

Title: Determining the terrain characteristics related to the surface expression of subsurface water pressurization in permafrost landscapes using susceptibility modelling

Authors: Jean E. Holloway et al.

General Comments:

This paper employs GIS to define the terrain susceptible to active layer detachment slides and mud ejection features at a High Arctic site. The paper provides a suitable GIS tool to locate these features at Cape Bounty, an approach which may be applicable for similar terrain elsewhere. The paper is quite technical, with lots of jargon so I thought that it might be better suited for a GIS specific journal or *PPP-Permafrost and Periglacial Processes* where readers might be more knowledgeable about pore water pressure phenomena. If it is to be published in *Cryosphere*, more effort could be made to relate the research to other cryospheric types/regions where pore water pressure occurs to elucidate processes across diverse icy bodies. Clarification about distance to water, potential incoming solar radiation in the model is required. It was not clear from the paper whether one is concerned with upslope water or downslope water, or water sources in both directions. Also, what defines water (puddle, stream, lake or pond)? It was also not clear the time frame that PISR was calculated for (1 month, 2 months, 2 weeks)?

The study's introduction indicated that rainfall was an important factor in triggering pore water pressure but there was little information about this variable in the study. I think that more effort could also be made to get information about ground ice conditions at the site. I believe that there is a GSC report for this area, from the mid-70's which might report some of this information. Another look at field photos, or data from other studies in this location might provide clearer indication of ice content.

Specific Comments:

1) In the abstract you indicate distance to water but is that distance to water upslope of the feature or downslope or both? It is also not clear in the rest of the text.

2) In your abstract perhaps indicate that the GAM model is a GIS-type model.

- 3) Be more specific in your abstract about PISR, instead of “relatively low PISR”, perhaps put a value in. Is PISR calculated for the whole summer, a few weeks? It is also not clear in your paper. Did you measure solar radiation directly at your study site? If so, how do these values compare with PISR.
- 4) In your abstract, perhaps put...Based on these results, this GIS method identifies....
- 5) At the beginning of the abstract, you indicate that late season precipitation is important for these features to develop but you don't use precipitation as an explanatory variable. In fact, I don't see any information about precipitation or late-season precipitation in the paper.
- 6) Again in your abstract, can you be more definite about distance...avoid saying....areas relatively far from water. Again is that upslope or downslope.
- 7) Page 2, Line 20-21. Perhaps cut down on the number of references to GAM.
- 8) Lines 27-28. Can you cut down on the references?
- 10) Page 3 Line 10. Put <10 m. There are some other places where you need to leave spaces...see line 14, 27, etc.
- 11) Line 13. Since you are concerned with the spring/summer period for slope failure, besides the mean annual temperature add information about the spring/summer temperature and also add information about these infrequent, high magnitude precipitation events.
- 12) Line 25. Provide information on the summer temperature in 2007 and heavy rainfall.
- 13) Line 27. Again put the temperatures in for 2011 and 2012, and maybe indicate how these temperatures compare with other areas in the High Arctic, and what other scientists were observing (glacial ice loss, sea ice). This will help put your work in context of other cryospheric phenomena.
- 14) Page 4, Line 24. Why did you select >10 m for distance to a water source and again was that upslope or downslope. Also, why did you select a distance to an ALD of > 20 m? Can you plot those randomly ArcGIS points in your map?

15) Page 5, Line 8. Can you plot the randomly generated control points for MEs (78).

16) Line 15. Do you have a reference to add to after...they all have the potential to contribute to areas having high PWP's?

17) Line 20. Again, is it distance upslope or downslope? Be specific, in terms of water, is it water table or a creek or a stream or a lake, pond. How do you define water? Many hillslope creeks in the High Arctic dry up after snowmelt, or are intermittent. Do you still estimate distance to them?

18) Line 23. Are you able to compare PISR with measured incoming radiation at a level site to see how they compare over a summer season? If you had a cloudy, rainy season then radiation across the slopes/plateau might not have been critical.

19) Lines 7-8. Can you say more about the TWI index? How does this compare to the new paradigm of 'spill and fill', which is perhaps a better theory of how water moves in arctic environments (Woo, 2012).

20) Lines 10-11. Are you sure that you don't have any information about ground ice content. There must be some geology maps of this area which give an indication of ice content. During your fieldwork, did you not dig a hole in these different landscapes to examine where the ice and moisture were accumulating? Perhaps, look at some of your pictures, particularly, active layer detachment slides. The headwall scarps might give you an indication of where the ice rich depths occur.

21) Line 13. Do you really need ρ in front of S_p ? Do you have a reference for VIFs?

22) Page 8. Line 14. Do you have a reference for a confusion matrix?

23) Lines 20-23. Is this a standard framework for susceptibility/sensitivity? Should you add a reference here?

22) Line 3. In terms of PISR, how does 1100 MJ/m^2 compare with what is generally measured during a summer season, and what is the time frame for the PISR estimate (i.e. is this over 30, 60 or 90 days). Do you start your calculations in late August, since you said these features often occur then?

23) Line 6. Again are you referring to upslope distance or downslope distance? I would think that upslope distance to water would be more important than downslope.

24) Line 16. Indicate the amount of rain which fell late July, also indicate the depth of ground thaw.

25) Line 26. What kind of soil structure did you have which allowed these slurries to occur?