

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

Martin Wegmann et al.

martin.wegmann@univ-grenoble-alpes.fr

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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.

C1

A: Thank you very much for your comment. Indeed the difference to previous computations was not highlighted, so we added a comment and a motivation about that in Chapter 3. See line 238 in the new document.

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.

A: We added a similar statement to the abstract. See line 31 in the new document.

L58: remove “the” before Arctic warming.

A: Removed

L60: remove “of the global warming signal”.

A: Removed

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

A: We added this citation to the references. See line 63 in the new document.

L66-68: awkward wording, please address.

A: Thanks for the comment. We simplified the wording. See line 68 in the new document.

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

A: Changed. See line 70 in the new document.

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

C2

A: Thanks for the comment. We simplified the wording. See line 72 in the new document.

L74: remove "This".

A: Removed

L89: add "between models" after SAF variability.

A: Added. See line 89 in the new document.

L97: change "an" to "a".

A: Changed. See line 96 in the new document.

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

A: Clarified. See line 88 and following in the new document.

L107: define CMIP at first use.

A: Defined. See line 106 in the new document.

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

A: Reworded. See line 108 in the new document.

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.

A: Highlighted this difference. See line 117 in the new document.

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

A: Clarified. See line 120 in the new document.

L163: change "local" to "site measurements" or similar.

C3

A: Reworded. See line 163 in the new document.

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

A: Reworded. See line 193 in the new document.

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

A: Corrected. See line 205 in the new document.

L194: Fix "contains". A: Corrected. See line 208 in the new document.

L194: Remove "Of these".

A: Removed.

L197: change "to ocean areas, so" to "as ocean areas, meaning".

A: Reworded. See line 211 in the new document.

L201: change to snow cover fraction.

A: Reworded. See line 216 in the new document.

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.

A: This circumstance is now explained in line 225 in the new document.

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."

A: Thanks for the comment. We addressed this issue. See line 233 in the new document.

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

C4

difficulties associated with a point to gridbox comparison.

A: We added comments on the grid box comparison. See line 248 in the new document.

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

A: Reworded. See line 255 in the new document.

L240: fix “decreaseof” and “theearlier”.

A: corrected. See line 259 in the new document.

L241: change “exposition” to “exposure”.

A: Deleted.

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

A: Thanks for the comment. We addressed this issue. See line 259 in the new document.

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

A: Added a brief comment. See line 296 in the new document.

L265: “We” shouldn’t be capitalized.

A: Corrected. See line 294 in the new document.

L267: remove “involved in the SAF computations”.

A: Removed.

L278: change to “better represents”.

A: Corrected. See line 311 in the new document.

C5

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?

A: Thank you for this thoughtful comment. We investigated this relationship now a little bit more in detail. You can find the new information in line 322.

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)?

A: We clarified the context and added additional information to the explanation of what we mean with snow melt sensitivity. See line 274 in the new document.

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?

A: Yes, we expect them to be WMO standard, that means observations are done over cut grass everywhere. See line 164 in the new document.

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

A: Changed. See line 389 in the new document.

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.

A: Reworded. See line 394 in the new document.

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?

A: Thanks for the comment. We now explain this feature in line 573.

C6

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

A: Thanks for your comment. Mean albedo is averaged over both, snow and snow free 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?

A: Thanks for the comment. It was very unclear before, we rephrased and clarified this point. See line 460 in the new document.

L426: remove "season"

A: Removed.

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

A: Changed. See line 485 in the new document.

L504: remove "properties"

A: Removed.

L506: remove "the"

A: Removed.

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.

C7

A: We removed the mentioning of vegetation and flooding. See line 554 in the new document.

L536: Fix "databecause"

A: Corrected. See line 572 in the new document.

L550: Should say "CMIP3/CMIP5".

A: Corrected. See line 582 in the new document.

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

A: Thanks for the comment. It is now highlighted in the abstract.

All Figures: Increase the font size for axis labels.

A: We increased the font size for axis labels.

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

A: We added latitude longitude labels.

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

A: We adjusted the axis range.

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

A: Corrected

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

A: Corrected

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

C8

A: We don't know how that happened, but we tried to fix it now for the new version.

Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2017-266>, 2017.