We appreciate the Reviewer's comments below and we have responded to the points in **bold text**.

Reviewer 1:

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)?

Response: Thank you for your comments. However, we disagree about the appropriateness of the journal. My coauthors and I feel that our paper is highly relevant to The Cryosphere as it presents new research on features that are unique to permafrost landscapes. Mud ejections in particular represent a significant gap in the literature. We have made an effort to relate the observations of the features we see at our site to other areas, in particular discussing how pore-water pressure (PWP) results in instability in other regions. We also clarified the model variables (distance to water, PISR, etc.) and believe that after incorporating the comments from the reviewers it will be suitable for publication in TC.

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.

Response: The introduction has been reworded. Factors impacting PWP are either intrinsic (ex. slope, drainage, solar radiation) or extrinsic (temperature, rainfall) and although extrinsic factors are important, this model only identifies intrinsic factors. Similarly, all areas across the landscape experience relatively homogeneous rainfall, and it is only certain locations which have high PWP, ALDs and MEs due to specific properties of the landscape at these locations. Therefore, we are using this model to identify these landscape variables. This section of the discussion has been removed, and the text has been reworded to clarify this.

The ground ice maps you mention don't have sufficient ground ice data for our area or detail. Permafrost cores have been taken at the site near and ALD, and the data shows ice enrichment from 60-80 cm bgs (Lamhonwah et al., in press). Observations in the headwalls of ALDs show ~0.5m of massive ice starting at ~80cm. Additional information has been added to the text.

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.

Response: We are referring to distance to downslope water sources. Distance to water was calculated using the Euclidean Distance Tool in ArcGIS and distances were measured from a ALD or ME to a hydrological vector layer. Text has been clarified throughout the manuscript to ensure that the difference between distance to water and TWI is clear.

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

Response: The GAM model is not a GIS-type model, it is a statistical model. We used the terrain variables (which were derived using GIS) as inputs into the statistical 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.

Response: A value has been added for PISR in the text.

4) In your abstract, perhaps put…Based on these results, this GIS method identifies….
Response: This has been changed.

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.

Response: The introduction has been reworded. Rainfall is a trigger for high PWP but does not explain sensitivity of the landscape to PWP, so less emphasis was put on rainfall in the introduction.

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.

Response: This has been reworded.

7) Page 2, Line 20-21. Perhaps cut down on the number of references to GAM.

Response: Some of the older references have been removed.

8) Lines 27-28. Can you cut down on the references?

Response: Two of the references which weren't necessary have been removed.

10) Page 3 Line 10. Put <10 m. There are some other places where you need to leave spaces…see line 14, 27, etc.

Response: This has been fixed throughout the manuscript.

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.

Response: Mean July temperature has been added to the text, summer precipitation totals, and information regarding the major rainfall events.

12) Line 25. Provide information on the summer temperature in 2007 and heavy rainfall.

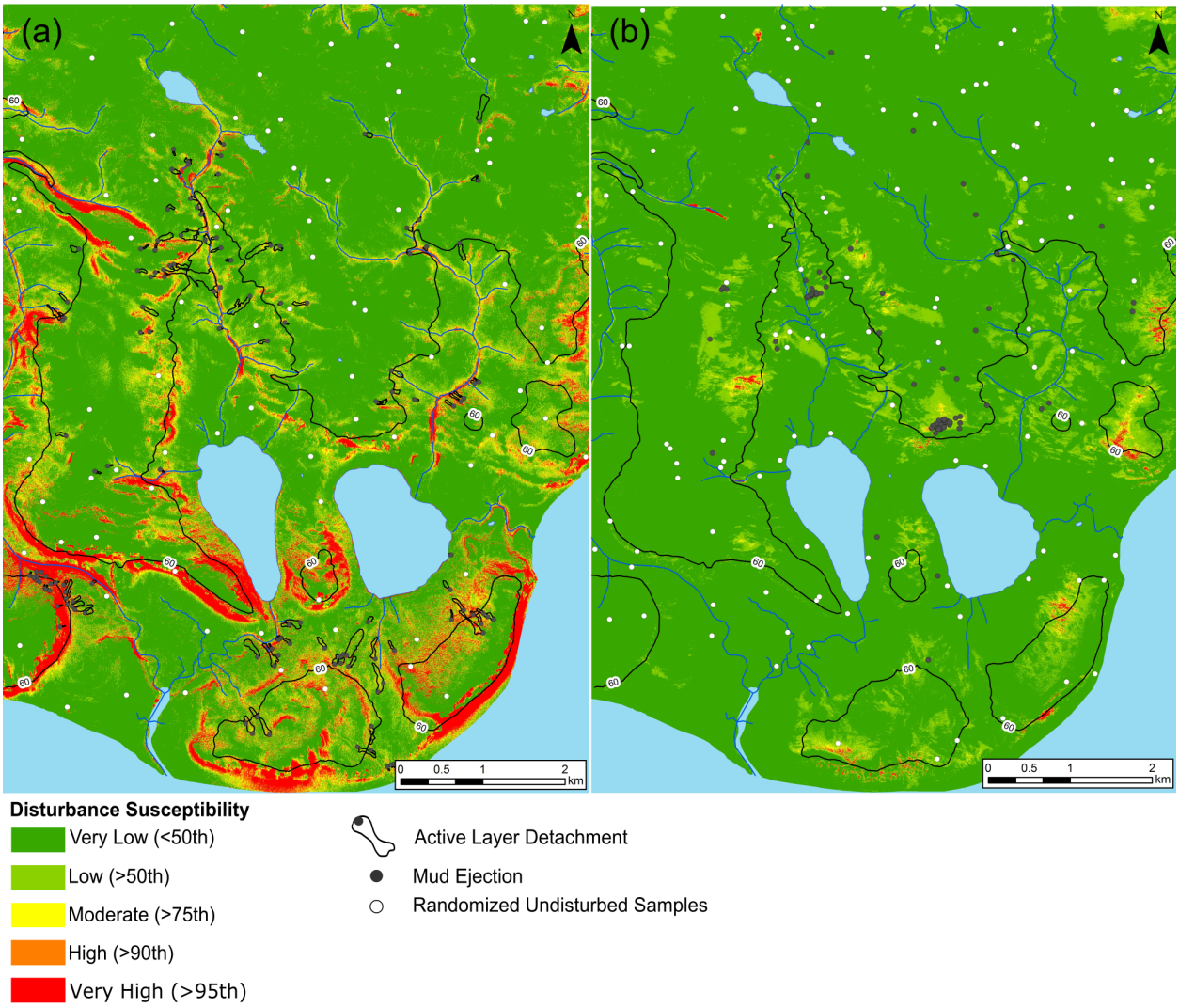
Response: Mean July temperatures have been added for 2007 and information about the major rainfall events.

