

## ***Interactive comment on “Forecasting temperate alpine glacier survival from accumulation zone observations” by M. S. Pelto***

### **Anonymous Referee #2**

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Review of “Forecasting temperate alpine glacier survival from accumulation zone observations” by M.S. Pelto

This is an interesting discussion and a salient topic – glaciologists are commonly queried about which glaciers will survive the current century, or how much longer these ice bodies will persist. I suspect that the analysis and conclusions are basically correct. That is, a retrospective look 50 or 100 years from now would probably indicate that Pelto’s ‘survival forecast’ was about right.

That said, I have some serious reservations about the manuscript. Primarily I think that Pelto’s conclusions are correct where they correlate with critical AAR trends – AAR values below  $\sim 0.2$  on a sustained basis clearly mean that the end is nigh, for most valley glaciers. This is stronger, in my view, than the observations/inferences of

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geometrical changes in accumulation areas (though these of course correlate).

1. I disagree with one of the major premises: that ‘stable’ retreat should be accompanied by negligible thinning in the upper glacier/accumulation area. On the long term, it is unreasonable to expect that “at some distance above the terminus. . .the glacier is no longer thinning appreciably even during retreat” (p.326, l.19-21). This conflicts with any understanding of climate-change and ice-dynamical feedbacks associated with glacier retreat. Perhaps it confuses the pure surface mass balance signal with the total (true) mass balance of the glacier. Thinning and drawdown at the terminus cannot help but to increase slopes and increase the dynamical discharge of ice, with these dynamical feedbacks and consequent surface lowering likely to induce an increasing negative (or less positive) mass balance, even at the highest elevations.

l.22 on this page: “will retreat to a stable position” should read “can retreat to a stable position”. It may or may not do so. So while the notion of an equilibrium response is reasonable (and clearly occurs), it is not as simple as such a response involving no geometric changes or thinning in the accumulation area. The best example I can think of is the legion of glaciers in the Alps that thinned and retreated substantially from their LIA maxima. Most of these glaciers witnessed serious adjustments in their accumulation area, but some of them were in a reasonable equilibrium through the 1960s and 1970s, before the current dramatic period of retreat.

2. The latter observation is obvious evidence that one cannot simply interpret accumulation area thinning or retreat as a disequilibrium response (section 2.2).

2. On p.326, l.4 the author suggests that DEM comparisons for different periods “exist for few glaciers” – is this really true? Bolch et al. , for e.g., do such an analysis for all of western Canada (~16,000 glaciers). Also, further down in this paragraph, the author contends that “Airborne laser profiling is also not feasible on small or on a large population of glaciers.” I think the Alaskan work (large area) and LIDAR work on numerous small ice masses belies this. Some of these statements are therefore misleading or

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untrue and this is not recommended as the best motivation for the author's methods.

3. p.330, methods. It seems unusual and lacking in rigour that the author did not employ the SPOT methodology over the North Cascades as a comparison and check on the methodology. It would be a stronger story if this was examined for comparison with the exceptional ground-truth observations.

4. p.331,332, Results. This is tough reading: a lot of detail and tough to synthesize to read prosaically about each glacier. I wonder if much of this could be better expressed in a Table, building on Table 1 with information like change in length of the terminus, AAR data, etc. for each glacier in the study.

Also, many minor editorial comments. The writing is a bit careless.

p.325, l.12, "glacier termini" p.325, l.15, delete "than" in "than requires" p.325, l.28, need a semi-colon after "photographs" p.325, l.29, comma after "ideally" and period at the end of this sentence "...data." p.326, l.4 "exist for few glaciers" – is this really true? p.327, l.17, "can be based" p.329, l.9-13, redundant (verbatim) with p.325, l.12-14. p.330, l.22, "based solely on criteria" p.331, l.25, "retained no or retained snow"? p.333, l.18 "the terminus changes to date have represented the full response of the glacier to climate change" – this cannot be true: facies changes? thinning? ELA? p.335, l.7, "developed by Andreassen"

The ms could use a serious proof-read for commas

There is inconsistent use of both fractions and percentages for AAR

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Interactive comment on The Cryosphere Discuss., 3, 323, 2009.

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