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The Cryosphere Discussions

Interactive comment on "Mass balance, runoff and surges of the Bering Glacier, Alaska" *by* W. Tangborn

M. Pelto

mauri.pelto@nichols.edu

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Tangborn (2012) provides a detailed examination of the PTAA model for reconstructing the mass balance of Bering Glacier, Alaska. This minimal input model offers substantial advantages in efficacy and reliability due to its reliance on low altitude long term weather station data. The potential for real time mass balance assessment also is advantageous. The Bering Glacier is important due to its size and potential sea level contribution. There are three issues that need attention before this paper can be a valuable contribution. 1) The model needs to be compared to another minimal model for glacier mass balance for example Marzeion et al (2012), commenting on similarities and differences. The model should also be contrasted to the more standard mass balance model using energy balance and positive degree days that typically relies on greater

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local data input. 2) The model must be better validated for individual years, instead of just an overall result. In this case it could be done by simply comparing the model ELA and actual ELA for a number of recent years, the latter are readily determined from Landsat and MODIS data. 3) The paper needs reorganization, with sequential development of model design-inputs, model calibration and model validation. More attention is needed in each area.

Specific Comments: 5097-8: Support the weather station choice.

Section 2-Mass balance results- change to Mass balance model approach

5097-10: The case for referring to accumulation and ablation balance differently is made, but you should use the Cogley et al (2011) wording for the annual mass balance, instead of just mean annual balance.

5097-10-13: This sentence is a result that should come much later.

5097-20: I do not see where the IACS report depicts this?

5098-9: What are the seven different mass balance variables-could be explained in text or table.

Section 3-The PTAA mass balance model- should come before section 2.

5098-17: Can more detail be provided here for previous model validation.

5098-19: The comparison should be made to other models not to field methods. How is the model similar and different from the Marzeion et al (2012) model? What are the benefits versus the standard degree day energy balance models, for example Hock (2003)?

5099-10: Muskett et al (2003) provide other nearby glaciers with similar changes indicating how the Bering Glacier fits. Larsen et al (2007) identify the losses of southeast Alaska glaciers and the elevation ranges of these losses. The area is not identical but does provide important guidance. The only comparable regional mass balance record

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for the Bering Glacier reported here should be noted from Lemon Creek Glacier (Miller and Pelto, 1999)

5099-20: How does this model generated ELA compare to the ELA from Landsat imagery 9/11/2004? The Landsat image does not indicate an ELA nearly as high as 1800 meters.

Section 4- Comparison with geodetic balances- this section should follow model calibration. Key aspects of validation are replicating the mass balance-elevation gradient and simulating the annual variations in annual mass balance. The details of this should go in section 4 or 5.

Section 5 should be incorporated as part of the validation.

5101-Section 7: This is a worthy and valuable goal to generate real time mass balance. However, should this plan be mentioned in this paper without a more comprehensive validation process? Figure 8 is the potential, but is it a robust result? The result could be tested against the transient snowline on specific dates, since that is the zero balance for that specific date (Pelto, 2011).

5102-7: Muskett et al (2009) report on surge cycle elevation changes, these should be noted and the impact on the modeled mass balance reported.

5102-9: The potential causal relationship makes sense; however, this data set is not a robust examination of the relationship.

5102-21: Figure 9a and 9b should be a single graph so we can better see the similarity. For example why is the 2008-2010 surge not as apparent in the accumulation record compared to the runoff records as other surges?

5102-25: The does not confirm the process, it supports the concept. In this section must reference the Burgess et al (2012) paper on Bering Glacier surges.

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