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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 #2

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Wegmann et al. use a collection of Russian station data to evaluate snow albedo feedback (SAF) in several reanalysis products. The authors find that SAF from in situ data is stronger than that of MERRA2 and ERA-Interim. This is largely as a result of station data being recorded in vegetation clearings. To account for this discrepancy, a simulation of ERA-Interim with prescribed grasslands is generated and shows much better agreement. SAF from the reanalysis products is found to be slightly stronger than satellite-derived averages obtained by prior studies, due to the high-latitude domain used here. There are only a handful of SAF estimates from observational sources, mainly satellite-derived, so the use of new datasets is encouraged. This analysis is of interest, well organized, and will be a useful contribution to our understanding of

regional SAF after some minor issues are addressed.

General comments:

1) The derivation of total SAF differs slightly from prior studies, and although it won't drastically impact results, a comment on the reasoning behind this should be added. Motivating studies (Fletcher et al., 2012; Fletcher et al., 2015) calculated NET SAF as independent of SNC and TEM (whereas here NET = SNC+TEM). Instead these components are calculated to show that they can explain most of NET. Also, note that Fletcher et al. (2015) found that the additivity of SNC and TEM was not well satisfied on regional scales, perhaps due to observational uncertainty.

2) The article is difficult to follow at times because of readability issues and typos. Several examples are listed below.

Specific comments:

Abstract: A comment should be added regarding the difficulty of comparing point and gridded data. Similar to what is on L579-582.

L58: remove "the" before Arctic warming.

L60: remove "of the global warming signal".

L63: Pithan and Mauritsen 2014 (Nature Geoscience) would be a good citation to add here.

L66-68: awkward wording, please address.

L69-70: change to ". . .an initial warming is strengthened over time. . .".

L72: change to "Snow can cause such a feedback because in its absence the surface absorbs more . . ." or similar.

L74: remove "This".

L89: add "between models" after SAF variability.

L97: change “an” to “a”.

L93-104: clarify that these studies are referring to the average SAF across the NH extratropics, not the entire NH.

L107: define CMIP at first use.

L109: “From a large set of SAF estimates for individual models” - reword this.

L111-117: Fletcher et al. (2015) only used the different snow cover and temperature datasets from reanalyses, not their albedos. This is an important difference from the current study.

L119: Satellite products of what? Snow cover, temperature, albedo, etc. Please clarify.

L163: change “local” to “site measurements” or similar.

L178-184: awkward wording – repetitive use of "diagnose".

L191: I don’t think Solar Radiation and Radiation Balance Data should be capitalized here.

L194: Fix “containes”.

L194: Remove “Of these”.

L197: change “to ocean areas, so” to “as ocean areas, meaning”.

L201: change to snow cover fraction.

L210: Why limit the study period to 2000-2013? I assume this may be related to the availability of satellite (i.e. MODIS) data used in previous studies, but this should be explicitly stated.

L218: Change to “for the MAM period and for 3 stations also June values are missing” to “during MAM and at 3 stations in June.”

L230-231: Some comment on the resolution of the reanalyses is needed, and the

difficulties associated with a point to gridbox comparison.

L235: Change “for the long-term climate change signal are highly correlated” to “under long-term climate change are highly correlated”.

L240: fix “decreaseof” and “theearlier”.

L241: change “exposition” to “exposure”.

L256: See general comment #1, and address this.

L264: Can you provide a brief comment on what those previous studies found?

L265: “We” shouldn’t be capitalized.

L267: remove “involved in the SAF computations”.

L278: change to “better represents”.

L289: Is there any evidence linking this directly to aerosols? Why isn’t there a larger disparity between MERRA2 and ERAI-land in Fig 2a?

L294-295: repetitive, remove “Considering the representation of day-to-day variability”.

Figure 3 caption: should say “station data”. Also, I’m not sure what the difference is between TEM and snow melt sensitivity here. On L252 it is stated that TEM will be referred to as snow melt sensitivity. Is this the snow cover sensitivity (snow cover change per degree warming)?

L335-343: The similar nature of these results implies that the vegetation types at most of the sites must be similar, can you comment on this?

L353: Change to “put the station data in context”.

L357: “Changing the vegetation to short grass adds about 1K to the responses” – the correct interpretation is that it adds an additional 1% albedo decrease per degree of warming.

Fig 5a: Why doesn't the ERAI-LG case have a snow-free albedo that resembles the stations if 0.2 is the albedo of grass?

Fig 5e: This looks the same as Fig 4f, is it? Why is one called "snow albedo" and the other "mean albedo"?

L424: "For ERAI-LG, the effect of the underestimated snow-free albedo and overestimated complete snow cover albedo cancel each other out" I don't understand what this is referring to, please clarify. Wouldn't an overestimated snow albedo and underestimated snow-free albedo create a larger albedo contrast, and thus stronger SAF?

L426: remove "season"

L450: change "for both" to "when it comes to"

L504: remove "properties"

L506: remove "the"

L515-518: I find it unlikely that day-to-day variability in albedo is strongly influenced by changing vegetation, as these processes occur on much longer timescales. Are you referring to the different vegetation states between the tower location (i.e., in a clearing) and the larger grid cell (mixture of vegetation types)? If so, please clarify, as this would impact the maximum surface albedo and thus the variability. Also, I don't see "flooding" as a major factor for spring albedo, clarify or remove this.

L536: Fix "databecause"

L550: Should say "CMIP3/CMIP5".

L579-582: I think this is a very important statement that should be emphasized in the abstract.

Figures:

All Figures: Increase the font size for axis labels.

Figure 1: I recommend adding some latitude/longitude labels.

Figure 2: Make the axis range for correlation plots the same (c,d) to allow for easier comparison.

Figure 7: Caption says "Figure 4", correct this.

Supplementary Material:

Table 1: Capitalize "lon" in the table heading.

Figure 5-6: The text on these figures is very grainy, please fix.

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