Referee 1

Dear Referee #1,

Thank you for your thorough and constructive review of our manuscript "Tracking In-Situ Snow Accumulation at Neumayer, Coastal Antarctica: Signs of Climatic Changes in the past 30 Years?". We greatly appreciate your detailed comments, which have helped us to substantially improve the manuscript.

Below we address each of your comments in detail. The text of your review is given in Roman font, while our responses are in italics. Line numbers refer to the lines in the submitted manuscript.

Major Comments:
[1] I would be interested to see more discussion or analysis of the drivers of apparent increase in autumn accumulation. In particular, the current discussion posits that an increase in EPEs might drive this trend. That seems like a hypothesis which could be explored with the available data. Of course, the time resolution of the Süd measurements isn't good enough for a definitive test of the hypothesis, but if I squint at Figure 4, it seems like there might be some increase in monthly accumulation variability over the MAM period from the beginning to the end of the record. (If there's not enough there for a meaningful analysis, noting that in the text would also be helpful to the reader.)

- *We thank the reviewer for this proposal. We agree that exploring the potential role of EPEs in driving the observed increase in autumn accumulation is very interesting. While a definitive test is limited by the monthly resolution of the Süd measurements, we note that weekly accumulation data are available at Spuso from 2009 onwards. In the edited manuscript we can include an analysis that leverages these higher-resolution data to identify extreme events (e.g., by filtering the top 10 % of weekly accumulation values) and aggregate them seasonally to assess whether the frequency or intensity of autumn accumulation has changed over time. Such an approach would allow a preliminary assessment of whether enhanced autumn EPEs contribute to the observed seasonal accumulation trends. However, a detailed study of such effects would increase the study considerably and is thus beyond the current focus. Nevertheless, we will consider it for a follow-up study.*

Line 23 – it may be worth noting the role of melt in SMB or justifying by citations why it is not important as your specific study site.

- *We thank the reviewer for raising this important point. While snowfall dominates surface mass balance at our study site, melt is not negligible and deserves clearer discussion in the manuscript. Previous studies indicate that melt at Neumayer is primarily a summer phenomenon driven by enhanced shortwave radiation during polar day, occurring mainly between November and February (Jakobs et al., 2019; Lenaerts et al., 2012). Gorodetskaya et al. (2020) quantify the*

average annual melt at Neumayer Station (several km away from our stake farm Süd) at approximately 50 mm water equivalent, which corresponds to about 12% of the mean annual accumulation (422 mm w.e.).
Given that melt is largely confined to summer, when the average seasonal accumulation amounts to 73 mm w.e. (after melt has occurred), this implies that melt represents a substantial fraction of the summer signal. We will therefore expand the introduction and discussion to better reflect the contribution of melt to seasonal SMB variability but also point out that "Süd" is colder and dryer than the vicinity of Neumayer Station, which is much closer to sea ice and open leads. In addition, as pointed out below, percolation does not play an important role (see Lenaerts et al., 2017). Moreover, melt cannot be directly monitored through stake readings, but manifests indirectly as increased densification of surface snow. This means that melt-driven mass loss may be underestimated in height-based accumulation records, adding to the overall measurement uncertainty.

Line 28 - https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2022GL099330 would be another appropriate citation relating to model underestimates of SMB variability.
Line 67 - https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029%2F2022GL100585 would be another appropriate citation discussing atmospheric rivers, extreme precipitation, and EPEs as drivers of overall precipitation trends.

- *Thank you, we have now included the recommended references in the Introduction.*

Figure 1 – the text is much too small, especially in the full Antarctica map inset. Please try to increase the label font size to the equivalent of at least 10 pt font at the 100% zoom level.
Is there a reason that the drift trajectories for SHM, Snow Buoy, and Spuso are not shown?

