RC2: 'Comment on essd-2021-249', Kristian Förster, 22 Nov 2021

Review of:

“The S2M meteorological and snow cover reanalysis over the French mountainous areas, description and evaluation (1958 – 2020)”

by Matthieu Vernay et al.

The authors would like to thank Kristian Förster for his remarks and suggestions to improve the quality of this manuscript.

This data paper presents a new snow cover reanalysis dataset for mountain areas in France. In contrast to other reanalysis products, the data is prepared for elementary areas, referred to as massifs. Delineating these elementary elements is based on the assumption that meteorological forcing is similar across each massif. For each of them, elevation bands and aspects are considered separately in order to summarize computational time and data. A set of models is used to downscale atmospheric reanalysis data (SAFRAN) and to predict snow cover (e.g., with Crocus) in the historic period 1958-2019. The paper comprehensively evaluates the accuracy of the data set (compared with station data), starting with meteorological data. Consequently, snow depth is evaluated. Finally, limitations are discussed in a well-balanced way, acknowledging uncertainties inherent in data and methods. I believe that this dataset is of great value for other researchers and I would recommend to publish this manuscript in ESSD, which is an ideal journal for this kind of research (data). I see only a few minor points that could be considered before publication:

General comments:

- Besides snow depth, snow cover duration could be a very important quantity. It would be great to have another time series chart, showing how snow cover duration evolved over time (similar or to or as a sub-panel in Figure 5). It would be also interesting to see whether observed trends in snow cover duration are reproduced by your reanalysis (as addressed by Reviewer #1). Moreover, this would also demonstrate how the dataset could be used by others.

We thank the reviewer for this suggestion, we added a 5th sub -panel in Figure 5 showing the temporal evolution of the simulated snow cover duration (SCD). The evaluation of this simulated SCD using surface observations is difficult since there are very few observations of SCD available over long time periods (most snow depth observations are carried out in ski resorts and stop before the total melting of snow and are thus useless in terms of SCD). Lopez-Moreno et al., 2020 carried out such an evaluation over the Pyrenees for the 2000–2017 period using MODIS products of SCD (Gascoin et al., 2015). Simulated SCD exhibits a good correlation with MODIS SCD (0.96) with a typical error of 20 days. The use of MODIS observations provides a comprehensive spatial coverage of snow cover duration observations but only for a short recent time period, preventing the evaluation of SCD long-term trends. However, work in progress at the CESBIO laboratory intends to use LandSat and SPOT archives to improve the length of time series back to 1985. Therefore, a more comprehensive evaluation of the trends of S2M snow cover durations will be done as soon as this product is available and could be expanded with lower resolution products such as Hüsler at al., 2014. This perspective has been mentioned in the revised manuscript in section 5.2 (Line 536).

- The definition of massifs as elementary elements for computation is a very interesting methodological approach of the paper, which could be interesting for future research. I found the description of this approach, however, rather vague. Here, I would expect a more comprehensive review of literature (e.g., summarizing areas with similar snow coverage is not so new, see, e.g., snow cover units etc.). Moreover, I was wondering how the variability of one of the massifs could look like. Maybe you could add a figure (appendix, supplement?) that shows the areas that are summarized in terms of aspect, elevation etc.

We added a review of literature of the semi-distributed modeling approach in Section 2.1. However, the definition of the massifs contours by Durand et al., 1999 was not based on an objective classification methodology but on an expert analysis of topography, difficult to describe in details (or to reproduce in another context).
Following the reviewer recommendation, we now illustrate the simplification of topography inside a massif by a new Figure 17 in appendix B.

- When reviewing the nc files (meteo and snow, respectively), I was a bit confused about the dimensions: In the allslopes datasets, time series are provided for each number_of_points. Indeed, it would be possible to check for each number the combination of terrain characteristics (slope, elevation) but I couldn't find any further information (sorry, if I missed something). Even the shape files do not include any relation to the numbers and their associated terrain characteristics. I think that this could be better explained in the appendix / the repository. For users just interested in, say, south heading slopes in massif #1 at elevation above 2000 m, it would be helpful, if they could easily retrieve the relevant number(s).

We thank the reviewer for testing the access to the data set and to feed us back the difficulties he encountered. We added more details to the description of the data set. In particular a « metadata » section (section 3.1.1) describes the practical way to access specific simulation points and the new Table 2 summarize the metadata which were previously not described. In addition section 7 (data access) has been extended to guide the data downloading.

Specific comments / Technical comments:

- There is no reference to Table 5

The missing reference to Table 5 has been added on line 282 (Section 3.1.3)

- Please rewrite "precipitations" in the manuscript (the plural doesn't make sense in my opinion)

The word precipitation is now singular every time it appears, we thank the reviewer for pointing out this typo.

I am looking forward to your final revised paper!

Best wishes.

Gascoin, S., Hagolle, O., Huc, M., Jarlan, L., Dejoux, J.-F., Szczypta, C., Marti, R., and Sánchez, R.: A snow cover climatology for the Pyrenees from MODIS snow products, Hydrol. Earth Syst. Sci., 19, 2337–2351, https://doi.org/10.5194/hess-19-2337-2015, 2015.

Hüsler, F., Jonas, T., Riffler, M., Musial, J. P., and Wunderle, S.: A satellite-based snow cover climatology (1985–2011) for the European Alps derived from AVHRR data, The Cryosphere, 8, 73–90, https://doi.org/10.5194/tc-8-73-2014, 2014.