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The Cryosphere Discussions

Interactive comment on "Monte Carlo ice flow modeling projects a new stable configuration for Columbia Glacier, Alaska, by c. 2020" *by* W. Colgan et al.

M. Pelto

mauri.pelto@nichols.edu

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Colgan et al (2012) have developed a detailed model for the Columbia Glacier that is both reasonable in design and in results. The use of a Monte Carlo simulation approach allows the authors to examine an ensemble of potential inputs and consequent results. This paper offers a model by which the response of even a relatively complicated glacier, multiple tributaries, large elevation range and a calving terminus can be examined and is a valuable contribution. My comments focus on two relatively minor, but potentially significant points in terms of model input. The peak accumulation values exceed what has been observed anywhere in the region. The ELA could easily be

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better validated against annual ELA data.

Figure 4 indicates the mass balance gradient of Colubmia Glacier. The highest values of retained accumulation are above 5 m w.e. at elevations above 2000 m. The values are too high versus the actual observed surface mass balance values noted for the region. In Figure 5 of Rasmussen et al. (2011) two observation points reach this level, versus eight under 3 m above 1800 meters on the glacier. Krimmel and Trabant (1997) used crevasses stratigraphy and found in the only detailed assessment of multi -year accumulation above 2000 m that for the five years between the 1992 Mount Spurr eruption and August 1997 that somewhat above 5 m of accumulation was observed, and with a density at this elevation somewhat above 0.5, this is only 2.5 to 3 m w.e. . On the Bagley Icefield at altitudes from 1600-2500 meters accumulation plateaus at 3 m w.e. (Muskett et al., 2003). During the Project Snow Cornice project on Seward Glacier in 1948-1949 (Sharp, 1951) retained accumulation did not exceed 3 meters at 1800 m. During the Icefield Ranges project observations on the upper Kaskawulsh and Hubbard Glacier indicated a maximum accumulation occurring before the highest elevations at close to 3 m (Marcus and Ragle, 1970). We have no good examples of retained accumulation consistently exceeding 3 m on the upper reaches of any Alaskan glacier. Previous models and balance gradients lacking field data, except those by Tangborn (1997) have also shown high accumulation values, but this is not borne out by surface observations. Why are the accumulation values used above 1600 m so high and what would the impact be of using more realistic somewhat lower maximum accumulation values.

Equation 7 as the authors note relies on the ELA being related to a given isotherm. In Figure 11 the ELA validation relies on just one or two observed data points in green. Why not use annually observed ELA's for better validation of both the isotherm notion and the model output for ELA. MODIS and Landsat imagery provide a relatively reliable annual means of assessing ELA since 2000 in Alaska (Pelto, 2011). For Columbia Glacier good Landsat imagery exists from 9/13/2003, 9/7/2004, 9/2/2005, 9/13/2006, 8/31/2007, 9/5/2009, 9/16/2010 and 9/11/2011 for ELA determination, which could provide a nice validation.

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