- *Thank you. We have made the following improvements to the figure (including recommendations from Reviewer 2):*

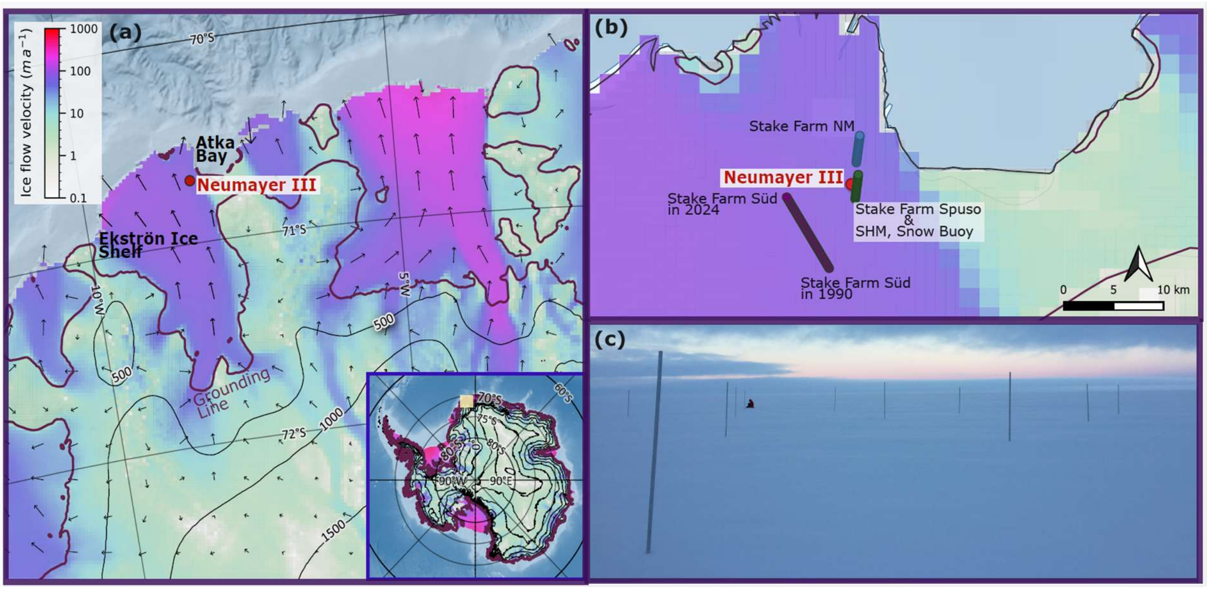

Figure 1: (a): Inset: Map of Antarctica with a yellow rectangle indicating the study area. Main map: Zoom-in on the Neumayer Station site. Black lines represent isohypses from the RAMP2 digital elevation model, and ice flow velocity

from the MEaSUREs dataset is shown as color-codeding and vectors. (b): The Stake Farms Süd, NM, Spuso and the SHM and Snow Buoy are located on the moving Ekström Ice Shelf; the series of dots indicates the reconstructed, interpolated trajectory of the three stake farms over their respective measurement periods. Basemap and datasets from Quantarctica v3. (c): Photograph of the stake farm Spuso. Photo: Linda Ort, used with permission.

Line 135 – can you comment on the sensitivity of the correction to different firn densification schemes, or to the appropriateness of the H&L model give any available density data from the site?

- *We thank the reviewer for raising this important point.*
- *We excluded densification schemes of wet firn from the pool of schemes, as percolation is not considered to happen in the snowpack at Neumayer based on the study of Lenaerts et al., (2017).*
- *We applied the Herron & Langway (1980) firn densification model using climatological mean temperature and accumulation rate representative for Neumayer. No site-specific parameter tuning was performed. The model was selected because it has been widely applied under cold Antarctic conditions with moderate accumulation rates, which are characteristic of our study site. As no other densification model was used, it is not possible to comment on the sensitivity to the choice of scheme.*
- *Regarding the appropriateness of the Herron & Langway model, we compared the modeled density–depth profile with seasonal in situ density measurements obtained at Spuso in 2021. The measured profiles extend to approximately 1 m depth and exhibit pronounced small-scale variability. In contrast, the H&L model represents a climatological steady-state densification scheme and therefore produces a smooth, near-linear increase of density with depth in the meter.*

