

Reply to RC 1

Reviewer: I read with pleasure the very nice manuscript by Magnusson et al. on data from the Dischma catchment in Switzerland. This is one of the most important research catchments in snow hydrology in Europe, and the manuscript is a very welcome addition to the existing literature at it outlines and delivers a hydrologically complete dataset to pursue snow hydrology science using data from this catchment.

I have only some very minor comments and recommend the manuscript to undergo a round of minor revision.

Authors: Thank you for your positive feedback on our study and your valuable comments for improving the manuscript. Below, we have provided our responses to your comments and outlined the changes we have made to the paper.

Reviewer: Abstract, line 9: may be worth starting by mentioning the exact spatial / temporal resolution rather than saying “high resolution” (as later done at line 15).

Authors: We have added the requested information to the abstract.

Reviewer: line 18: “the most extensive spatial snow depth dataset”: I guess you mean from lidar and/or photogrammetry correct? This does not include reanalyses or satellite observations. Perhaps it would be good to mention this by simply saying “the most extensive spatial snow depth dataset derived using such techniques” (as you already mention lidar and photogrammetry before)

Authors: Added.

Reviewer: line 79: mention which is the latest inventory used?

Authors: The inventory is based on “Glacier Inventory 2016” described in Linsbauer et al. (2021). We have added this information to the manuscript.

Linsbauer, A., Huss, M., Hodel, E., Bauder, A., Fischer, M., Weidmann, Y., Bärtschi, H. & Schmassmann, E. 2021, The new Swiss Glacier Inventory SGI2016: From a topographical to a glaciological dataset. *Frontiers in Earth Science*, 22, doi:10.3389/feart.2021.704189

Reviewer: Section 3.1: I was a bit surprised to see a constant temperature lapse rate here. One could consider at least seasonal or monthly values. Why was this choice made?

Authors: The elevation difference between the 1.1 km COSMO grid and the 100 m grid, to which we downscale the weather forecasting model data, is less than 85 m for 50% of the 100 m grid cells and less than 203 m for 90% of the cells. Seasonal lapse rates in the European Alps, particularly in the

nearby Italian and Austrian Tyrol regions, vary from 4.5 K/km (December–January) in winter to 6.5 K/km (April–August) in summer, as reported by Rolland (2003). Based on these variations and our assumption of a constant lapse rate of 6.5 K/km, combined with the elevation differences described above, the error introduced compared to using a seasonally varying lapse rate is estimated to be less than 0.2 K for 50% of the grid cells and less than 0.4 K for 90% of the grid cells during the coldest months (December–January). During the remaining months, the estimated errors are typically much lower. Considering these findings in light of other uncertainties, such as those associated with precipitation, we find the use of a constant lapse rate for temperature downscaling to be reasonable.

Rolland, C., 2003: Spatial and Seasonal Variations of Air Temperature Lapse Rates in Alpine Regions. *J. Climate*, 16, 1032–1046, [https://doi.org/10.1175/1520-0442\(2003\)016<1032:SASVOA>2.0.CO;2](https://doi.org/10.1175/1520-0442(2003)016<1032:SASVOA>2.0.CO;2)

Reviewer: Section 3.4: what do you mean with “optimal assimilation scheme”? Also, I am a bit puzzled by the fact that all weather variables but precipitation are from COSMO, while precipitation comes from CombiPrecip. How is correlation and consistency between precipitation and other variables (e.g., relative humidity or incoming shortwave radiation) preserved?

Authors: We utilize an “optimal interpolation scheme” to assimilate ground snowfall data, a widely used data assimilation method for precipitation analysis. We have included citations in the manuscript to clarify that “optimal interpolation” refers to a specific data assimilation technique.

According to MeteoSwiss, CombiPrecip “provides the best estimate of ground-level precipitation distribution currently available for Switzerland” (<https://www.meteoswiss.admin.ch/services-and-publications/service/weather-and-climate-products/combiprecip.html>; last accessed 2024-11-19). For this reason, we selected CombiPrecip over the precipitation fields generated by COSMO. At the same time, COSMO incorporates the same radar data as CombiPrecip in its analysis by applying an approach known as latent heat nudging (Leuenberger, 2005). This technique adjusts atmospheric thermodynamic quantities to align predicted precipitation rates from COSMO with raw radar estimates. However, unlike CombiPrecip, latent heat nudging does not incorporate ground-level precipitation measurements. To summarize, the latent heat nudging scheme reduces differences between COSMO and CombiPrecip precipitation estimates. This leads to much reduced inconsistencies between precipitation given by CombiPrecip and other variables obtained from COSMO (e.g., relative humidity and shortwave radiation).

Leuenberger, D., 2005: High-Resolution Radar Rainfall Assimilation: Exploratory Studies with Latent Heat Nudging. Diss. ETH No. 15884, Research Collection, <http://hdl.handle.net/20.500.11850/48174>

Reviewer: line 182: “of” after “impact”?

Authors: Changed.

Reviewer: line 264: isn't this underestimation of precip a bit in contradiction with the previous statement of CombiPrecip providing unbiased hourly precip fields (line 121)? I am not surprised

about the potential underestimation at high elevations, so perhaps mention this in the description of CombiPrecip too (see also the discussion about the runoff ratio later)?

Authors: The evaluation of CombiPrecip was performed using precipitation gauges located on altitudes mainly below 2000 m.a.s.l. Thus, the quality of the precipitation product at high altitudes is more uncertain, while at lower altitudes the verifications show low biases. For better clarity, we have added a sentence informing that the evaluation of CombiPrecip was made using precipitation measurements with the majority located on altitudes below 2000 m.a.s.l.