

## ***Interactive comment on “A comparison of glacier melt on debris-covered glaciers in the northern and southern Caucasus” by A. Lambrecht et al.***

### **Anonymous Referee #2**

Received and published: 28 March 2011

#### Summary:

This article details the findings of 3 field seasons of ablation measurements on debris covered portions of glaciers in 2 basins to the north and south side of the Caucasus divide. Glacier extent and debris cover extent evolution through time is presented for the last 35 years, and then the field measurements are used to constrain a model experiment to compare the ablation and influence of debris cover on ablation in the 2 catchments.

#### General comments:

The comparison exercise undertaken is an interesting idea, as the north and south side of the range appear to differ in the occurrence of debris cover, if the 2 basins chosen

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are representative. It would be an interesting topic to explore the climatological and possible geomorphological reasons for this. The modelling approach is a good idea and although simple, seems appropriate for the limited dataset available. However this paper does not give sufficient details of either measurements, or analysis undertaken to be acceptable as a useful addition to the scientific literature on debris covered glaciers. The discussion lacks direction, in the form of a clear aim, and critical assessment of the findings – there is no real conclusion regarding why the incidence of debris covered ice differs in the north and the south. In addition, the whole article needs to be read by a native English speaker before being acceptable for publication, as the text contains repetition of many minor errors which are too numerous to list here, and the language used tends to be imprecise. Consequently, I recommend that the paper in its current form is not suitable for publication in TC, although the field data and modelling work could be publishable in the context of a paper with a stronger aim and glacio-climatological interpretation of the analysis.

Specific comments:

### Section 1

Specify the aims more clearly. Is the goal to understand why there are fewer debris covered glaciers in the south, or to specify the effect of debris cover on runoff in the north and south of the divide? It is not clear enough why it is of interest to compare these basins.

### Section 2

Back up this section with improved maps. Also the descriptions of the area and glacio-geomorphological features in it need to be made more precise and quantified where possible.

Some of the glaciers appear to have only very marginal debris cover. In maps 1 and 2 it appears to me that there is only 1 glacier in each image that have truly debris covered

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tongues, the remainder have some debris cover but only on the margins. What is the local geology difference that explains the difference in R mentioned in the conclusion?

Provide details of the 3 AWS's used in a table (location (x,y,z), types of sensors, height of each sensor, logger, logging interval, duration).

Debris temperatures were only measured in one glacier for 4 days. How many thermistors in Djankuat glacier? Where? How deep? What type of sensor?

### Section 3

Provide more details of images and maps used. Resolution and sources of previous maps? Error estimates of previously mapped areas? Error assessment of manually delimited glaciers from the SPOT images? Clarify reasons for using additional images in the southern catchment – I understand it to be due to cloud cover?

Paragraph starting line 11 p 437 does not belong here – reported observations of debris cover type should be in section 5 alongside the ablation observations.

### Section 4

The quality of the ablation measurements is not clearly explained. How often were the stakes measured, and how? Were the stakes in the naturally occurring debris thickness or were the plots prepared to a specified debris thickness?

Is 4 days of debris temperature monitoring sufficient to stabilise the profile after installation of thermistors?

### Section 5

The higher melt rates found at longer time scales may be due to the progressive warming of the debris as the melt season progresses –justify attributing this to washout of fines and resettling alone.

What was the quality control criteria of ablation measurements used? Were any

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points/measurements discarded and, if so, why?

I would expect degree day factors for different debris thicknesses to conform to the shape of previously published curves of the melt dependence on debris thickness i.e. an increase at thin debris thicknesses followed by an asymptotic decline, but it does not. This needs discussion and explanation.

## Section 6

As climatological parameters are used as explanation of the differences in ELA, a table characterising the climate conditions in each basin should be included (section 2). Also, drawing on meteorological explanations of differences needs to be somehow linked to the DDF's – which cannot take cloudiness etc. into account.

Explain acronyms of hydrological models listed as examples

## Section 7

How was the debris thickness surveyed? At how many points? Just at the 11 stakes It is interesting that the critical debris thickness is quite thick, while the thickness of 50% reduction is lower than previously published estimates.

Figures:

Need a general orientation map of the station locations relative to the 2 glacier study valleys, with frequently named glaciers indicated by letter. Need to include station and stake locations one of the map options within the paper.

It's a personal preference but I suggest improving the quality of the graphs, excel does not produce especially elegant graphs and it would be a simple task to make the layout and appearance of the graphs much better.

Fig 1: show where the site is on the inset map; add stake locations as points on the studied glacier

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Fig 2: show where the site is on the inset map; add stake locations as points on the studied glacier

Fig 3: what is the purpose of this graph? If it is to convince the reader of the theory of precipitation events lowering the temperature on the glacier, then known precipitation events should be marked on the graph

Fig 4 and 5: scale should stop at 4500; better as 2 panels(a and b) alongside the current figure 5; give area units as square kms; a line without markers would look cleaner in my opinion; do you even need to show the catchment hypsometry?; excluding the clean ice glaciers from the southern catchment may have skewed the elevation of maximum ice cover

Fig 6: not really needed, as numbers are so few, these can simple be listed in the text

Fig 7: not a clear figure – I am surprised a the irregularity of the values obtained; need inset blow-up of thin debris cover portion of graph; I suggest linking some of the points with lines to improve legibility.

Fig 8: label the data collected in this study as ‘this study’; need inset blow-up of thin debris cover portion of graph; I suggest linking some of the points with lines to improve legibility

Fig 9: label the data collected in this study as ‘this study’

Fig 10: end the x axes at 3300m to eliminate unused space

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Interactive comment on The Cryosphere Discuss., 5, 431, 2011.

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