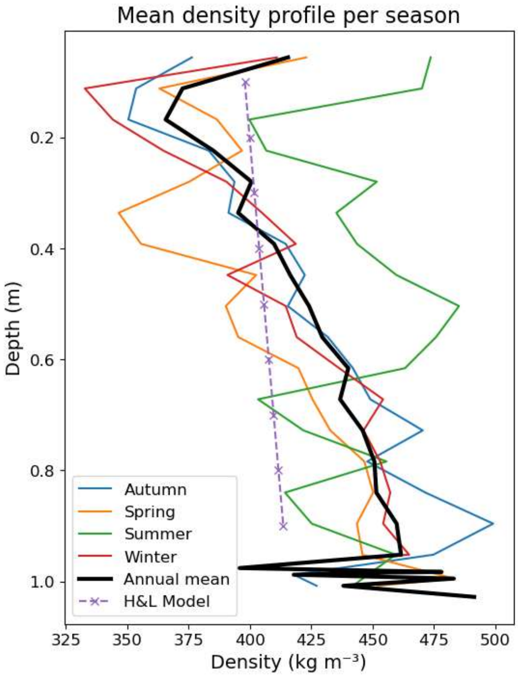

Figure 2: Seasonal mean density-depth profiles derived from in situ measurements at Spuso in 2021. Colored lines represent the mean profile for austral autumn (blue), spring (orange), summer (green), and winter (red). The black solid line denotes the annual mean. The dashed purple line shows the density-depth relation modeled using the Herron & Langway densification scheme based on 30-year climatological mean temperature and accumulation rate.

Line 191 – the comment that higher measurement frequency leads to lower accumulation values per measurement interval is an interesting one. Is this a well-known issue? Are there perspectives on why this occurs? Perhaps a citation here would be appropriate.

- *Apologies, we might not have been clear enough in the text, as we realize now. We simply wanted to state that for a given measurement interval the amount of measured accumulation is larger than two shorter measurement intervals within the period would have been used – the sum of the accumulation of the two shorter intervals would be the same as the one from the longer interval. For instance, if we record a=10 cm over the long interval, then the shorter intervals 1 and 2 would yield values a1+a2=10 cm, but any distribution of the 10 cm on the* *intervals could be possible (e.g. 1+9, 2+8, ...). Consequently, the accumulation values recorded in shorter intervals are usually lower than over the longer interval.*

- *We will improve the explanation as follows:*

"Since shorter intervals capture only a fraction of the total accumulation within a longer period, a direct comparison of raw accumulation values across datasets with different measurement frequencies is not meaningful."

Line 284 – it would be interesting to see the scatter plots for the individual stake vs farm average somewhere in the supplement.

