The study demonstrates the potential of assimilating L-band InSAR-derived snow depth retrievals to enhance snowpack simulations. The results showcase improved spatial and temporal resolution in capturing snowpack properties, leading to more accurate predictions of SWE/Snow Depth compared to open loop or control simulations. The paper is well-written and grounded in established scientific principles. However, some aspects of the methodology and analysis could benefit from further elaboration to strengthen the overall validity of the findings.

We are appreciative of the Reviewer's comments. Below, we address the Reviewer's specific comments (in bold blue).

Major comment

The study utilizes L-band InSAR data to estimate changes in snow depth, which necessitates knowledge of snow density. As I understand it, the authors propose using an average density derived from bias-corrected ASO data. After evaluating the error associated with different time periods, they opt to employ this information to calculate incremental snow depth. By combining absolute ASO information with incremental L-band data, the data assimilation process is transformed into a traditional data assimilation problem. However, Equation 3, based on Liens et al. (2015), derives incremental SWE without requiring snow density but necessitates calibration of the parameter alpha. In the present form, I am not totally sure about the rationale behind assimilating Δz instead of ΔSWE. A clearer explanation of this decision would help to avoid potential confusion.

The use of InSAR data to estimate changes in snow depth requires snow density to estimate the bulk snowpack permittivity (Eq. 1). We do not use the snow density from ASO data, which is only available for specific dates. For InSAR retrievals, as stated in Section 2.3, we use average bulk snow density between two repeat pass dates from MSHM reference runs.

Eq. 3 provides a linear relationship between SWE and InSAR phase change, but still requires the calibration of parameter alpha (Liens et al. 2015). Besides, InSAR retrieval using this method will only provide change in SWE and to convert it into absolute SWE, we will need prior SWE measurements or snow depth and snow density. In general, snow depth measurements are more readily available (e.g. lidar or ground measurements) and also since we evaluate the model results with snow depth measurements from the lidar and ground-based measurements, we employ Eq. 1 for the estimation of snow depth change in this study. We have added the following sentences in the revised manuscript for clarification:

Ln 259 – "Also, InSAR retrievals only provide change in snow depth or SWE, so even for SWE changes, one would require prior SWE measurements or snow depth and snow density to obtain absolute SWE for assimilation. In general, snow depth measurements are more readily available (e.g. lidar or ground measurements) and models with data assimilation can provide close estimate of snow density, so this study also provides a framework for using InSAR snow depth change for data assimilation."

Specific comments

L101: NISAR mission was already introduced at L80

Corrected.

L112: This sentence is unclear due to the lack of context about the dataset. Please provide more details or consider removing it from the introduction.

The sentence has been revised for clarification.

"The InSAR retrievals with the common first flight date (but different repeat pass) with airborne lidar measurements of snow depth were used for …"

L 228-230: for which snow density the value of 69 cm is valid?

This was for $\rho_s = 300\ kgm^{-3}$. It has been added to the sentence.

Section 2.4 the source of the density estimation used to derived the snow depth from the InSAR data has to be clearly stated.

For InSAR retrievals, as mentioned in Section 2.3, we use average bulk snow density between two repeat pass dates from MSHM reference runs.

Section 3 To enhance the clarity and conciseness of the results, consider summarizing the key findings in a table (now only in the text as numbers). This will make it easier for the reader to compare different scenarios and draw conclusions.

We have added the following tables in the revised manusript.

Table 2: Coherence for treeless and forested environment for different retrievals.

	Period (days)	Coherence (HH)	
		Treeless	Forested
Feb 12-19	7	0.71 ± 0.15	0.65 ± 0.18
Feb 19-26	7	0.6 ± 0.18	0.5 ± 0.2
Feb 1-12	11	0.48 ± 0.18	0.47 ± 0.19
Feb 26 – Mar 12	15	0.49 ± 0.17	0.39 ± 0.18
Feb 1-19	18	0.47 ± 0.18	0.43 ± 0.19
Feb 1-26	25	0.46 ± 0.18	0.43 ± 0.18
Feb 1- Mar 12	40	0.39 ± 0.16	0.36 ± 0.17

Table 3: InSAR retrievals of snow depth change with different polarizations for Feb 1-12

Polariation	Coherence	% missing	Avg. Change (cm)
VV	0.51	8	-1.13
HH	0.46	11	-0.1
HV	0.39	36	2.61
VH	0.39	54	-2.67

Table 4: Root mean square error (RMSE) for modeled snow depth (cm) over treeless environments with reference to pit (IOP and TSD) and snow pole measurements.

	Pit	W1A	W1B	W3A
CTRL	35.2	17.6	21.2	27.2
OL	36.0	11.57	14.80	30.8
DA	18.3	8.1	21	20.8
DAU	18.0	8.5	22.2	19.2

L448 please revise the sentence

The sentence was revised.

