# Author's Response #2

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We thank the editor, the anonymous reviewer #2, as well as the new anonymous reviewer #3 for taking the time to help to improve our work. We adjusted our manuscript accordingly. Additionally, we again revised and improved the language and adjusted some minor details to make the manuscript easier to read and more understandable. Here, we address the reviewer comments point by point, stating the according changes we made in the manuscript *in green*.

1. **Anonymous referee #2 (Report 1):**

**The author addressed my comments well and improved the manuscript. I have two minor suggestion which should be included in the discussion of the manuscript before publication.**

**1.1 Would it be possible to provide a paragraph with the 'best practice' procedure for next campaigns to provide solid data to better explain the stratigraphic noise in order to increase the effective resolution of climate reconstructions from the East Antarctic Plateau. Like what type of measurements should be included/or not (e.g. isotope, snow density, snow SSA, precipitation patterns, depositional conditions, accumulation rate, slope inclination, surface roughness, direction/distances/size of the locations etc.) and the why?**

Thanks for this suggestion. We agree with the reviewer that it would be interesting to study additional processes that influence the isotopic composition in order to deepen our understanding of the snow deposition and the signal formation. We already mention the possibility of detailed surface observations as a helpful extension to our study (Zuhr et al., 2021, Picard et al., 2019). Densities and SSA measurements could give some indications regarding the stratigraphy, however, the relationship of both densities as well as SSA to stable water isotopes is not unambiguous and not well understood (Laepple et al., 2016, Stuart et al., 2023). They are therefore not suggested in our study.

So far, we have a section on implications for future studies (Sect. 4.5), which includes suggestions for optimized sampling locations to achieve a high resolution climate signal from the EAP. However, based on your comment, we will clearly distinguish our different implications and move part of the text to a new section 4.6 named: "Suggestions for optimal site selection for high resolution climate reconstructions from the late Holocene".

We divide this new section into three parts: first, we talk about the importance and possible strategies for site selection as before. Then, we suggest a best practice sampling setup, which was also used in this study, by adding the following sentences (Lines 283):

“The sampling setup at the thoroughly selected sites should follow the suggestions of Münch et al. (2016): the distance of replicate cores should be larger than the expected decorrelation length of stratigraphic noise, for example 10 m in the DML plateau area. The number of cores should be chosen based on the expected amount of stratigraphic noise and the intended signal resolution. Based on the findings by Münch et al. (2016), we suggest to take 5 replicates at locations with similar environmental properties to Kohnen Station. The sample direction should be perpendicular to the overall wind direction if the surface roughness is measured across the sampled cores as in this study.”

Finally, we add a paragraph about the signal interpretation regarding sublimation/snow metamorphism and precipitation intermittency: While the quantitative impact of sublimation/snow metamorphism on the isotopic composition is still a matter of debate (Wahl et al., 2022), it has been shown that precipitation intermittency might be responsible for 50 % of the total noise variance in local isotope records (Laepple et al., 2018, Münch et al., 2021). These two processes are probably coherent across our study region but should in general be considered when interpreting isotope records. We therefore add (Line 289):

“Signal interpretation should further consider influences on the isotopic composition from, e.g., sublimation (Wahl et al. 2021), snow metamorphism (Stuart et al. 2023) and precipitation intermittency. The latter can be responsible for up to 50 % of the noise variance across large spatial scales (Laepple et al., 2018). The sampling strategy we propose here could therefore be expanded by replicate cores taken at optimal distances to account for precipitation intermittency, as suggested by Münch et al., (2021).”

**1.2 Could you elaborate a bit whether snow metamorphism and the vapor exchange between snow and atmosphere due to sublimation and/or deposition could also have an impact on the stratigraphic noise?**

Stable water isotopologues can be altered when exposed to the atmosphere, before or after deposition (Wahl et al. 2021, Stuart et al. 2023, Ebner et al. 2017). Both snow metamorphism and sublimation do however, not change the stratigraphy itself, and do therefore not notebly influence stratigraphic noise. Instead, they can introduce an overall isotope bias and need to be accounted for in the overall isotope interpretation (Wahl et al. 2022). As elaborated in comment 1.1, we now mention the need for a cautious signal interpretation that also considers sublimation and snow metamorphism in a new section 4.6.