- *Thank you, we will include such a figure in the supplement:*

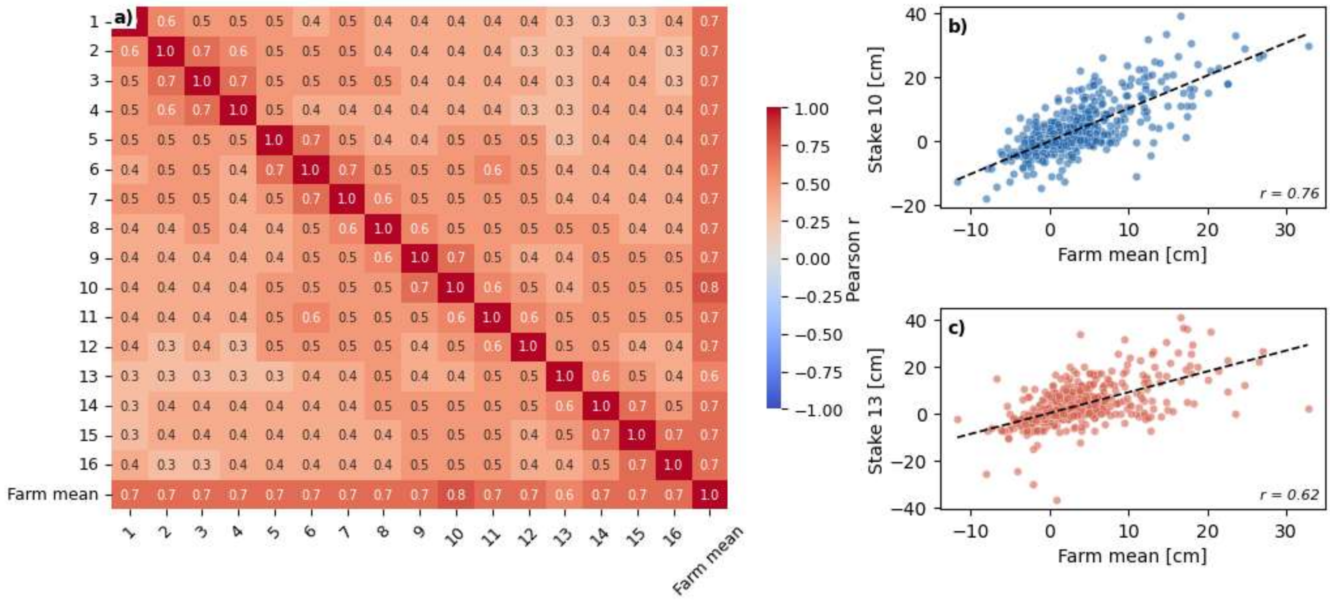

Figure 3: Correlation between individual stakes and farm mean of the weekly accumulation measurements at Spuso in cm. (a) Pearson correlation matrix of all 16 individual stakes and the farm mean. (b) Stake 10 showing the highest correlation with the farm mean (r = 0.76). (c) Stake 13 showing the lowest correlation with the farm mean (r = 0.62). Dashed lines indicate linear regression fits.

Figure 6 – I think that panel (a) would be easier to interpret as line charts like those shown in Figure 5. But maybe I am missing some key aspect of the data that is not well-represented in that format?

- *Yes, we can see the point, maybe the comparison of the different sites could be easier in a line chart. However, we chose the bar chart to visualize the cumulative character of the data shown here, hoping that the comparison is as easy to the eye than for the line chart.*

Line 337 – why 1991-2020 as the climatological reference period at Süd? Specifically, why exclude the last four years of data in this average but not at SHM or Spuso?

- *We thank the reviewer for this important comment. The 1991–2020 period at Süd was selected to represent a standard 30-year climatological reference period in line with WMO conventions. The subsequent years (2021–2024) were excluded from the reference mean to allow an independent assessment of whether these recent values deviate significantly from the preceding accumulation regime.*

For SHM and Spuso, however, no full 30-year record is available. Therefore, we used the longest available time span to calculate the mean in order to maximize sample size and reduce statistical uncertainty. We acknowledge that this results in a slight methodological inconsistency between sites and offer to clarify this in the revised manuscript to ensure transparency.

Line 364 – the distinction between looking at slope vs. magnitude was not entirely clear to me as first in this description, since both are described as indicating above or below average accumulation. Perhaps you can clarify that slope shows deviations relative to the few preceding years (so a sort of change in local average) vs. magnitude which shows deviations from the climatological/long-term average. It might also be helpful to comment on the time period over which you find it meaningful to interpret the slope of the anomalies. Are you thinking about interannual slopes, slopes over a few years of data, etc?

- *Thank you very much for this helpful suggestion. We have rewritten the paragraph as follows:*

"The variable of interest is the slope of the detrended time series. While the magnitude of the anomaly reflects the total cumulative deviation from the long-term mean, the slope indicates the direction and persistence of changes within a given period. A sustained positive (negative) slope therefore corresponds to a phase of above-average (below-average) accumulation. To distinguish persistent above- or below-average accumulation phases from short-term fluctuations, slopes are mainly interpreted over periods of several months or more, while sharp, short-lived deviations (e.g., "sawtooth" patterns) may indicate individual EPEs. Periods with a slope near zero correspond to average accumulation conditions.''

Line 414 – there is a bit of an unexpected jump in the discussion here. Maybe this transition can be clearer if you remind the reader of the specific conclusions you are trying to explain, with some reference back to a figure or table.

- *Thank you, we consider to use the following paragraph as a better transition:*

"While the previous analysis focused on directional anisotropy, the site-specific variograms reveal additional differences in spatial coherence between the three stake farms (Fig. 3). The separate variogram for Süd, NM, and Spuso show that Süd generally exhibits lower stake-to-farm-average correlation, which… ~~Any small remaining differences in overall correlation between Süd and NM or Spuso are minor and~~ …may reflect local surface…"