Reviewer #2

General Comments:

This study by Cao and Gruber provides a timely evaluation of reanalysis performance in cold regions, underscoring key challenges in modeling mean annual air temperature (MAAT) and snow water equivalent (SWE). Presenting the work as a Brief Communication is appropriate, as it efficiently draws attention to issues of broad relevance. While a full uncertainty attribution is beyond the current scope—as noted in the response to Reviewer #1—the study lays a solid foundation for future work and enables rapid dissemination of important insights.

Recommendation: Minor revisions are recommended to improve clarity and strengthen the manuscript's impact. The core message is clear and timely; addressing the points below—primarily through brief clarifications or additions—would enhance the study's novelty and broader applicability without requiring new analyses.

Additional Insights for Consideration:

1. Clarify the role of ERA5-ENS: The use of the ERA5 ensemble is a valuable aspect of the study. However, the distinction between uncertainty within a single system (ERA5-ENS) and the broader inter-reanalysis spread could be further emphasized. This contrast may offer readers a clearer sense of where structural versus internal uncertainties dominate.

The notably smaller spread in ERA5-ENS (yellow line, Fig. 1) compared to the full multi-reanalysis ensemble warrants explicit discussion. This comparison could provide valuable insights into the relative importance of different uncertainty sources.

2. Highlight the spatial dimension of spread: The spatial maps in Figure 2 could be enhanced by including a difference panel or masking approach (e.g., isolating high-cryosphere, low-station-density zones). This could help illustrate where the reanalysis disagreement is most consequential for downstream applications.

Could the authors clarify whether the larger spread in high-altitude regions (e.g., High Asia, Greenland Ice Sheet) is primarily tied to low observation density or elevation-dependent processes (e.g., snow physics)? For instance, does Greenland's spread pattern align more with other high-altitude regions (suggesting elevation-driven uncertainty) or with low-altitude cold regions like Arctic tundra (suggesting temperature-driven uncertainty)? A brief discussion of how these factors interact in different cryospheric regimes would strengthen the interpretation of Figure 2.

3. Cryospheric Regime Variability: The study treats cold regions (MAAT < 0°C), yet these areas encompass diverse cryospheric regimes (e.g., high-altitude glaciers versus Arctic tundra). To enhance the analysis, the authors might consider: Stratifying results by cryosphere type: Does MAAT spread differ significantly between permafrost-dominated versus snow-dominated regions? For instance, snow-physics errors (such as MERRA-2's precipitation correction limitations) may be predominant in mountainous areas, while soil-thermal biases (Cao et al., 2020) might dominate in permafrost zones. A supplementary map or table categorizing spread according to cryosphere classification (using the already collected PZI and snow cover data) could reveal important process-specific discrepancies.

4. Elevation Dependencies: The Tibetan Plateau case (mentioned in the text) demonstrates notable elevation-dependent warming (Gao et al., 2018). Does MAAT spread show similar elevation dependence? Such analysis could help distinguish between:
a) Station-density effects (where lower elevations typically have better observational coverage)
b) Model physics limitations (e.g., inadequate representation of elevation-specific processes like katabatic winds or radiation biases)

5. Temporal Analysis of Spread: Given that Arctic amplification rates have shown distinct shifts approximately between 1990-2005 and 2015-2020 (Rantanen et al., 2022), it would be valuable to examine whether ensemble spread has correspondingly decreased in more recent years (particularly post-2000 with improved satellite assimilation). A persistent spread despite improved observations would strongly indicate fundamental process-representation issues beyond observational limitations.

Suggested Improvements:
1. The inclusion of a simple elevation-binned analysis (using existing data) could significantly strengthen the interpretation of regional variations in spread.
2. A brief discussion of how cryosphere type and elevation might interact to produce the observed spread patterns would enhance the manuscript's conceptual framework.
3. The temporal analysis of spread could be incorporated without requiring substantial new analysis, as the study already covers 1991-2020.

Specific Comments:
L36: Could the authors clarify what defines the 1991–2020 period as 'high quality' for reanalyses? For example, does this refer to improved satellite data assimilation, expanded observational networks, or advances in modeling? A brief explanation would help contextualize the results." Also, what do the authors mean by high quality observation in L56?
Lines 97-100: “Qin et al. (2020); Kraaijenbrink et al. (2021). “>> (Qian et al., 2020; Kraaijenbrink et al., 2021)
“Cao et al. (2020); Domine et al. (2019)” >> (Cao et al., 2020; Domine et al., 2019)
“Reichle et al. (2017)” >> (Reichle et al., 2017)

L159:(CDS), C.C.C.S.C.C.D.S? Could the authors update it to follow the recommended format from the CDS website:” Copernicus Climate Change Service, Climate Data Store, (2021): … (**Accessed on DD-MMM-YYYY**), 10.24381/cds.cf5f3bac”

Figure 1: The dotted line in the legend is difficult to associate with the corresponding dashed color lines in the figure. It took considerable effort to interpret their meaning correctly. I recommend clarifying the legend by explicitly stating that solid lines represent the mean state and dashed lines indicate the trend (e.g., "(solid: mean, dashed: trend, left Y-axis)" after each color label), while shaded areas on right Y-axis. This would significantly improve readability and interpretation.

Reference: Rantanen, M. et al. The Arctic has warmed nearly four times faster than the globe since 1979. *Commun. Earth Environ.* 3, 168 (2022).