

Interactive comment on “Recent mass balance of Purogangri ice cap, central Tibetan Plateau, by means of differential X-band SAR interferometry” by N. Neckel et al.

M. Pelto

mauri.pelto@nichols.edu

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Neckel et al (2013) provide two data sets on the distribution of thickness changes of the Purogangri Icecap, China from 2000-2012 that are used to assess mass balance. There are three key issues that deserve greater coverage, before the results can be considered complete or robust. First a key outcome not discussed is that thinning at the terminus and thickening at the head of the glacier indicates a steepening balance gradient, which is observed for glacier in warmer and wetter climates and warmer and wetter years. Second there are several glaciers that have experienced a significant retreat during the study period, these are not quantified or discussed (Figure 1). To

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appreciate the unusual advance noted, the context must be set in relation to the more common extensive terminus thinning and retreat, that is ignored. The terminus thinning is truly extraordinary on several glaciers, exceeding 50 m, for a period of only 12 years. Third, two density scenarios are utilized for mass balance determination, and one result is discarded without proper justification. There is an evident bias toward the model that shows equilibrium, which could well be justified, but is not in this paper.

Specific Comments:

1120-13: Here and in other locations change, “extend” to “extent”.

1120-15: Why comment on the one glacier that advanced significantly and not the three that retreated even more.

1120-19: Reference for most extensive non polar ice? Alaska is generally listed as having more ice than the Tibetan Plateau.

1126-15: Why assume such a low accumulation area density, there is an ice core from this ice cap that indicates the depth at which the snow transitions to ice. This can be used to determine a mean density for the entire ice. It is reasonable to expect that thickness changes over such a short period are mostly from gains in firn versus ice, but this will still have a density somewhat above 600 kgm⁻³. Better justification of both density choices is needed. Reference to firn core densities would be useful in this.

1126-24: One of the potentially most important findings of this paper is that the icecap is close to equilibrium overall, despite rapid thinning at the terminus and modest thickening in the accumulation zone. This can only be accomplished by having a steeper balance gradient. Steeper balance gradients are found in warmer and wetter climate zones. Raper and Braithwaite (2009) or Braithwaite and Raper (2007) and Rasmussen (2004).

1127-5: The two different density approaches yield different results, the more negative mass balance results is discarded without due justification and is not mentioned in the

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abstract or conclusion. Why is the lower density approach is considered less valid? If it is because of better agreement to area changes, that is not a robust validation. Glacier extents do not respond in the same decade to most climate change. Since, more glaciers are retreating than advancing, extent change does not strongly support the notion of an equilibrium balance.

1127-12: The authors correctly point out the significant ice advance of one outlet, but ignore three glacier retreats that are of greater magnitude according to their Figure 1 and five other retreating fronts that are evident. I have attached an annotated Figure 1 indicating these eight. The point is that though the area change is not great, terminus response has been generally one of retreat, and the authors do not address this. The extent of thinning is extraordinary on several of these and is worth noting.

1129-19: "did not retreat" is incorrect as several glaciers did retreat significantly. That the ice cap did not lose significant area is more accurate.

References: Braithwaite, R. J. and Raper, S. C. B.: Glaciological conditions in seven contrasting regions estimated with the degree-day model, *Ann. Glaciol.* 46, 297–302, 2007.

Raper, S. C. B. and Braithwaite, R. J.: Glacier volume response time and its links to climate and topography based on a conceptual model of glacier hypsometry, *The Cryosphere*, 3, 183-194, doi:10.5194/tc-3-183-2009, 2009.

Rasmussen, L.A.: Altitude variation of glacier mass balance in Scandinavia. *Geophys. Res. Letters*, 31, doi:10.1029/2004GL020273, 2004.

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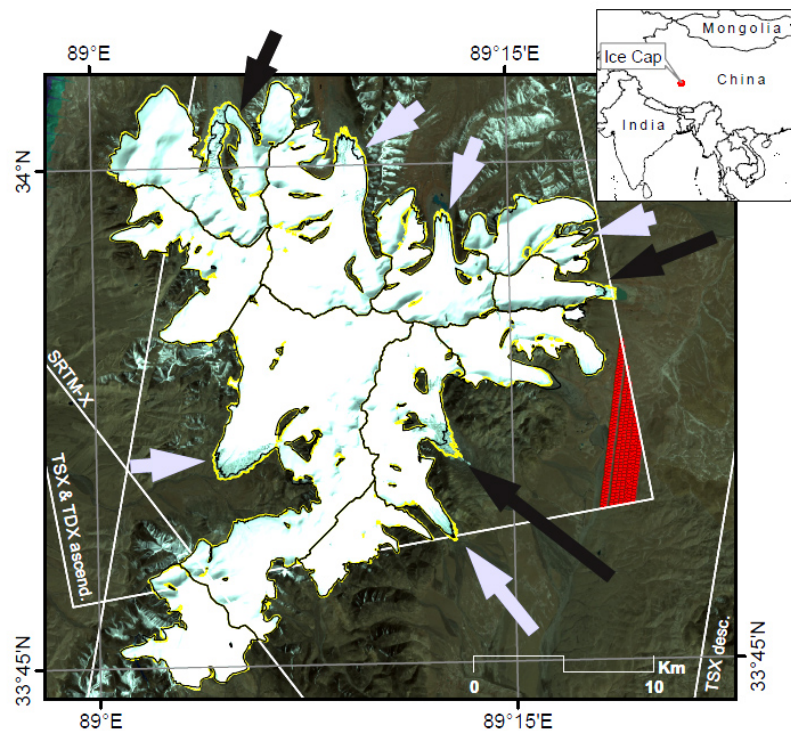


Fig. 1. Porongangri Icecap outlet glacier retreat 2000-2012 noted with black arrows for those with retreating more than 500 m and light purple arrows for those retreating less than 500 m.

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