

The Cryosphere Discuss., referee comment RC2
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Comment on tc-2021-281

Álvaro Ayala (Referee)

Referee comment on "Temporal stability of long-term satellite and reanalysis products to monitor snow cover trends" by Ruben Urraca and Nadine Gobron, The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-281-RC2>, 2021

Urraca and Gobron investigate the long-term temporal stability of snow-related variables produced by two global climate reanalysis products (ERA5 and ERA5-Land) for the period 1950-2020 (1980-2020 in the case of ERA5-Land) and the weekly Snow Cover Extent (SCE) charts produced by NOAA Climate Data Records (CDR) for the period 1966-2020. The authors compare these products against a set of 470 ground stations over the Northern Hemisphere. Temporal stability is investigated by calculating the bias in snow depth and snow cover duration of the products at each ground station. The authors found that the assimilation of new observations and satellite products improves the accuracy of snow variables of the reanalysis at the expense of introducing step discontinuities in the long-term time series, or, in the case of NOAA CDR, producing an artificial positive trend since 1990. Finally, the authors also use the ground stations data to update snow trends over the North Hemisphere.

I think that this a very good article, the research questions are clear and interesting for the scientific community and The Cryosphere. Results are well presented, and a clear message is provided in the Conclusions. The paper is a bit difficult to follow because it uses several data sets and methods, but overall, I think that the authors did a very good job in organizing the text. My recommendation is to accept the article with minor revisions. I have several short comments that could help for improving clarity.

COMMENTS

- Temporal stability. I have some suggestions to improve the use of this key term:
 - I think that adding the word "temporal" would make the title more informative "Temporal stability of long-term satellite...".
 - Please provide a formal definition of temporal stability in the Introduction. Paragraph 5 could be a good option. In the glossary of GCOS (2016): "Stability may be thought

of as the extent to which the uncertainty of measurement remains constant with time. In this publication, values in Annex A under "stability" refer to the maximum acceptable change in systematic error, usually per decade." The thresholds defined by GCOS could be written next to the chosen definition.

- As the authors don't use data from Canada it might be good to comment about the limitations of the analyses of snow trends in the Northern Hemisphere.

SUGGESTED TECHNICAL CORRECTIONS

2: The acronym EO is not used again in the article.

2: I would remove the parenthesis.

3: "Temporal stability is essential but..." Essential for what?

5: "some longest satellite and reanalysis products" but NOAA CDR was not originally a satellite product, or yes? Maybe you can find a more general term than satellite?

11: lack of direct data assimilation

11: at the expense of

14-15: This sentence is a bit confusing. I would suggest using here the "trade-off" sentence of the conclusions.

25: What variable would be "snow-albedo feedback" with units $W m^{-2} K^{-1}$? Can you be more specific?

32: What do you mean by "changing vegetation"? Do you mean seasonal changes? Does it affect the spatial representativity of ground stations?

34: What is the source for the 11 long-term stations in the Southern Hemisphere? In Chile and Argentina there are several snow stations with long-term data, although not with a very high frequency (Masiokas et al., 2006).

46: On the other hand, microwave-based...

74-75: Please explain what data are used to update the trends.

98: "consistent with" wouldn't be more precise "derived from"?

101-102: "but snow..." can be deleted as is a repetition from the previous paragraph.

141: series.

159: "The coarse products evaluated" this is a bit unclear as it seems that you are evaluating the reanalysis. Please replace by something like: "The coarse pixels correspond to that of ERA5 and ERA5-Land"

160: Why did you choose 2015?

184: 50 or 5%?

185: in the middle of these values

226: affected by the station removal.

233: $SSE \leq 4.01$

252: RIHMI instead of RIHIMI. There might be more typos with this acronym, please revise.

257: lack of direct data assimilation

274: In what figure can we see the positive trend?

282: Delta bias was not defined as percentual. Please add the word "percentual" or similar. What would be the base for that percentage? Bias before?

361: ...1950-2020 using data from the ground stations.

424: The acronym NWP has not been introduced

Figure 2: Please add Snow Cover Fraction and Snow Depth in the caption.

Figure 7: Why not showing the map of MAM in b?

Figure 9: Please add in the caption that the trends are computed with the ground data.

Sometimes supplementary figures are named AX and sometimes SX.

Figure A2: Is panel b RIHMI-NOAA CDR correct? It seems that there are very few valid observations. These data the same as those used in Figure 7a, aren't they?

Table 2: According to line 170, the units of SSE and SSB should be days/year.

References:

Masiokas, M. H., R. Villalba, B. H. Luckman, C. Le Quesne, and J. C. Aravena (2006), Snowpack variations in the central Andes of Argentina and Chile, 1951-2005: Large-scale atmospheric influences and implications for water resources in the region, *J. Clim.*, 19(24), 6334–6352, doi:10.1175/JCLI3969.1.