

## ***Interactive comment on “Impact of debris cover on glacier ablation and atmosphere-glacier feedbacks in the Karakoram” by E. Collier et al.***

**Anonymous Referee #1**

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Review of

Impact of debris cover on glacier ablation and atmosphere-glacier feedbacks in the Karakoram

by Collier and others

General

This paper uses a triple-zoomed high-resolution regional climate model to calculate the impact of debris cover the surface mass balance of glaciers in the Karakoram. A considerable effort has gone into quantifying and outlining glacier extent and debris cover, and putting it in the model grid. Debris cover is very heterogeneous so a simple distance-thickness relation was adopted, giving <0.5 m debris for the longest glaciers in

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the domain. Given the resulting large uncertainty in debris thickness, the present study must be regarded as a first order estimate of the impact of debris cover on glacier SMB.

Although the net effect is small (<10% reduction in ablation) interesting spatial patterns emerge. In addition, the lower atmosphere reacts to the altered energy exchange with the glacier/debris covered surface.

The paper is well written and concise. The science is original, understandable and interesting. The figures are of good quality and in the right amount. The paper may be accepted pending some minor revisions.

Major comments

Only a single summer season is simulated (2004). Show some time series from a lower-resolution atmosphere product that support the assertion that this is a representative summer.

Page 2266: Explain why both a minimum wind speed and a maximum flux reduction must be introduced to get good results; this fix is rather blunt and I would expect one correction should suffice. And why is using different stability correction not an option, for instance Holtslag and De Bruin (1998)?

Minor comments

p. 2261, l. 5: suggest: "...a fraction that is approximately twice as large..."

p. 2261, l. 12: the -> this

p. 2263, l. 2: magnitudes? Please specify the level of agreement.

p. 2264, l. 9: suggest: "... were rasterized on a grid with a resolution that was 50-times higher than the original grid spacing of the domain."

p. 2264, l. 28: refreeze -> refreezing

p. 2265, l. 27: cold/warm temperatures -> low/high temperatures (please correct

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through MS)

p. 2269, l. 11: LST has not yet been defined?

p. 2270, l. 21: MB -> CMB

p. 2271, l. 4: the ELA is defined over the mass balance year, so a 'focus on the ablation season' is no valid argument. The fact that you present a summer SMB profile then means that it is not allowed to call the SMB=0 elevation the ELA. Please adjust.

p. 2273, l. 5: "...in upwards of 800 additional melt hours in DEB compared with CLN." DO you mean melting at the debris-ice interface, or are you comparing surface temperatures here? In that case, the name 'melt hours' is somewhat strange, as the debris surface is warming up rather than melting.

p. 2273, l. 27 and further: over a melting ice surface, a convective mixed layer will not develop, rather a shallow, stable (glacier wind) layer. Please reformulate to reflect this.

Table 3: Unit for surface roughness length should be m, not m-1.

Figure 2 caption: multiplied -> multiplied

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Interactive comment on The Cryosphere Discuss., 9, 2259, 2015.