We thank Reviewer #2 for their thoughtful comments. The reviewer's text appears in black with our responses in bolded blue.

Based on both reviewers' comments, we significantly revised and reorganized the introduction of the paper. We also moved the section of governing error equations from the appendix to the main body of the text (now Section 2), provided more detail in the derivations, and removed all references to the unpublished companion paper.

General Comments

The authors assess six potential error sources that may influence NISAR L-band snow water equivalent retrievals using the phase-change approach. To do so, they apply equations describing the theoretical influence on signal phase for each component, using a combination of observed and modeled data to derive the expected influence. These phase shifts are used as input to the SWE retrieval algorithm to determine the expected magnitude of SWE change errors from each factor. The study is a necessary and well-conceived sensitivity analysis, not an observationally focused effort. While the authors do not assess all potential factors that influence SWE, the authors offer a thoughtful discussion of their study limitations and the recommendations that can realistically be drawn from this study. They provide well-written, clear, and concise methods, with effective and visually appealing figures and results. It is already a strong paper, and it was enjoyable to read and will be a good addition to the literature on InSAR-based SWE retrievals – especially as NISAR data begins to become available for SWE mapping. I have only minor comments that I believe would further strengthen the manuscript.

Thank you for these positive comments; we are glad to hear that you enjoyed the paper.

Specific Comments

1. The concept of the 12-day baseline may warrant a clearer description in the introduction or methods. How it differs from a 12-day moving-window approach should be clarified.

"Temporal baseline" is a common phrase in the InSAR literature but this comment helped us realize that it may be less familiar to our intended snow science audience. In our revised introduction we define the phrase the first time it appears (line 37). In other instances we changed the wording from "baseline" to "period" or something similar (e.g. Abstract line 17). We also revised our methods to include the phrase "moving window" which we agree is a more widely understood term (lines 206-215).

2. The last sentence of the abstract 'For individual 12-day baselines, removing as many errors as possible….' comes across as very general. The study has several key takeaways and suggestions that are presented at the end of the conclusion – I'd suggest drawing upon those to provide a more impactful and informative concluding sentence to the abstract

Done. The end of the abstract (lines 22-27) now reads: "Removal of other error sources requires careful consideration of the SWE monitoring application: for tracking seasonal

SWE accumulation in areas with deeper snowpacks, correcting some errors but not others may actually decrease accuracy by removing offsetting cumulative effects. For individual 12-day periods, wet and dry tropospheric effects (due to changes in water vapor and pressure) should be removed for accurate interpretation of spatial patterns of snow accumulation at basin to range scales, and site-specific factors should be considered to assess the relative influence of vegetation, soils, and surface deformation."

3. The introduction is lacking a summary of the InSAR SWE retrieval literature, particularly in terms of observed errors from field testing. I recommend that the authors draw on that literature to provide more insights into expected retrieval errors based on observational data.

While revising the introduction, we made an effort to describe the previous literature in more detail instead of inserting long lists of references. Lines 35-38 report error metrics from previous studies, and we also mention challenging environments for the technique in lines 41-42.

4. While I am sure each of the 6 assessed components are described in the unpublished companion paper in detail, it would be helpful to the reader if the authors could provide brief (but more detailed than is currently provided) descriptions of each component. For example, some background as to what drives ionospheric variability or surface deformations would be useful to mention early on in the introduction.

We moved the section of governing error equations from the appendix to the main body of the text (now Section 2), provided more detail in the derivations, and removed all references to the unpublished companion paper.

5. In Figure 6, the exceedance probability of the ionospheric error contribution looks like a step function with error only occurring in ~0.025m bands. This is not reflected in the red line which summarizes all error components as well. – why is this?

Good eye – the IGX IONEX data have a precision of only one decimal point, and applying Equation (4) when ΔTEC = 0.1 is equivalent to a SWE error of 0.02549 m. So this is the minimum step size in ionospheric error that we can calculate using this dataset. When all errors are incorporated (i.e. the red error curve in Figure 6) the other datasets have higher precisions and the error curve becomes essentially continuous. We added a note about the coarse precision of the ionospheric data and resulting stepwise behavior to the caption of this figure (now Figure 7).

6. There are opportunities in the discussion and conclusion to add more statistical metrics, which would strengthen the analysis and provide key insights for readers. See Line 279 ('largest error values'). Paragraph 1 of the conclusions attempts to clarify the expected errors using the exceedance statistics, but its presentation could be clearer in my opinion. Presenting the 50% exceedance for each component would provide a good indication of the relative influence of error across all 6 assessed error sources. The delta SWE threshold should also be consistent and clearly described.

