

## Reply to R2

This paper discussed a new spatially distributed Italian snow reanalysis through combining remote and in-situ measurement techniques with the already existing Snow Multidata Mapping and Modeling system (S3M). Evaluation of the reanalysis through comparison with separate in-situ (snow course) and remote sensing products (C-SNOW) showed reasonable error within the produced snow products including snow depth, snow water equivalent, and snow density. The output products showed agreement with inter- and intra-annual accumulation and ablation trends in various climatological regions throughout Italy where different snowpack characteristics exist.

The reanalysis and associated paper(s) are novel and show significant potential for use with climatological analysis and monitoring of the Italian snowpack, and the overall grammar and organization of the manuscript were good with minimal issues. However, revisions are required to improve the manuscript before it should be accepted to ESSD.

We appreciated all these suggestions, which we will welcome in the revised version of the manuscript. Please see below for our detailed response and planned changes.

**It would be useful to have analysis of average error of snow depth, SWE, and density for each of the 10 homogeneous regions mentioned first on Line 146 and shown in Figure 3a. Given the distinct geographical and climatological characteristics of each region and non-uniform distribution of the in-situ sites, regional differences in error may be expected that would be important for users of this data to understand. It would also aid in the constraint of the relative importance of SWE in each of the basins discussed in Section 4.2 and Figure 10.**

Changes to manuscript: We agree with this comment and we will provide this assessment. This is feasible using C-SNOW data, but we will also look for additional independent data points across the Italian Alps.

**Lines 115-116: Further information about these linear regressions should be presented. How were they derived and applied?**

Once all temperature data for a given hour are downloaded, data are organized by meteorological regions as dictated by the Italian Civil Protection (see the boundaries of these regions at <https://mappe.protezionecivile.gov.it/it/mappe-rischi/bollettino-di-vigilanza>, last access on November 3, 2022). For each of these regions, a region-specific hourly linear regression between air temperature and elevation is fitted, and then applied using the region's Digital Elevation Model to derive temperature maps.

Changes to manuscript: Part of the information above was already reported in the manuscript, but we will integrate it with the passage about distributing using a Digital Elevation Model. Per comments by Reviewer 1, we will also provide a climatology of air temperature lapse rates.

**Line 162-163 and Figure 3: It is discussed that SCA maps are not assimilated but are used to clip pixels that are snow free from snow depth maps. Figure 3 shows the SCA and snow**

depth maps individually but it would be helpful to have an additional panel showing the post-SCA clipped snow depth map to highlight the data that is being assimilated.

Changes to manuscript: This is possible and will be done in the revised manuscript.

**Line 1: “The” at the beginning of the sentence can be omitted.**

Changes to manuscript: Agreed.

**Figure 1. Further detail is needed in this flowchart. Specific information on the meteorological variables as discussed on Line 101 as inputs should be displayed.**

Changes to manuscript: Agreed. This will be done in agreement with similar comments by Reviewer 1.

**Line 147-148: “expert knowledge”. This doesn’t need to be exhaustive, but it would be nice to know what other primary conditions were considered in the expert knowledge.**

Changes to manuscript: We will add such details. In this regard, we aggregated SOIUSA regions based on a tradeoff between maximizing data points availability in each region and complying with expected climatology (e.g., differentiating inner-Alpine valleys from coastal, maritime mountain ranges).

**Lines 233-237 and Figure 4d: Distribution of root mean squared error in Figure 4d shows a right skew. As such, median should be used instead of mean.**

Changes to manuscript: Agreed.

**Line 284 and Figure 8b: Same as above. Data shows right skew and median should be used rather than mean.**

Changes to manuscript: Agreed.

**Line 353: Should be ‘1st’, not ‘1th’.**

Changes to manuscript: Agreed.

**Figure 3a: Add legend.**

Changes to manuscript: Agreed.

**Figures 2, 3, 4, 5, 6, 7, 9, and 10: Color blind-friendly color palettes should be implemented.**

Changes to manuscript: Agreed.

**Figures 2, 3, 4, and 8: Can’t see lat/long grid lines. Suggest changing to more visible color.**

Changes to manuscript: Agreed.

**Figures 2, 3, 4 and 9: Increase size of color bars/scales and add additional values.**

Changes to manuscript: Agreed.