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Interactive comment on “Estimating the avalanche contribution to the mass balance of debris covered glaciers” by A. Banerjee and R. Shankar

L. I. Nicholson (Referee)

lindsey.nicholson@uibk.ac.at

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Determining avalanche inputs to glaciers is an outstanding problem for determining mass balances in steep mountain terrain, and this paper tackles the issue of determining avalanche contributions to glacier mass balance using an idealized glacier flow model. The paper is generally well written and pleasingly concise, and there are just a few additional details that I think would improve the paper.

General comments:

Please provide a location map for the glacier.

Is it possible to include some information on the glaciological mass balance determination – how many stakes and stake distribution over the glacier surface for example?

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In the GIF referenced there appear to be two colours in the upper ablation zone that do not have a corresponding value in the legend – are they actually the same yellow and red categories as in the lower terminus? If not how did you deal with them?

Please briefly detail the source data used for the geodetic mass balance in Vincent et al., 2013.

Can you detail on the range of avalanche inputs you tested and add a description of your quantified criteria for an acceptable avalanche contribution according to criteria (a) and (b) – I mean what do you consider ‘compatible’ (as in (a)) and how close to 1km difference do the actual and steady-state lengths need to be to be acceptable in your analysis?

You neatly find that avalanche contribution corresponds to the mismatch between the glaciological and geodetic mass balance, but you do not discuss the discrepancy between your modeled mass balance -0.2 m w.e./y and the previously determined geodetic mass balance of -0.45 m w.e./y. Do you have a comment on this?

Specific comments:

P642/L19 Reference should read Nicholson and Benn, 2006

P643/L4 An extra ‘the’

P643/L28 Change we conjecture to we hypothesise

P644/L3 I think this paragraph belongs in the conclusions of the paper

P644/L13 This is a matter of personal taste, but I do not think this paragraph is necessary.

P645/L18 I suggest adding the italics in: “the negative magnitude of the net glaciological balance is relatively large compared to negative net mass balance “

P646/L15 It is not clear here what is meant by ‘both inputs’, perhaps better to say: “But

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to obtain a particular non steady state, both inputs of some past thickness profile and the time dependent mass balance function are necessary.”

P646/L24 Can you comment on how well the simple bedrock is likely to match reality here? Is there any information on that? Did you follow an optimization procedure to determine the bedrock slope and highest elevation of the bedrock?

P647/L2 Could you explain what guided these choices of f_s and f_d ?

P647/L6 Change smoothening to smoothing .. and also later in the paper

P647/L26 I'm not clear how this part of the argument relates to avalanche inputs, it appears to refer more to the role of debris cover in slowing terminus retreat

P649/L14 Change till to until

P649/L15 Might be better to say the ‘prescribed’ specific mass balance profile, rather than the ‘current’ one, as you are here describing the optimization procedure. Also I suggest the following change for the same reason: We then tune the avalanche contribution to the mass balance profile such that (a) the retreat rate is compatible with the observations and (b) the glacier length differs from the previously determined steady-state length by about 1 km.

P649/L23 Change satisfy to satisfies

P650/L1 Add italics “robust as it is tied to the”

P650/L23 In the discussion you state that avalanche inputs take longer to affect the dynamics? It sounds like an unsubstantiated statement as its written now, but I think you refer to the model behavior observed at the beginning of section 2.5, so try and make this more explicit.

P651/L5 I suggest starting this sentence with “At first glance, this may suggest. . .” and remove the following paragraph break.

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P651/L7 Should read: “Benn and Lehmkuhl (2000) have argued . . .”

P651/L10 Should read “of Scherler et al. (2011b) show. . .”

Interactive comment on The Cryosphere Discuss., 8, 641, 2014.

TCD

8, C77–C80, 2014

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