

Interactive comment on “Multi decadal glacier area fluctuations in Pan-Arctic” by S. H. Mernild and J. K. Malmros

Anonymous Referee #2

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I found this paper a bit problematic. Both the description of background, methods, the analyses, the (lacking) comparison to other work as well as the scientific writing are, in my opinion, not good enough as is. The paper needs serious reworking if to be published in TC.

Some major concerns. 1. Citations to previous work. The authors seem to be ignorant of much of the previous work in the studied regions and in general on the methods. The first sentence in chapter 4 illustrates this. There is a wealth of information both using optical satellites, mass balance studies and topographic surveys and the authors should compare their results with finding from other studies. A good place to start is the compilation of GLIMS relevant papers: <http://www.glims.org/Publications/>, but there are also other sources to search.

C2342

The GLIMS (Global Land Ice Measurements from Space) project is not mentioned in the paper either. It could have been referred to. Is the paper meant to be a contribution to GLIMS?

2. The 321 glaciers- why and how are these selected? I tried to find this explained in the paper, but I see no discussion of it. there should be manymore than 321 glaciers covered by the imagery selected. How much do their selection contribute in area is not mentioned either (would be natural in both the abstract, the summary and in the results) and how much do they represent in total of the glacierized area in the selected regions?

3. The temperature analysis could have been avoided, this is better done by using longer time series (analyzing trends over a 25 year period is indeed speculative and not standard method). A glacier's response is based on more than just temperature, precipitation is also important. In Scandinavia the advances of glaciers in the 1990s was precipitation driven and this could have been mentioned with a ref or two. Glaciers also have different response times depending on their size, geometry, mass balance gradient etc, some glaciers may have quite long responses. I believe many of the 321 glaciers may react partly to climate forcings prior to the mid 1980s.

4. The methods are a bit difficult to understand, did they digitize the outlines? fig 3 points to automatic delineation, but the authors write about digitizing of margin positions (p 4421). Did they select some and not others?

Some specific comments: 4418-line 8. avoid mentioning of climate warming here, rather state the total area studied. -Define the term 'Pan-Arctic' first time used 'The average rise in air temperature' is an odd phrase. -17- only relative new refs, many refs before this to choose from. -Bloch- is Bolch, written wrongly throughout

4420- 6- the introduction lacks reference to work prior to this, many too choose from also before 2007, little on the methods in the introduction -16-shrinking rate on average, what is this based on? -20-321 glaciers, why this selection, how representative are

C2343

these glaciers? explain and discuss here or later

4420-3-Landsat may be characterized as medium high resolution, not high 10-why this 0.028 limit, could be explained 17-what is the basis of this selection, image availability, random selection or what?

4421-7- 3/5 (or 4/5) is the most common in use, 2/5 seldomly used. Ok to try other approaches of course, but then discuss the pros and cons and compare the results. Should be discussed. In figure 2 it says ratio 2/5, it seems to be in contrast to this text. References are lacking here, many to choose from if the literature is searched. E.g. Racoviteanu et al (2009) and Paul et al (2009) for recommendations for glacier inventory studies and further references.

Both ch 2.1. and 2.2 is difficult to comprehend and methods a bit different than standard. The references made to other work are not satisfactory. On uncertainty, here citations to other work performing such analyses could have been made.

4424-14- here it says 0.1, but earlier it was stated that 0.28 was the lower limit.

4427-other factors than just air temperature, trends not good for such a short period Odd that the summary and conclusions are shorter than the acknowledgements.

4432-why have two columns in the table that have identical values for all (ground resolution and precision error)

4434-table 3-miss absolute areas for totals

4437-which Landsat-image(s), the first or last of the series?

4438- a bit unusual to use 2/5 ratio, could be compared with the more common 3/5 and 4/5

4444-fig.8-what is the background in the figure, the Landsat imagery, should be classified or explained. The lower left figure, id 5, seems to be Storbreen as discussed in another TC paper (see fig 9 in Andreassen et al 2008). It thus seems incorrect that

C2344

this glacier has shrunk along the whole perimeter as figure 8-id5- is showing. This might due to snow and cloud conditions or the mapping method/threshold. See the 2008-paper for more discussion. Some more discussion on methods and uncertainties is needed to be taken in this paper in general.

4446- a broader sample than the 321, a better method description and discussion is more needed than figure 10 and the related text in the paper

References Andreassen, L. M., Paul, F., Kääb, A., and Hausberg, J. E.: Landsat-derived glacier inventory for Jotunheimen, Norway, and deduced glacier changes since the 1930s, *The Cryosphere*, 2, 131-145, doi:10.5194/tc-2-131-2008.

Paul, F. R., Barry, R. G., Cogley, J. G., Frey, H., Haeberli, W., Ohmura, A., Ommanney, C. S. L., Raup, B., Rivera, A., and Zemp, M. Recommendations for the compilation of glacier inventory data from digital sources, *Ann. Glaciol.*, 50(53), 119–126, 2009.

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