We thank the editor and reviewers for their constructive comments on this manuscript. Below, we explain the changes we have made to the manuscript and address the comments made by Referee #1. Comments made by the reviewer are in *black italics*, and our responses are in red.

RC1 (Anonymous Referee #1)

L119: The authors state that MODIS MoG imagery records the intensity of the reflection of a satellite-emitted radar signal. This is untrue. MODIS is a passive sensor which records visible/near-visible solar radiation reflections.

> We thank the reviewer for catching this error. These lines have been amended to the following:
>
> *"MODIS is a passive sensor that records the intensity of (near-)visible solar radiation reflections; the MoG surface morphology map is derived by high-pass filtering of red-light MODIS images (Haran et al., 2018). MoG surface morphology imagery therefore provides a semi-quantitative approximation of the reflectivity of the ice surface, which depends on the slope / curvature."*

L125: 'Conversely' is confusing here. Both the preceding sentence and this one focus on shortcomings of the MoG approach, whereas conversely would suggest that we're about to be told something about what it is good for. 'Furthermore' instead?

> We agree and have changed 'conversely' to 'furthermore' as suggested.

L136: Please add a further reference that cites the OIB project.

> References to both MacGregor et al. (2021; Reviews of Geophysics) and Paden et al., (2019; NSIDC) have been added here.

L139-140: Either expand this methods explanation or remove incompletely - there isn't enough information to judge whether the fact that an ML approach was used is important to the present study or not. If it is, expand why, otherwise I suggest removing this methodological detail.

> The reviewer is correct that this methodology was not carried out in the present study, but instead refers to the previous study of Paxman (2023). We have therefore removed the excess detail and the text is now simplified as follows:

"This dataset (Paxman, 2023) also contains quantitative metrics of valley cross-profile morphology, including depth, width, V-shapedness, and curvature, as well as classifications of valleys as either 'glacial' or 'fluvial' based on their morphological similarity to glacial or fluvial valleys observed elsewhere in the Northern Hemisphere. For the purposes of this study, we only examined the morphometrics of valley profiles whose classification is associated with high confidence (for more information the reader is referred to Paxman, 2023)."

L277: add a reference to Fig. 4g for concerning the thermal state analysis.

A reference to Fig. 4g has been added here.

L279: (subjective) - I suggest starting a new paragraph here for clarity.

Agreed; a new paragraph has been started here.

L332: is 'mapped mountain valley networks' missing the term 'glacial'? (to distinguish from fluvial)

It is, thank you for catching this. We have inserted the word 'glacial' here.

L480: The first part of this sentence is really the conclusion of the previous paragraph, so perhaps would be better off added there. Then the paragraphs will match points (a) and (b) introduced in L466-469.

This is a good suggestion and we have followed the suggestion of the reviewer and shifted this sentence to the end of the previous paragraph.

L494: would 'also' result in higher rates of mass accumulation and turnover 'there', or similar (i.e. is the intended meaning that the conditions which enable higher rates of mass accumulation in turnover in the EH also cause the ~same conditions in the SH?)

This sentence was intended to point out that the high precipitation rates in the SH would likely translate into higher rates of turnover than in the EH (all other things being equal), which argues against the possible scenario that greater valley depths in the EH were caused by higher mass turnover rates / flow velocities there than in the SH. We have rephrased the section to make this clearer:

"An alternative scenario is that the eastern and southern highlands were occupied by erosive mountain ice for similar durations of time but the ice in eastern Greenland was associated

with higher rates of mass turnover (and therefore greater basal sliding velocities and erosion rates). However, this possibility can likely be discounted because the elevated palaeo-precipitation rates in southern Greenland that are consistently indicated by general circulation models (Fig. 3b) would likely result in higher rates of mass accumulation and turnover here than in eastern Greenland (all other things being equal).”

L572-580: I struggled to understand this paragraph. This might be my shortcomings in being able to 'imagine' isostasy, but I think nonetheless that some rephrasing would be beneficial.

We appreciate that this text was not clear to readers less familiar with isostasy. We have therefore rephrased this entire paragraph to make the logic easier to follow:

“Moreover, isostatic calculations indicate that glacial valley and fjord incision in the near-coastal regions of eastern Greenland must have primarily occurred prior to ca. 2.5 Ma (Pedersen et al., 2019). This is because incision of these deep valley and fjord systems would be expected to have driven hundreds of metres of flexural uplift of the adjacent coastal areas via erosional unloading, but late Pliocene-early Pleistocene (ca. 2.5 Ma) shallow marine sediments are exposed along the shoreline and have not experienced significant uplift (Pedersen et al., 2019. This indicates that fjord incision and concomitant isostatic adjustment must have largely pre-dated the deposition of these sediments, pointing towards selective glacial valley and fjord incision having largely occurred prior to the Quaternary in eastern Greenland.”