

Interactive comment on “Reduced melt on debris-covered glaciers: investigations from Changri Nup Glacier, Nepal” by C. Vincent et al.

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General Comments:

The authors submitted a mass balance study of a previously researched debris-covered glacier in the Nepalese Himalaya, based on a number of years of field data including stakes, GPR measurements, DGPS measurements, terrestrial photogrammetry as well as UAV surveys. Their measurements are distributed over the ablation area which is predominately covered by debris. They furthermore compare their results to other MB data from nearby clean ice glaciers.

MB studies, especially including field data, are still rare and a very important contribution to current literature for the region. This is especially true for the ongoing discussion of the effect of debris on glacier melt. The manuscript is therefore an important contri-

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bution to current science and well suited for the Journal.

The authors present their data very well and provide a clear description of the work process. They also provide important results in terms of applicability of local stake measurements for wider MB studies. The results could well be used by other field studies as a solid comparison and should be a reference publication for future remote sensing studies that make judgements about the differences between debris covered and bare ice glacier's response to climate change in the region.

Specific comments:

L31 / L526: Stating in the manuscript that it will have 'major' implications for future work is – personally speaking – not called for as this judgment should be left to subsequent researchers referring to this work or using its Results. If the authors however think it is necessary for their work to use this wording, at least a strong backing for it should be provided. While I agree that the study is a significant contribution and there are many arguments in the text that warrant that, I believe that after it is stated in L526 there is no actual explanation which are these specific implications (and the reader is left to judge him- or herself). I believe it should be made more clear which of the excellent results the authors believe lead to the major implications (also because 'results' is not equal to 'implications for future work').

Section 4.2 – on cross sectional velocity (Fig.4): There seems to be a reduction in velocity between 2011/2012 and 2014/2015 (Fig. 4b). Although it is only reasonable to take a mean value, perhaps a discussion of this trend would be prudent also in relation to a trend in SMB over the study period.

L 491ff: Although the authors conclude that for Changri Nup the insulating effects dominates likely enhancing melt factors like ice cliffs and lakes, considering the observed consistent differences in local elevation changes (Table 1), it would be interesting to see – without a detailed study which would of course exceed the extent of the manuscript with its current aim - whether for example the higher rates around cross section P and

V compared to others correspond to an increased occurrence of cliffs and lakes.

Minor Comments/Technical Corrections:

L19: Since that number ($>1/4$) is often confusingly defined in many studies as it is sometimes not clear whether authors mean ‘just debris covered area’ or ‘the cumulative area of all glaciers with debris cover’ (the way it is used in the manuscript is correct) it would be prudent to refer to a publication at this place.

L133: I believe ‘accrued out on’ is neither correct English nor is it really clear what is meant with it.

L196: ‘Kriging’

L211: ‘... the elevation was three times larger than the normalized median absolute’

L335: ‘...profile M, and the mean rate of ...’

L346: ‘Mean elevation changes ... were (!, plural) obtained’

L363: ‘a RMSE’

L366: ‘changes were compared’ (tense!). L366: I do not think that ‘reduced profiles’ is the correct term. Either repeat a word and ‘incomplete profiles’ or simply ‘on these profiles’.

L378: what is meant with ‘check area’?

L399: the variable ‘b’ is ‘B_M’ in the equation

L420: I would expect a citation for the ice thickness uncertainty. Other studies even provide lower estimates (e.g. Gabbi, 2015)

L 521: Remove ‘Indeed’

L522: ‘... ,ice flow velocities derived from DGPS field measurements ...’

Figures and Tables:

Table 1: Explain what the letters M to Z refer to (i.e. 'the letters refer to cross sections as in Fig. 2')

Figure 1/L735: '...delineation of ...' Figure 4/L753: '...a second order polynomial function ...' Figure 7/L774: remove first 'only'

References

Gabbi, J. (2015). ON THE UNCERTAINTIES IN GLACIER MASS BALANCE MODELLING, Doctoral Dissertation, ETH Zurich, VAW

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