful application of the PTAA model.

Other glacier-climate models are not referenced because they do not set a precedent that would lead to the glacier ablation-global temperature model that we introduce. The mean annual ablation calculated for the Wrangell Range glaciers is based on daily temperature observations at two regional weather stations, and the average area-altitude distribution for 30 glaciers. The global temperatures are an average for 7000 stations in the Northern Hemisphere, which is considered a proxy for the global climate. It is the linear regression between annual ablation and global temperature that is the basis for the climate model that we present.

References Nelder, J.A and Mead, R.: A simplex method for function minimization,

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Tangborn, W. Mass balance, runoff and surges of Bering Glacier, Alaska, The Cryosphere, 7, 1-9, 2013.

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