We added the 50% exceedance error values for all curves shown in the figure in a new table (Table 4), which we agree helps clarify the text with references in the Discussion (lines 415-417) and Conclusions (lines 479-481). Based a comment from the other reviewer and to address the point in this comment about the consistent ΔSWE threshold, we also added a new paragraph in the results comparing the exceedance errors with zero/nonzero ΔSWE = 0 (lines 363-369):

"We used a similar analysis to investigate whether non-snow errors behave differently on days with vs. without a snow event. We split the October 1 through April 1 dataset into days where ΔSWE = 0 (1784 total measurements) and days where ΔSWE =/= 0 (21,698 total measurements), representing both accumulation and ablation events. When ΔSWE = 0, the 50% exceedance thresholds were 0.210~m for total non-snow error and 0.031 m for non-ionospheric error. When ΔSWE =/= 0 the 50% exceedance thresholds were 0.230~m for total non-snow error and 0.030 m for non-ionospheric error. The error curves for the two cases (not shown) were quite similar to those in the left panel of Figure 6. This result indicates that non-snow factors affect the phase relatively consistently, regardless if a snow event occurs or not."

Technical Suggestions

Line 40: I recommend mentioning the target +/- 10% goal when introducing the decadal survey

Done (now lines 48-51).

Line 46 (& referenced elsewhere): The submitted (unpublished?) companion paper (Hoppinen et al.,) should be published before this work is published, since this relies directly on those presented methods

This comment has been addressed by the expanded equation derivations (now Section 2).

Line 53: Briefly noting other potential error sources here would be relevant

This comment has been addressed by the expanded equation derivations (now Section 2).

Consider more descriptive section titles (sections 3 and 4) and adding an additional sub-section of results after the error exceedance analysis (before the gridded analysis), as this came across as a separate analysis sub-section

Done. Based on this comment we also took a more liberal approach with subsections when revising the equation derivations (Section 2).

Line 128-129: Providing an explicit example of such interactions would be helpful. The author's use of examples elsewhere in the paper really helps its clarity in my opinion.

We added an example from our data as well as a more hypothetical discussion in lines 242-251:

"However, the interannual variability of the total cumulative error (i.e., the width of the boxplot) changes between stations and most stations also show positive errors (overestimated SWE) in at least one year. This indicates that it may be difficult to predict the general behavior of the total error at any site based on errors measured in previous seasons. For example, at Sunset the largest positive error (0.096 m) occurred in 2016 and the largest negative error (-0.191 m) occurred in 2025, but peak SWE measurements in the two years were very similar (0.452 m in 2016 and 0.444 m in 2025). Wide interannual variability at a site is likely driven by the complex interactions between the error factors and their physical drivers at seasonal scales. For example, a series of several early season snow accumulation/melt events would likely result in fluctuating tropospheric effects (i.e., changes in air pressure and precipitable water associated with frontal passage) but the secondary soil permittivity effects from melting snow are partially controlled by antecedent soil moisture conditions, which we do not assess in our analysis."

Line 222: consider adding the relative difference in error (numerically) between the morning and evening overpasses – it is clear in Figure 5, but the specific magnitude of the difference is less so, especially because of the different temporal variation patterns

We added more detail about the AM/PM differences in ionosphere error in lines 344-352:

"For example, at Trial Lake, the seasonal average AM ionosphere error (mean of the middle AM orbit line) is 0.010 m with an average interquartile range (IQR) of 0.377 m. The seasonal average PM ionosphere error is 0.013 m with an average IQR of 1.031 m. The largest average difference between AM and PM errors is 0.312~m on November 27, a critical early-season period when total SWE and ΔSWE are typically small. Ionosphere errors of 0.312 m potentially represent more than 100% of the snowpack at many WUS locations in late November. The largest difference between AM and PM IQR is 1.206 m on April 12, another critical monitoring period around the timing of peak SWE in the WUS. AM and PM results are similar at Paradise and Disaster Peak. For these reasons, we recommend using ascending NISAR overpasses to generate NISAR interferograms for ΔSWE measurements, which will acquire data at approximately 06:00 local time."

Line 236: Consider adding further justification as to why the ionospheric component was excluded from Figure 6b

This was simply to improve clarity of the figure; we added this detail explicitly in lines 374-375.

Line 344: Where did 670% come from? The highest error was around 500% in the presented tables

The highest total cumulative error in Table 1 is indeed 581%, but this sentence refers to the specific ionospheric cumulative error which is 670% at Quemazon (also shown in Table 1).

Line 352: Is there a relevant manuscript/source that the authors would refer readers to review to better understand how the ionic corrections are made? Consider adding a source within the text that details ionospheric correction effects – in the discussion, if possible

We added two relevant citations along with a few sentences describing the primary drivers, spatial and temporal variation cyles of the ionsphere, and the primary impacts of it on InSAR pairs in lines 101-106:

"The varying electron density of the ionosphere is affected by solar UV radiation, Earth's magnetic field, and atmospheric gas concentrations; interactions between these factors cause electron density concentrations to vary over multiple spatial (sub-kilometer to tens of kilometers) and temporal (diurnal, seasonal, and interannual) scales (Lean et al., 2016). The resulting impacts on InSAR phase are frequency-dependent and can introduce larger errors at lower frequencies, like NISAR's L-band measurements (Meyer and Agram, 2017)."