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The Cryosphere Discussions

Interactive comment on "Modelling and mapping climate change impacts on permafrost at high spatial resolution for a region with complex terrain" *by* Y. Zhang et al.

Anonymous Referee #2

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General comments

The aforementioned manuscript by Zhang et al. demonstrates the use of numerical process based modelling to calculate and investigate two important permafrost variables including distribution and active layer thickness (ALT) in an Arctic area with complex topography. This paper is of particular interest to the community of The Cryosphere because it investigates permafrost conditions spatially with the effects of transient climate change whereas many only look at equilibrium conditions. There are several novel aspects of this study and I believe the authors have done an excellent job acquiring good data to use from many sources. I believe this study fits both the scope

of the journal and illustrates a technique, which is transferable to other areas meriting publication upon the following issues being addressed or cleared up.

I am concerned about the resolution of this study (10 x 10 m), I understand that the remote sensed ecosystem classification is at this resolution however, the DEM is not. The DEM is taken from Canadian National Topographic system maps, which only have a resolution of 30 x 30 m. I do not see how the authors were able to resample this to a finer resolution. Please provide a rational as to how this resample was done, without addition elevation data or justification the study would have to be completed at 30 x 30 resolution which is sill very fine for this area.

I feel the title of this paper would benefit from the addition of "Arctic" this is because of the different type of permafrost research which is done in mountainous areas (e.g. Apline Europe) apposed to that which is done in High Arctic areas (e.g. Canadian High Arctic Islands). This study area is unique because it encapsulates some aspects of both systems and thus should be mentioned in the title. In addition I feel that not enough is done to speak about this uniqueness in the study area section, there is no mention of elevation ranges as an example.

Another aspect of the methods that needs to be addressed is the interpolation of Mean Annual Air Temperatures. Almost all Environment Canada stations are located in valley bottoms or areas of low elevation and as a result it is difficult to predict temperature change with elevation. Many models use a standard Surface Lapse Rate (SLR) of -6.5°C/km which on a yearly scale has been shown to be inaccurate (See Lewkowicz and Bonnaventure, 2011). What SLR was used to make this model? The justification for this should be included in the discussion section of this paper.

I feel that the Discussion and conclusions section should be split into two sections. I feel as if more should be spoken about in the discussion, which is currently a bit short. One aspect that should be discussed in more details is the errors an uncertainty associated with this modelling as well as the application to different areas in the future.

I have to say however, that the use of the Appendix for equations is appropriate.

Minor comments

In the introduction Page 4601, line 29, avoid using the word “we”. In the methods section page 4602, line 23, I believe a reference is needed.

In figure 1a, consider labeling Herschel Island, as this is an international journal and much permafrost research is conducted there so it provides a good reference.

In figure 1b, there is a line extending off the coast into the Beaufort Sea, what is this?

For figures 2 and 5 consider using colour categories rather than a ramp as this will make changes easier to see especially in 5c.

References

Lewkowicz A.G. and Bonnaventure P.P. 2011. Equivalent Elevation: a New Method to Incorporate Variable Lapse Rates Into Mountain Permafrost Modelling. Permafrost and Periglacial Processes. 22: 153-162, DOI: 10.1002/ppp.720.

Interactive comment on The Cryosphere Discuss., 6, 4599, 2012.