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The Cryosphere Discussions

Interactive comment on "Deriving mass balance and calving variations from reanalysis data and sparse observations, Glaciar San Rafael, northern Patagonia, 1950–2005" *by* M. Koppes et al.

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Koppes et al., (2011) provide a detailed examination of the surface and calving balance fluctuations of Glaciar San Rafael, a key glacier of the Northern Patagonia Icefield. Due to the lack of field data available to assess mass balance, a mass balance model has been generated that incorporates calving and surface balance determinations. This is a well written and comprehensive assessment of the means for determining the mass balance of Glaciar San Rafael. I look forward to the revision of this paper that with additional verification will strengthen the results. There are two significant suggestions I focus on for this important paper. The first is to replace the use of degree day function

for determining snow ablation from ice ablation derived on the Greenland Ice Sheet, with one from a more temperate and comparable region. Second is to determine the volume flux at or near the ELA and compare that to the assessed accumulation zone balance, and to the combined calving flux and ablation volume loss from below the ELA.

1128-15: Can cite lapse rates from the Southern Patagonia Icefield from Rivera (2004) and Kerr and Sugden (1994) are supportive of this value they have 6.0 to 6.5 Ckm−1.

1130-22: What is ELA0 for San Rafael?

1133-24: Compare to Table 1 values from Fukami and Naruse (1987) and Figure 6.15 Rivera (2004).

1134-4: Braithwaite and Oleson (1988) not a good reference here, and does not generate confidence in the resultant degree day factor used. The Greenland Ice Sheet is not a good analog for the NPI when comparing snow and ice ablation. Hock (2003) provides a table comparing the degree day factor for melt from snow and ice regions from a number of glaciers. Hock (2003) finds that the ratio is closer to 0.7 for snow ablation to ice ablation for temperate glaciers. Takeuchi et al (1995 and 1996) and Rott (1998) on Patagonia glaciers generated a degree day factor as well that should be consulted.

1134-15: The rate of rise of the transient snow line during the melt season can provide another test of the model. Hock et al (2008) discuss the use of this method. The movement of the TSL provides a measure of ablation if the balance gradient is known or a measure of the balance gradient if ablation is known.

1135-15: One of the key measures for mass balance is the balance gradient, which is not constant with elevation of course but is yet a key measure that should be reported. What is balance gradient for Glaciar San Rafael? Naruse and others (1997) found .010-.015 on Moreno and Upsala Glacier and Rivera (2004) .013 on Chico Glacier. These data can be used for verification and support. The World Glacier Monitoring Service in its glacier mass balance bulletins provides three key diagrams for each glacier examined in detail: mass balance versus ELA, mass balance versus AAR and the balance gradient. I would recommend that since the ELA has been determined (Fig. 5) that the former of these two plots be added.

1138-5: Rott et al (1998) contrasted volume flux balance and surface mass balance on Moreno Glacier. This provides an excellent means of comparison of modeled surface mass balance. In Koppes et al.(2011) data is provided for the ELA region that would allow volume flux determination at 1100 meters and volume flux is determined at the calving front. The ELA flux or somewhere near the ELA provides an independent check of the surface mass balance determination in the accumulation zone (Pelto et al. 2008). The change in volume flux from the ELA to the calving front provides an independent check on the ablation zone balance losses. Given the data is readily at hand for determining an approximate volume flux at the ELA and the calving flux is already determined, this should be done.

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