**1.3 Minor comments: Table 2: The 'O' in d18O is sometimes italic, sometimes not. Not consistent with the text.**

Thank you. We corrected the style of the O in δ18O to match the style of the text and figures.

2. **Anonymous referee #3 (Report 2):**

**In their study, the authors quantify the relationship between stratigraphic noise in the stable water isotopic signal of the top 1 m snow and the environmental properties inclination, surface roughness, and accumulation rate. Based on these findings, the authors aim to provide guidance for future snow, firn, and ice core drillings to obtain higher SNR. The paper is well-structured and presented in a clear way. The impact of the results is discussed appropriately within the limitations of the relatively low number of analyzed snow cores, and given p-values allow for reasonable assessment. The study provides useful contributions to the assessment of stratigraphic noise in Antarctic snow records and will be an appropriate contribution to The Cryosphere after some minor revisions:**

**2.1 Figure 5: The study, particularly Figure 5, would benefit from clarity on the uncertainties in the environmental properties. I recommend adding horizontal uncertainty bars in Figure 5, but at least the uncertainties for surface roughness, accumulation rate, and inclination should be provided in the discussion.**

Thank you for this very good suggestion. We added the following method description in section 2.6:

Uncertainty of the slope inclinations, Line 117: "To assess the uncertainty of these estimates, we calculate the slope inclinations with the same azimuth over 10 km segments across 36 different points, located at 200, 400 and 600 m around each study site (12 different directions in steps of 30°) and extract the SD of these slope inclinations."

Uncertainty of accumulation rates, Line 122: "To get an estimate for the uncertainty of these values, we use the accumulation rate over the last 200 years from the B32/DML05 ice core at Kohnen Station (Oerter et al. 2000). We calculate the SD of the 5-year black averaged record, since 5 years roughly represents the accumulation period in our snow cores. For each site, we scale the SD to the local mean accumulation rate.

Uncertainty of surface roughnesses, Line 128: "Further, we resample with replacement the height values from each site 1000 times, estimate the surface roughness from these samples, and use the SD of these surface roughness values as a measure of uncertainty."

We added these uncertainty estimates as horizontal error bars to manuscript Figure 5 (see Fig. 1 below) and also to the new figure in Appendix D (see your comment 2.3 and Fig. 2 below).

