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Interactive comment on "The periglacial engine of mountain erosion – Part 1: Rates of frost cracking and frost creep" *by* J. L. Andersen et al.

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Received and published: 12 June 2015

This manuscript is a concise, well-written account of a newly-developed numerical model that explores the competing effects of frost cracking and frost creep in periglacial landscapes. A companion manuscript inserts the model described here into a broader landscape evolution model. This manuscript has a firm basis in the existing literature, and implements sensible, substantial advances on existing models. The numerical experiments are elegant, and the outcome is significant insight into the controls on the key processes operating in periglacial landscapes. I enjoyed the manuscript, and I find little to criticise.

On the whole, the account of the numerical model is comprehensive, but there are a couple of minor omissions; strictly, rho and c are not defined, and it would be helpful

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to have a more explicit definition for wf. The model necessarily contains a series of parameters for which there are few constraints, and the primary motivation here is to demonstrate the importance of acknowledging, for example, that flow restriction is important, and that it is different in different materials. Nonetheless, it would be helpful if the authors could provide more discussion on the basis of their choices, e.g., the four values of flow restriction for unfrozen sediment, frozen sediment, unfrozen bedrock and frozen bedrock. Section 4.3.3 and Figure 11 document what happens without considering flow restriction, or when holding it uniform across all materials, but it would be good to see discussion of the significance of the choices when all four materials are assigned unique values for flow restriction. Similarly, it would be good to expand upon "variable moisture content... could potentially influence..." in section 5.2.

Some minor comments:

Section 3.1. It reads a little strangely that the movement of water is a key component of the frost cracking model, yet the authors "ignore the thermal effect of fluid advection". I doubt this is a concern as far as the model is concerned, but it would be helpful to have a little further content here to support this assumption.

Section 3.2. Perhaps alert the reader at first mention of vw that water availability is considered carefully in the discussion.

Section 3.3. "silt-sized" is mentioned rather apologetically here, yet the grainsize of the sediment would seem to be a key control on frost creep behaviour. This is indeed explored in the discussion of the companion manuscript (Egholm et al., p. 346), yet not considered further here. Could the authors explore this theme here, too? Also, the formatting of the equation on p. 296, l. 19 is rather untidy.

Section 3.4.3. Vcw is given with units of m^2 in Table 1, but here it is in cm.

Fig. 10. What do the arrows labelled "snow" represent?

Fig. 12. Using the same colour scale for (a) and (b) might help to illuminate the

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differences between the two results.