Reply to R1

This paper employed an S3M model to blend multi-source in situ data and satellite observations to produce a spatially explicit and multi-year reanalysis of snow cover patterns across Italy at 500 m resolution. After validating with C-SNOW products, in situ measurements, and annual streamflow, this product has been proved effective, and could be potentially used in better understanding the contribution of snow on water resource management.

Despite of its significance, several issues still need to be resolved before a publication to ESSD. More detailed introduction about how to produce snow cover area from multi-source remote sensing images, and how to produce the reliable snow depth maps over the entire study could be sufficiently explained. In addition, it is suggested to add more indexes to validate the output snow estimates. Besides, the figures should be further refined so as to improve the overall presentation.

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.

Figure 1, the schematic of S3M was too simple, it is difficult to understand the key model/method, the data flow, and the output data.

Planned changes: We will rethink Figure 1 to better highlight key models and methods, as well as data flows.

P115-116, please provide the elevation gradient for air temperature when you interpolated in situ air temperature.

Planned changes: We will provide summary statistics of lapse rates in the revised manuscript.

P125-135, the snow covered area used in S3M model are produced from Sentinel 2, MODIS, and H-SAF initiatives. How did you produced snow cover area from Sentinel 2? How did you preprocess the MODIS and H-SAF data? Have you filled up the data gaps caused by cloud cover? How to fill the data gaps? How about the accuracy of the blended snow cover area products?

The workflow used in IT-SNOW is described at lines 126-139 and includes details on how SCA from Sentinel 2 was produced and its expected accuracy ("Sentinel-2 SCA is produced by operationally applying the Sen2Cor algorithm by ESA [...] and SCA maps were validated against snow depth sensors at national scale (not shown). Albeit lower in accuracy than snow-specific and high-resolution products like Theia (Gascoin et al., 2019a), Sen2Cor generally provides snow masks with accuracy above 80% (Main-Knorn et al., 2017)."). On the other hand, we did not report details on data sources and processing for MODIS and H-SAF products, for which we used the already available products as distributed by the respective data providers and did not execute any specific postprocessing. Besides mosaicking maps from multiple sources with different revisit times, no additional gap-filling for cloud coverage was performed (assimilation for cloud-covered pixels was thus foregone).

Planned changes: We will add the above to the manuscript.

Figure 2-4, and 8, please add scale bar and change the color of latitude and longitude grids from black to white or gray. It is difficult to identify detailed numerical value from current stretch effect of color bar.

Planned changes: We agree and will modify maps as requested.

P145-155, the in situ stations are primarily distributed in north areas in Figure 2 (a), so how did you produce the reliable snow depth maps over the entire study area? How about the overall accuracy of the daily snow depth maps over the entire 10 homogeneous regions? If some of the homogeneous regions are lack of snow depth data, how about the final output after running the S3M model for these regions?

As we specified at lines 152ff, if less than 10 snow depth data points are available for a given homogeneous region, then spatialization and thus assimilation *for that homogeneous region* is foregone. Regarding accuracy, we then specified that "previous evaluations of this multilinear-regression model in Aosta valley show that it successfully captures orographic gradients in snow depth with an average uncertainty of $\pm 10\%$".

Planned changes: We will further clarify the above and will look for additional, independent measurements of snow depth across the Italian Alps to perform a specific evaluation of snow-depth maps.

Figure 3, please add legend for (a); it is cannot see NaN class (in orange color) from (b); add scale bar for (a)-(c).

Planned changes: Agreed, we will modify figures as requested.

Figure 4, why did not show the results over the entire study area?

Histograms in panel (c) and (d) do refer to the entire study region, while panel (a) and (b) refer to the two subregions of Italy with deep seasonal snow cover (see Figure 9).

Planned changes: We will specify the above in the caption of Figure 4, but would like to keep the figure as it is now in this regard.

For the validation results, please also add Mean Absolute Error, Positive Mean Error, Negative Mean Error, and R Squared.

Planned changes: Agreed, we will include these metrics as requested.