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.

Response: Mean July temperature has been added for 2011 and 2012. Above average temperatures were recorded in 2007 and 2012 in other areas of the arctic, and reference has been made to the SWIPA report to put this in context.

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?

Response: On average the width of channels are Cape Bounty are substantially less than 10 m. To ensure that randomized points were not placed in a stream a rule of >10 m was selected. This refers to the downslope distance to a water source. Again, to ensure that randomized points were not placed within the boundary of existing ALDs a minimum distance of 20 m was selected. Points were generated using the "Random Point" tool in ArcGIS with the additional criteria (>10 m from a water source and >20 m from an initiation point) limiting to a minimal extent where they could be placed. The location of the random points has been added to Figure 4.



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

Response: The location of the random points has been added to Figure 4.

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

Response: The relation of each variable to drainage, soil moisture, and thus PWP were explained individually throughout that section and references were included for each variable.

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?

Response: We are referring to distance to downslope water sources. Distance to water was calculated using the Euclidean Distance Tool in ArcGIS and distances were measured from an ALD or ME to a hydrological vector layer which included lakes and rivers (can be seen on Figure 4 and 5). Text has been clarified. These rivers are the larger streams and rivers in the area and remain active throughout the hydrological season.

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.

Response: The mean value for PISR at our site is 1267 MJ/m2, indicating that ALDs have higher probability of occurring where PISR is lower than the site average. More information has been added to put this in context in Section 5.1.

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).

Response: In this study a FD8 flow algorithm was applied to allow water to flow into multiple neighbouring cells based on the concave or convex nature of the landscape. TWI is an indicator of the likelihood of saturated soil conditions during rain events, and represents hydrologic parameters influenced by slope morphology. TWI provides us with information on where soil moisture is likely to be higher as a result of the accumulation of surface water. This is important as an increase in subsurface water content can lead to increased porewater pressure which is a triggering factor for ALDs and MEs. More detail has been added to the manuscript. Woo (2012) discusses the fill-and-spill concept, and logically this is happening in our area to some extent, however, these subtleties of storage heterogeneity in hillslopes and catchments are difficult to account for using spatially derived data and the landscape scale. However, the TWI index does consider convexity and concavity, and in this manner partitions the slope into various segments.

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.

Response: The ground ice maps available for the field area are highly generalized. Permafrost cores have been taken at the site, but the data is unpublished. Observations in the headwalls of ALDs provide further information about ground ice which has been added to the text.

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

Response: The ρ in front of Sp is necessary as this is the notation for this coefficient. The reference Neter et al., 1996 has been added for VIFs.

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

Response: There is no reference needed for the confusion matrix as it is a standard methodology (a more complex contingency table).

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

Response: It is the dominant method for susceptibility modelling used in the literature. References have been added.

22) Line 3. In terms of PISR, how does 1100 MJ/m2 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?

Response: Total PISR is only calculated for the snow free period which is July 15 – September 15, and this information has been added to the text. The mean value for PISR at our site is 1267 MJ/m2, indicating that ALDs have higher probability of occurring where PISR is lower than the site average. More information has been added to put this in context in Section 5.1.

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.

Response: Distance to water refers to the downslope distance to a water source and TWI incorporates the upslope contributing area. Downslope distance to water is an indication of drainage and wetness of the landscape, and water sources have the potential to erode banks and cause ALD initiation. This has been added to the text.

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

Response: General information about the frequency and magnitude of rainfall has been added throughout the text.

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

Response: The soils are composed of mineral fines formed in glacial and marine sediments. We observed desiccation cracking at the site and MEs coming out of cracks in the ground. More information on this has been added.