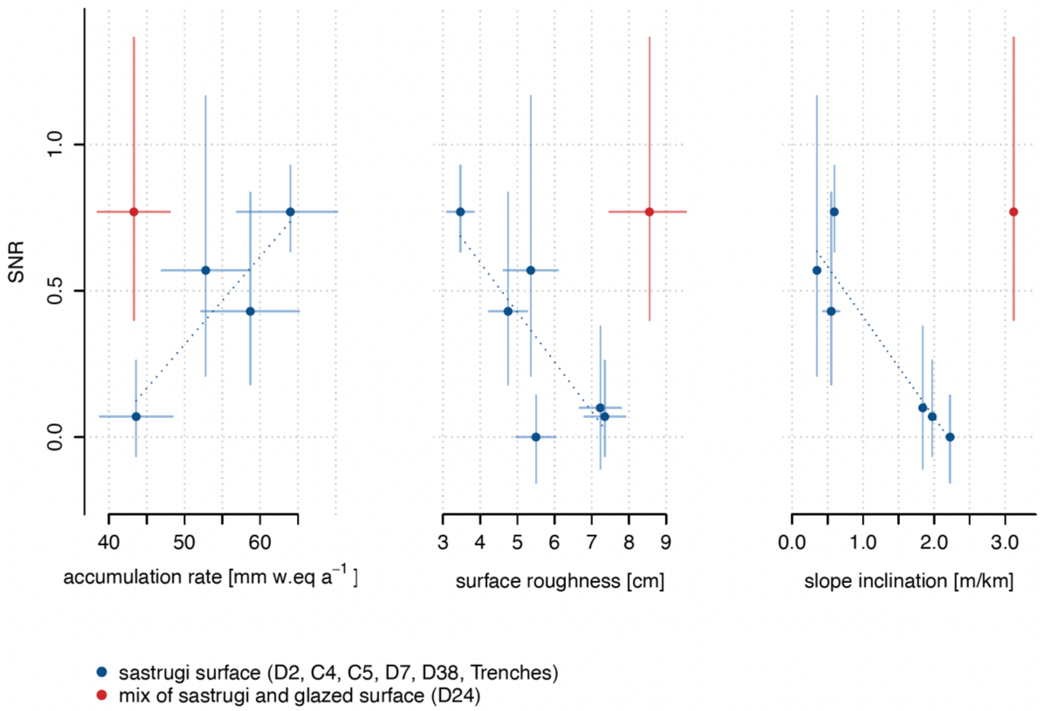


Figure 1: Comparison of signal to noise ratios (SNR) to accumulation rate A [mm w.e. a$^{-1}$], surface roughness $SD_{SH}$ [cm], and slope inclination [m km$^{-1}$]. Most sites were dominated by sastrugi while at D24 we observed a mix of sastrugi and glazed surfaces. The latter was therefore excluded in the linear regression analysis (dashed lines). Vertical lines indicate the 95% confidence intervals of the SNR estimates, while horizontal lines represent the uncertainty of the environmental properties (2 ∗ SD). Uncertainty of 10 km slope inclinations are very small such that they are not visible for most of the sites.

**2.2 L197 (lines in initially submitted manuscript): add p-value for correlation SNR with accumulation rates**, and **L204: p-value for r?**

The p-values were already added in the second version of the manuscript. Instead of only indicating if a value is smaller than 0.05 (in the first version of the manuscript), we now state the according p-value for each correlation.

**2.3 L219: add figures in the style of Figure 5 to Appendix to support the values presented in 4.4**

We appreciate this good suggestion and added an according figure in Appendix D (Fig.2 below).

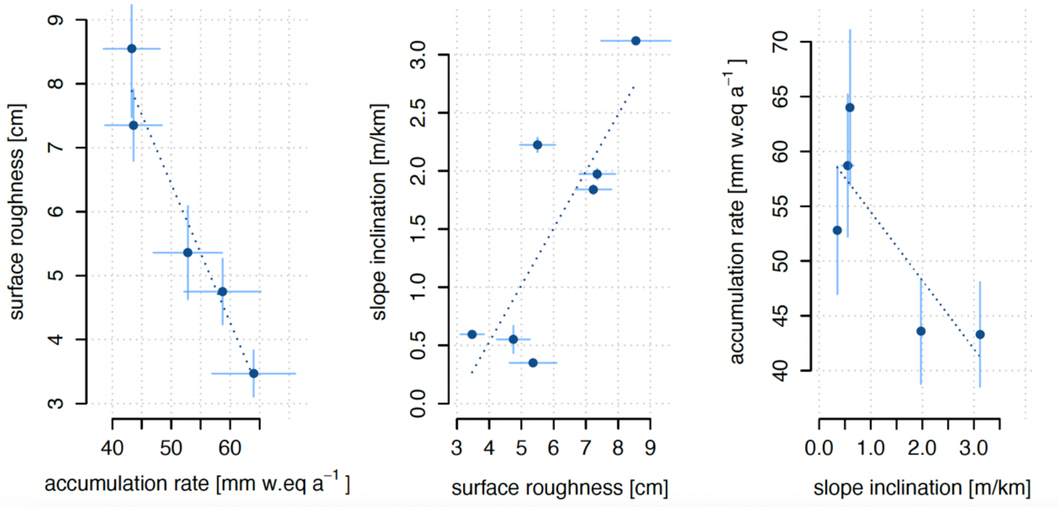


Figure 2: Comparisons between accumulation rate A [mm w.e. a$^{-1}$], surface roughness $SD_{SH}$ [cm], and slope inclination [m km$^{-1}$]. Vertical and horizontal lines represent 2 ∗ SDs of the according environmental property as an indication for uncertainty. Linear regression lines (dashed) suggest possible relationships. Uncertainty of 10 km slope inclinations are very small such that they are not visible for most of the sites.

## Literature

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