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Interactive comment on "Spring snow albedo feedback over Northern Eurasia: Comparing in-situ measurements with reanalysis products" *by* Martin Wegmann et al.

Anonymous Referee #1

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Summary

This study evaluates snow albedo feedback (SAF), its components, and their underlying physical processes, using in-situ observations and two reanalysis systems. The analysis and results are well motivated and presented. My biggest concern is that important methodological details (for example the configuration of the ERAI-LG simulation) are omitted from the discussion, and some key findings are not described in sufficient detail, making it challenging to evaluate their impact. My assessment is that the work is sufficiently novel and interesting to warrant publication, but only after the authors address some important comments and revisions, described below.

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Discussion paper

Comments

L166: It is not clear whether the authors themselves performed the ERAI-LG simulation, or if this is an available reanalysis product from ECMWF? If the latter, please provide a reference. If the former, please provide much more information about how the experiments were configured and performed. This is pivotal to be able to assess whether the differences between ERAI-L and ERAI-LG are, in fact, explained by the land cover, and not some other confounding variable(s).

L197: by "attributed to ocean areas" I assume that the authors mean that they were coastal sites, and that the predominant land cover type in the corresponding ERA grid cell was ocean. Is that correct? Perhaps a clarification is required here.

L210: Given that observational in-situ data are available 1964-2015, and reanalyses are reliable at least over the satellite era, some justification is required here for why the period 2000-2013 was selected for the study (especially since 2009 data are missing almost everywhere, so n$\sim$13).

L232: Is there any sensitivity to the grid cell extraction method? For example, another approach would be to use a "nearest-neighbor" remapping; would this change any answers?

L253: The use of a local T2m is non-standard, and does not correspond to the feedback quantification model by Cess and Potter 1988. Perhaps the authors could offer some explanation here, and a description of what impact this change has on the results, and their interpretation?

L259: Surely a major limitation of estimating alpha_land using MAMJ when Sc=0% is that there are many locations for which Sc is always > 0 in MAMJ. What do the authors use for alpha_land in those cases? And how much "more realistic" do the authors find that using MAMJ is, compared to August? My suspicion is that the values should be very similar.

L289: Perhaps the authors have some additional evidence (spatial maps, for instance) to support the claim that the higher correlation for MERRA2 is due to aerosol deposition? If so, then I think it needs to be shown, because on its own Figs.2c-d do not really allow us to draw any meaningful conclusions about physical processes. Also, on L396 the authors state that it is the vegetation schemes in MERRA2 and ERAI-L that decrease the snow albedo; is this contradictory to the point about aerosol deposition?

L306: The issue of grid vs point comparisons is a very common problem. I wonder if anyone has attempted to use spatial interpolation (e.g. kriging) on the 40+ station observations to produce a "gridded" snow depth product?

L308: I am not sure where the evidence is presented to support the claim about snow-free albedo?

L399: I am confused by Figs.4-5. In Fig.4b it is shown that the mean SNC term (alpha_snow - alpha_snowfree) is similar for the stations and ERAI-LG, and in Fig.4f the mean alpha_snow values are also similar. Yet, in Fig.5a, the alpha_snowfree values are hugely different (for which I could find no explanation), so how can Fig.5a be correct, and yet still produce similar SNC in Fig.4b?

L402: If the observed snow-free albedo is similar to that for grass, why does the ERAI-LG simulation still do so badly in this quantity (Fig.5a)?

L424: The sentence ending "overestimated complete snow cover albedo cancel each other out." seems to be highly important; however, it was not clear which panels of Fig.4/5 are supposed to show this cancellation? Also, what is "complete snow cover albedo"?

Supplement Figs.5-6: I recommend centering the colorbar labels in the bins, so that it is clear which color corresponds to which vegetation type.

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