"The OL run shows similar tendency as InSAR retrievals,"

L492 To enhance clarity, please provide a more detailed explanation of how the density value was determined. This will help to avoid confusion and strengthen the overall understanding of the methodology.

In this study, the average bulk density (depth weighted density) between two repeat pass dates from the reference MSHM model runs were used for the InSAR retrievals.

Code availability: Some of the links provided in the code availability section are not functional. I strongly recommend making the data and code used to reproduce the results openly accessible. This includes model outputs and InSAR-derived snow depth data. Given that many of the results in this paper were made possible by the open access nature of the data used, it would be beneficial to maintain this level of transparency and openness.

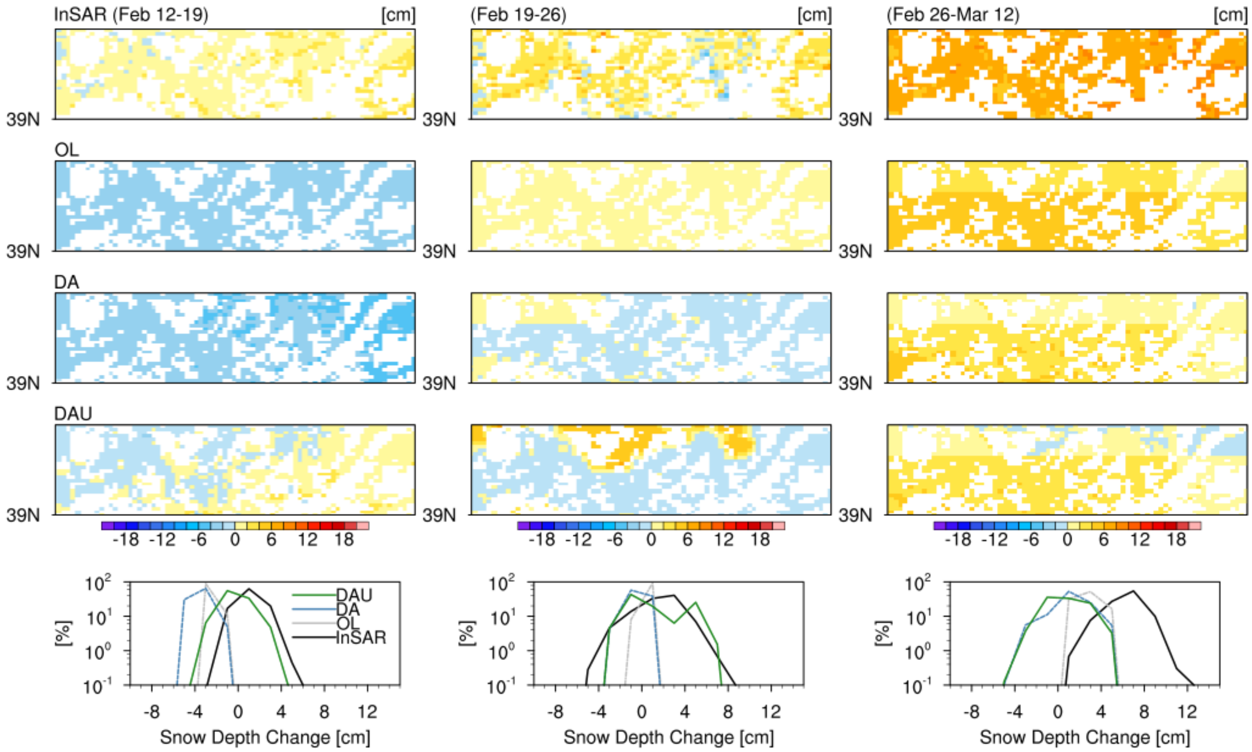
The data and code used to reproduce the results are openly accessible. The source codes for MPDAF will be made open with the publication of Shrestha and Barros (2024, WRR) which is still under review.

Figure 5 a The legend seems a bit unclear. Could you please provide more details or clarify the meaning of the different colors used?

The colorbar was choosen just to highlight the spatial heterogenity in coherence.

Fig 9 To better highlight the spatial variability, consider including a zoomed-in view of a specific region, similar to Figure 5.

The spatial variability shown in Fig. 5 is at 3-5 m resolution. In Fig. 9, the spatial variability is shown at 90 m resolution. The figure below shows a zoomed portion of Fig. 9 near the centre of the domain. At this scale, much of the small scale variability is filtered out, so a zoomed-in view does not add much information for the discussion.



InSAR (Feb 12-19)
(Feb 19-26)
(Feb 26-Mar 12)
[cm]
39N
OL
DA
DAU
-18 -12 -6 0 6 12 18
DAU
DA
OL
InSAR
[%]
Snow Depth Change [cm]