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The Cryosphere Discussions

Interactive comment on "Relative effect of slope and equilibrium line altitude on the retreat of Himalayan glaciers" *by* T. N. Venkatesh et al.

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1. *Somewhat more critical treatment of the underlying assumption. For example, it is not reasonable to assume that the western and eastern Himalaya have similar climatic conditions: not only does the summer monsoon season vary between these area, but also the western and northwestern Himalaya is heavily influenced by snowfall during the winter westerlies.*

We agree that climatic conditions are different in the western and eastern Himalayas. In this investigation, we wanted to show that if ELA changes are similar,

glacier retreat will be different, depending upon geo-morphological parameters. Our premise is that on a climate time-scale, to the first order, the ELA changes resulting from global climate change are of similar magnitude.

As suggested, a paragraph about the limitations of the assumptions made will be added.

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2. *Second, the authors should clearly mention that there are several other factors playing an important role of glacial-frontal behavior, for example: debris coverage, glacial exposure or aspect, internal dynamics, topographic relief that influences debris coverage, solar shielding, and snow avalanching.*

We agree that there are several factors which influence glacier-frontal behaviour. These are mentioned briefly in the manuscript. In this paper we have looked at how much of the frontal behaviour can be explained using just the mean slope and ELA change. As suggested, more text about the role of debris cover, etc. will be added.

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3. *In general, the manuscript lacks citation from the cryospheric community, which have looked at some of the other factors influencing glacial frontal behavior.*

More citations will be added.

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4. *Previous publications which point out several links between individual parameters. For example, Scherler et al. (2011-JGR) and Scherler et al. (2011-nature geoscience) argue that steeper glaciers are often characterized by higher relief*

TCD
5, C1859–C1863, 2012

and result in higher debris coverage. Debris Coverage, especially in the ablation zone, strongly influences frontal retreat behavior. In addition, steeper catchments also have higher numbers of snow avalanches that change the mass behavior of the glacier.

This has been documented to be an important factor in some Himalayan catchments (see publications by Kevin Hewitt).

We agree that there would be links between different parameters such as those mentioned above. It is not our argument that factors such as debris cover do not play a role. We say that it is enough to use the slope as the geometric measure. Due to the linkages between steepness and other factors, their role is indirectly accounted for when we estimate the coefficients α and dh_e/dt from the control set.

Relevant text and the citations mentioned above will be added.

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5. *Specifically, when comparing the Zemu and Gangotri glaciers that sit in very different climatic regions in the Himalaya. The Gangotri glacier receives some winter precipitation, while the Zemu glacier is heavily influenced by the summer monsoon. Certainly, the steepness of the glacier results in different behavior (I agree with the authors), but there are several other factors that may be related to steepness (see above) and thus steepness is not the process controlling glacial behavior.*

The several factors which influence glacier-frontal behaviour are mentioned briefly in the manuscript. The climatic differences between Gangotri and Zemu are possibly one of the factors which influence the behaviour on a smaller time-

scale. Our contention is that on a longer time-scale, the difference in slope plays an important part. This is supported by our results.

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6. *Comparing probability distribution. I suggest the other use a simple parametric (e.g., Kolmogorov Smirnov (KS) test) to test if both distributions are drawn from different sources. In other words, are the distributions shown in Figure 3 are really different given the sample sizes? Note: I am not arguing against the author's statement, but a KS test would strengthen their point. Instead of a KS test, a more sophisticated parametric test can be used as well.*

This is a good suggestion. We will perform the Kolmogorov Smirnov test on the two distributions.

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7. *Figures: Change the order of the figures. Before referring to individual locations in the Himalaya, you should present the location map – this is currently Figure 10!*

Order of figures will be changed in the revised manuscript.

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8. *The location map should include international borders (and say so in the captions). The state border between individual Indian states can be omitted.*

Map will be changed in the revised manuscript.

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9. *Second, consider plotting Figure 3 + 9 (both probability distributions of slope) right next to each other – I found myself flipping back and forth several times.*

The probability distributions will be plotted in the same figure.

10. *The captions of Figure 3+9 should also include the bin sizes used for plotting the PD.*

Caption will be changed accordingly

Interactive comment on The Cryosphere Discuss., 5, 2571, 2011.