The paper shows some nice comparisons between model results (ERA5-Land combined with SnowModel) and measurements from the Airborne Snow Observatory. Given the more discouraging conclusions about such models by Liu et al. (2022), I am surprised, but the analysis here seems robust. As the Conclusion notes, the analysis provides a viable method to estimate the water resources in the snowpack in areas with only an austere information infrastructure.

We would like to thank Jeff Dozier for taking the time to review our manuscript. We are confident that we can address every comment in a revised manuscript as explained below.

A few comments to improve the manuscript:

Line “06” (106?, bottom of section 2.1). The reported accuracy of SWE, <0.01 m, is ambitious. In their reports to the water agencies, ASO quotes a density RMS uncertainty of ±20 kg/m^3, but verification is based on snow courses and snow pillows, which are all on open, flat terrain and have their own uncertainties of SWE and depth.

Especially, you should note that ASO’s translation of snow depth to SWE depends on local measurements of density, typically snow pillows that have a depth sensor also along with snow courses where both SWE and depth are measured.

The reported accuracy on the 3 m snow depth products is 0.08 m(Painter et al., 2016) and from spatially intensive sampling, the reported accuracy for the 50m snow depth products is < 0.01 m (Painter et al., 2016, Figure 15). There are no published references for the 50 m SWE product. However, for a 1m deep snowpack and a conservative 10% uncertainty in snow density (20-50 kg/m3), we estimate the uncertainty of the 50m SWE products to be 0.02 - 0.05 m w.e.

Section 2.2.2: How are you getting snow albedo for the EnBal part of SnowModel? The ASO spectrometer can be used to retrieve values, but the combined ERA-Land/SnowModel uses the ASO data for validation, not as a driver. The melt rate and disappearance date of the snowpack are sensitive to albedo and consequent radiative forcing by light-absorbing particles (Painter et al., 2010).

We used the default values implemented in EnBal (Liston and Elder, 2006). The default value of the snow cover albedo is 0.8 in dry conditions. The default value of melting snow albedo is 0.45 under the forest canopy and 0.60 in non-forested areas.

Figure 3: The colors used to identify the lines in the plots are too indistinct. Perhaps combine color with line style to make the differences more obvious?

We propose to update figure 3 with this design

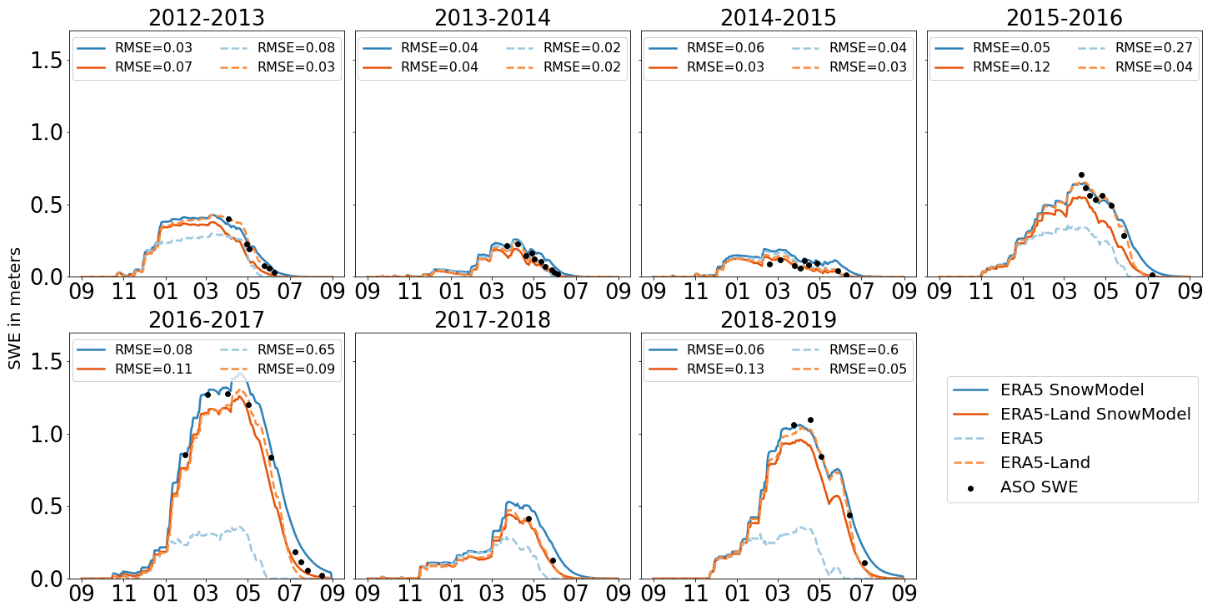

Figure 6: Label the axes. They appear to be UTM zone 11N coordinates, but the identification of the comparison in rotated text is confusing. At first I thought they had something to do with the y-axis.

