

Interactive comment on “Linking glacier annual mass balance and glacier albedo retrieved from MODIS data” by M. Dumont et al.

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1 Summary

This study introduces a new methodology to obtain broadband albedo of snow and ice surface on a 250 m spatial resolution from MODIS. The methodology consists of i) multi-spectral data fusion, ii) conversion of obtained radiance to spectral albedo using the anisotropy factor and estimates of incoming radiation, iii) conversion of spectral albedo to broadband albedo using a LUT or quadratic combination. The results of these methodology are subsequently compared with field measurements and terrestrial photography albedo maps and applied on the Saint Sorlin Glacier over the period 2000–2009 to i) understand the evolution in albedo over time and ii) relate albedo to variations

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in mass balance.

2 General comments

I think the authors provide a high quality paper that clearly illustrates the advantages of improved satellite data processing on the understanding of spatial and temporal variations in surface albedo. Although I think the paper is rather complete, I still have some comments related to some small changes/additions, that, in my opinion, can be performed to improve the paper.

3 Major comments

1. I think the methodology of inferring mass balance variations from variations in minimum albedo (and the comparison of this technique to the technique of Rabatel (2005) is now well hidden in the paper and when reading it it feels as a surprise add-on. I would recommend to add this method (and the comparison with Rabatel's method) to the methodology section 3 and clearly state it as an objective of the paper to see if mass balance variations can be derived from variations in albedo. This will make it more logical for the reader.
2. The proposed method and also Sirguy (2009)'s method are based on the assumption that each pixel represents identical surface areas over time. This is, however, often not true as the effective sensor footprint is often much bigger than 250-500 m (e.g., the work of Tan et al. (2006)). I propose some discussion on this is added to the error sources section.

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4 Minor comments

1. p2368,L2-5: a reference to the accuracy of the GDEM product will help the reader to understand the associated uncertainty
2. p2371,L7: I think it is helpfull if it is repeated very shortly how E_s and E_{diff} are derived, so the reader is not obliged to read earlier works.
3. p2371,L12 "seven spectral albedo": Typographical error?
4. p2376, last paragraph: it would be interesting to see the standard deviation or variance in terrestrial photograph albedo per MODIS pixel. This should illustrate the increased variance in albedo near the edges.
5. p2379,L20 + Figure 5: I understand the logic of plotting only composites of minimum albedo, but I think it would be good for completeness and clarity if you plot the actual observed albedo (e.g., in a semi-transparent color with fine lines) and the composites of minimum albedo on top of it (e.g., in an opaque color and in a more bold line type).
6. p2380,L15: $\sqrt{29}$, where does this square root come from?
7. p2380,L1 "are also indicated in Fig.6": are also indicated in Fig.6 as error bars?
8. p2381, L9 "close to the date": Can you give an indication on how close?
9. Fig.5: A color figure would be much easier to read.

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References

Tan et al. (2006) The impact of gridding artifacts on the local spatial properties of MODIS data: Implications for validation, compositing, and band-to-band registration across resolutions. *Remote Sens Environ*, vol. 105 (2) pp. 98-114.

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6, C1759–C1762, 2012

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