Reply to M. Pelto

Original review in gray italic.
Response as black standard text.

Nuth et al (2013) completed and review the most extensive inventory of Svalbard glaciers to date. The figures in this paper are exceptionally informative. The paper and inventory will be an important addition to our current and future ability to analyze and understand glacier change in Svalbard. The authors need to more carefully address the response time issue. The main weakness of the inventory is the lack of a fixed time period for which the glaciers are analyzed. This is presently an unavoidable issue for this inventory that includes the important characteristics in Figure 5, and is not focused primarily on area and length change.

Thank you very much Dr. Pelto, for your interest in reading our paper and your efforts to publish this short comment. We have tried to address all your comments, the most significant of which about the response time of glaciers. We agree that response time should be carefully addressed, and hope that our response clarified our short discussion of response time. Finally, thanks for pointing out the UNAVOIDABLE weakness of the inventory about the time spans since we are forced to use the data available, which happens to be multi-temporal images from various aerial surveys and satellite images. This wide temporal assortment of data was required in order to cover the entire archipelago with cloud-free scenes.

Specific Comments:
2497-5: Why is 10% a threshold at which the centerline length change is no longer used?

This seems to be a misconception. It is not that the centerline length change is no longer used. We use the centerline length change to determine the distance along the centerline that should be used for generating perpendicular widths. For example, if the centerline length change is larger than 10%, then perpendicular lines are generated for the centerline over the area of change. If the change is smaller than 10% of the centerline length, then lines perpendicular to the centerline are generated for the first 10% of the centerline. Then, for each glacier, and average of these perpendicular lines are used as an estimate of the glacier tongue width. Have added a few additional sentences here to clarify.

2502-14: or 2507-21: Would not increased area/width length changes during Epoch 1 help lead to greater centerline length change in Epoch 2?

I am not sure I understand this point? The idea with these sentences is that an analysis of area change alone leads to the conclusion that glaciers in Svalbard have lost more area per year during Epoch 1 than Epoch 2. The reason for this is that large lateral losses are included in the area change estimates. Alternately, by accounting for the changing width of the tongue, it becomes obvious that the length change is greater during Epoch 2 than Epoch 1, which corresponds with the centerline length changes.

2505-28: Johannesson et al (1989) compared two means of calculating Tm: Tm=f L /u(t) (1) Tm=h/-b(t) (2) Tm in these equations is dependent on four variables: L the glacier length, u(t) velocity of the glacier at the terminus, h the thickness of the glacier, and b(t) the net annual balance at the terminus. The former equation, which was proposed by Nye (1960), typically produces longer full response times of 100 to 1000 years, the latter full response times of 10 to 100 years (Johannesson et al, 1989).

The variable f is a shape factor that is the ratio between the changes in thickness at the terminus to the changes in the thickness at the glacier head (Schwitter and Raymond, 1993). Pelto and Hedlund (2001) observed that equation 1 overestimated Tm and because of the wide spatial variability of u(t), it is not expected to yield a consistently accurate result on small land terminating alpine glaciers such as in the North Cascades. The second equation however is designed for glaciers where ablation is the dominant loss process. For calving glacier ablation is often not the dominant loss process. Further for calving glaciers as we have witnessed, calving often enhances the response to climate. For non-calving glaciers flow typically declines near the terminus, whereas for calving glaciers the velocity typically increases. The result is for calving glaciers a faster response to climate change using equation (1) than for equation (2). If you mention response time, the second approach must be mentioned and would likely be a more valuable approach for calving glaciers.

Thanks for this discussion. For the paragraph at hand, we did not list any equations, but tried to keep the discussion of response time general. The reasons for this was that we felt it important to mention response time when discussing these changes, but also to describe the difficulty in interpreting the changes, especially due to the varying response times that probably exists amongst these glaciers. In general, we refer to Johannesson et al (1989), and we explicitly discuss your equation 2. If "ablation" is defined as any loss of mass from the glacier, whether melting or calving (as defined in the "Glossary of Mass Balance" (Cogley et. al., 2011), then I am not sure I understand your point, "*The second equation however is designed for glaciers where ablation is the dominant loss process*". More importantly really, does equation 2 consider that ablation can consist of calving? I am not sure. Nonetheless:

The paragraph of interest is meant to introduce the concept of glacier response time, infer its importance in interpreting area and length changes, and further provide some of the essential references needed to read up further on response time. It is not meant to fully explain the changes we see here, but rather provide a reason for the scatter in the changes that we see.

2506-6: This statement of still responding to previous climate changes is particularly true for Epoch 1 as it is much longer time span. In Epoch 2 much of the change should reflect climate changes during Epoch 1 and Epoch 2.

Sentence has been revised.

2506-19: Figure 8 illustrates what appears a clear regional signal of greater retreat in Epoch 2 in southern Spitsbergen and less in northeast Spitsbergen.

Thanks for this observation. We were originally careful about how much interpretation should be done, but have now included this point in the text.

2508-21: Is it worth citing Kohler et al (2007) who noted the recent increased thinning on the upper section of Spitsbergen glaciers, that represents a volume change, but less of an area change?

Yes, this is an interesting point. We have referred to the paper earlier in the manuscript. The reason we refrain from referencing it here is that that study focused on relatively small, land-terminating glaciers while our area estimates are from all glaciers both large and small, land and tidewater terminating.

Comments accepted as is:

Figure 8 better identify inset map location in the caption.

2501-4: The changes in central Spitsbergen are the largest in Figure 6b as noted, *based on Figure 5 this is a region of dominantly smaller glaciers, which is worth noting.*

2505-21: This inventory does not meet this definition as it is not one point in time, consider rewording.