We have added the axes labels as suggested.

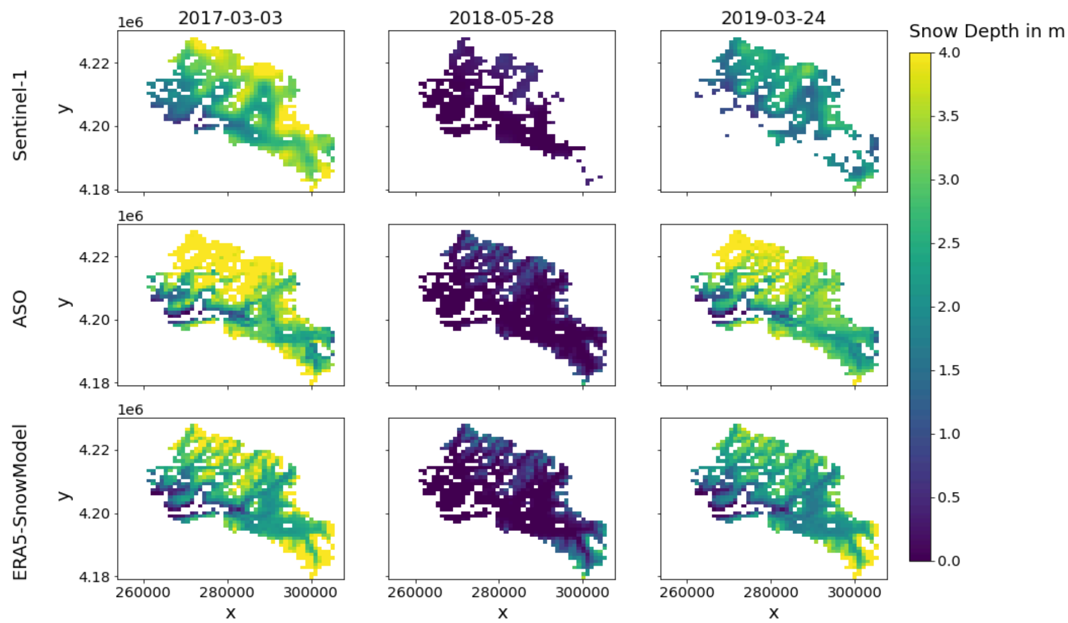

Figure 7 Line 47 in caption: recommend data “are” instead of “is”.

ok

Line 01 in the Discussion. The phrase “the ASO program has shown that useful SWE products can be derived from remotely sensed snow depth” needs a caveat, in that the ASO model of snow density is adjusted based on in situ measurements of snow density.

We agree with this relevant comment. We will change the sentence to “Although we are interested in SWE and not snow depth, the ASO program has shown that useful SWE products can be derived from remotely sensed snow depth when combined with in situ measurements and modeling of snow density”

Line 21-22 in the Discussion. Perhaps cite the Liu et al. (2022) analysis here?

We agree the Liu et al. (2022) analysis should be cited. We added the citation in the introduction : *However, reanalyses cannot be used directly to force a mountain snowpack model because the grid cell size is too coarse (approximately 30 - 50 kilometers for ERA5 and MERRA-2 respectively), which creates large biases in the computed SWE (Wrzesien et al., 2019; Liu et al.,2022).*

Line 21-22 in the Discussion refers to the meteorological forcings of ERA5 used in the study (while Liu et al. (2022) focused on direct SWE products from the reanalyses). We will rephrase with : *Another limitation is the fact that ERA5 meteorological forcings may not be homogeneous across the globe due to the uneven distribution of the assimilated observations.*

I agree with the final paragraph of the Discussion. The combination of ERA5, SnowModel, and Sentinel-1 provides a way to analyze the snowpack in mountains with only an austere infrastructure. There are uncertainties of course, but the methods could provide some information in areas where few data exist.

Support for Open Science: The manuscript should identify the sources of data and code availability used in the analyses. I could do my own searches, but statements like “from the Copernicus Climate Change Service (C3S) and can be queried via their application programming interface” (Line 92) could be phrased more helpfully.

We will add a reference to the tutorials of the Climate Change Service on how to retrieve the data: (Retrieving data — Climate Data Store Toolbox 1.1.5 documentation, 2024)

Similarly, the citation to “Copernicus Digital Elevation Model, 2023” (Line 96) is not in the bibliography.

The reference is actually the second item of the bibliography.

Some information is missing about the “code availability section” mentioned on Line 45.

We added a code availability section at the end of the paper.

References

Retrieving data — Climate Data Store Toolbox 1.1.5 documentation: https://cds.climate.copernicus.eu/toolbox/doc/how-to/1_how_to_retrieve_data/1_how_to_retrieve_data.html, last access: 27 June 2024.

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