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The Cryosphere Discussions

Interactive comment on "Annual and interannual variability and trends of albedo for Icelandic glaciers" *by* Andri Gunnarsson et al.

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This paper presents the application of MODIS snow albedo products to characterize the spatial-temporal variability and trends of glacier albedo in Iceland. The albedo data are derived from the M*D10A1 products after interpolating missing data due to the frequent cloud cover. The topic is interesting since Icelandic glaciers are frequently exposed to volcanic ashes deposition causing large albedo changes and thereby modulating their response to climate forcing (Schmidt et al. 2017). A strength of the study is the extensive in situ dataset that was used to evaluate the MODIS products (20 AWS). My main concern regarding this study is the apparent lack of novelty with respect to previous works by Möller et al. (2014) and Gascoin et al. (2017) who also studied the albedo changes over Icelandic glaciers. Some figures in the manuscript provide similar

information as Gascoin et al. (2017).

In particular the introduction does not clearly state why it was needed to go beyond previous studies by Möller et al. (2014) and Gascoin et al. (2017). I see some differences that could indeed justify this new study. The authors used M*D10A1, while the latter studies used MCD43A3. However, the authors should strengthen this part of the manuscript by providing a detailed comparison of both products. As it stands, the results cannot be compared to those reported by Gascoin et al. (2017) mainly because the authors computed the RMSE and correlations at the monthly time step whereas we used daily values (see L245 "The comparison presented here is in fact similar to previous work on Icelandic glaciers by Gascoin et al. (2017) where the MCD43A3 was evaluated with RMS errors ranging from 8–21%."). Looking at Tab B1 it seems that M*D10 products are more accurate than MCD43?

Also, an important aspect is that MCD43 provides albedo over all land masses, whereas M*D10A1 provides only albedo of the pixels that are detected as snow-covered. This can be an issue in Iceland where large regions of glaciers may not be detected as snow due to the tephra layer. This issue should be investigated to make sure that the MCD11 product is not interpolating the albedo of clear-sky, snow-free pixels.

The trends should be masked or marked where MK test is not significant (Figure 10).

The improvements in MCD11 albedo with respect to the original product are very small (about 0.01 RMSE, Tab.2). In addition it is indicated (L181) that the thresholds for outliers rejection were manually adjusted so the conclusions remain limited to this study. The main benefit of MCD11 is rather that it is a gap-free product which facilitates the utilization of the data.

The authors indicate that a motivation of their work is the integration of this albedo product in operational snow melt runoff model. It would be useful to have more background information on this aspect. What albedo is currently used by Landsvirkjun or

other agencies? Is the developed product compliant with operational context if there is a lag of at least 5 days before updating the albedo (since temporal interpolation is based on a 10 days window)?

Minor comments

L31 in an maritime climate

L34: Seasonal glacier melt : what does it mean: seasonal snow and ice melt from the glacier area

L41: are

L93: this paragraph gives me the impression to come out of the blue. The objective should be more clearly linked to the literature review and identified knowledge gaps.

L153: "Daily averages" is not the correct wording if it refers to of hourly albedo values. I understand from the above paragraph that the daily albedo was in fact calculated from daily sums of incoming and reflected radiation (which is recommended to reduce measurement noise).

L168: what is a "median based statistical rejection of outliers."

L173: I don't think you need these references to justify this general statement.

L184: these pixels are not unclassified, since they are classified as cloud.

L185: this approach is very similar to our algorithm for cloud pixels interpolation in MOD10 products (Gascoin et al. 2015). We used the same predictors. It should be cited if it has inspired your own algorithm.

L188 Correspondingly reads a bit odd here

L191 "monthly, basis"

L204: The calculations were

L215-220 the whole paragraph should be removed (it is method, not results)

L246: results are not directly comparable (daily vs. monthly) (see my main comments)

L253: "indicating high sub-pixel albedo variability" This is a bit vague and unexpected comment since large areas of Icelandic ice caps have a rather homogeneous surface (in comparison with Alpine glaciers for example). We studied albedo subpixel variability from Landsat data to explain the discrepancy between AWS measurements and MODIS retrieval. L273 experienced as an smoothing

Fig 3: a similar figure can be found in Gascoin et al 2017

Fig 4, 6, 7: rainbow colormaps are not recommended (see e.g. https://www.nature.com/articles/519291d)

Fig 6: the figure does not display correctly on my computer, I suggest to replace it by a bitmap (raster) version

L440: this sentence should be removed or reformulated since there is no information on glacier mass balance in this study

L462: Do you mean when MODIS will stop operating? Note that the successor of MODIS is rather VIIRS.

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