We thank the three reviewers for carefully reviewing our manuscript and are happy to strengthen our study according to their suggestions.
In addition to our initial reply to RC1, in the following, we provide a general response to the overall and key aspects mentioned in the three reviews together, as well as a point-to-point response to all reviewer comments respectively.

Our point-to-point responses to the individual comments are given below in blue and italics compared to the reviewer comments which are given in black without italic font.

Author response to key aspects common to all RCs

*With regards to the comments made on **novelty and relevance** of our study, in the revised manuscript, we try to be more direct about **our goals** and **main motivation**. Namely, we aim to estimate the Antarctic Ice-Sheet's vulnerability to changes in ocean thermal driving. To get a rough estimate of potential changes in thermal forcing, we identify features from continental shelf bathymetry that are similar to Filchner Trough which could provide warm water masses access to the grounding line once the cavity switches into a "warm" state. Furthermore, we calculate the connectedness of Antarctic grounding lines to the open ocean. Based on this, we derive an upper-bound of temperature (and thus basal melt rate) changes in ice shelf cavities around Antarctica.*

We strengthen the relevance of our study by additionally providing the derived access depths data for a 500m x 500m grid spacing in the supporting material as well as the code to update the access depths when new data becomes available. In a revised manuscript, we will further extend the section on how our findings may influence PICO tuning in future studies and how this relates to the current settings and other melt parameterizations. To this end, we will now also include an updated delineation of basin boundaries for PICO in the ocean based on our findings (taking up the suggestion made by RC1).
As suggested by RC2, we will also revise the title of our manuscript to strengthen the main message i.e. that we look into bathymetric constrained warm mode melt estimates derived from analyzing Oceanic Gateways in Antarctica.
As suggested by RC2, we will overall stream-line our manuscript to fit our target audience, namely stand-alone ice-sheet modelers (using PICO) and those working on the coupling to coarse grid ocean models, as our study provides bathymetry-informed estimates for temperature and salinity as used in basal melt parameterizations such as PICO.

*Concerning the comments made towards our **terminology and methodology,** we will include a more in-depth and more comprehensive explanation of the concept of access depths, through a revised Figure 1 and by rephrasing 1) how access depths are defined and derived, 2) how we define critical access and 3) by showcasing how we conducted the analysis, providing estimates on the computational cost and the numerical code of the flood-fill.*
*In the revised manuscript we will also add further explanations how our approach relates to the **ISMIP6 protocol,** i.e. that we foremost analyze bathymetry and subsequent grounding line connectedness and that our analysis can be adapted to whatever ocean dataset there is available.*

*To reduce complexity, we will rework the use of **our parameter "g"** that we introduced to describe how much percentage of a basin grounding line can be accessed by open ocean*

water masses at depth. When revising our quantitative results, we will now additionally exclude all parts of the ice sheet where ice is grounded >0m (as correctly pointed out by RC2). We will propose a new Figure visualizing the distribution of access depth at the grounding line (formerly Figure 3).

*Generally, **more than one ice shelf** can be included in one PICO basin. We will make sure to discuss related caveats in the revised manuscript (which was especially raised in RC2). We will clarify the use and definition of a **prominent gateway**, that we had initially defined as "one or several deep troughs that provide access to most of a region's grounding line". Here, "most of a region's grounding line" had referred to 10% or more of the grounding line accessed at one distinct access depth level in our preprint and was highlighted by the magenta boxes in Fig. 3. In regions where we do not see this feature, but a rather gradual increase in access with grounding line portion/fraction, we actually cannot state that an oceanic gateway is present.*

*In the revised manuscript, we will update our **temperature estimates** and **change the overall narrative on our two scenarios.** We will refrain from speaking about "warm-water intrusions"; instead, we will give an "upper-bound" estimate, as we rather consider a macro-scale/basin wide transition in melt mode associated with prevalent access of ocean water from off-shore. To this end we will also assess how the T_CSB estimates change when taking the maximum (instead of the mean) temperatures along the CSB. This would follow our refined intention of a bathymetry-derived upper bound to melt rate changes. Further, we will clarify the paragraph in which we define the temperature estimates and add further discussion on how ocean temperatures may change (e.g. CDW->mCDW) when intruding onto the continental shelf (what we do not resolve). While we take the temperature estimates T_CSB as proxy for mode 2 melting conditions, we will state in the revised manuscript more clearly that T_CF is representative for mode 1 melting (after Jacobs et al., 1992). To this end, we will consider the bottom temperatures at the calving front, instead of averaging them at the overflow / access depth of that basin.*

In order to resolve the discrepancy of our estimated "present-day" melt rates to observations (as pointed out by all three reviewers), we will change our methodology for the melt estimates as follows:

Our used PICO parameters from Reese et al., 2023 were tuned to represent bulk present-day melt rates as well as to match the melt sensitivity at Filchner-Ronne (cold based) and Amundsen Sea ice shelves (warm based). In the tuning process, the input temperatures from Schmidtko et al., 2014 for each basin were adjusted so that melt rates, as well as melt rate sensitivities, would be in line with observations. These necessary, yet to a point unphysical, temperature corrections can hence be seen as an additional factor in the tuning. To be consistent with the tuned parameters, we will propose to take the forcing field from Reese et al. 2023 as present-day baseline temperatures. For estimating "upper bound" estimates of bathymetric-constrained warm mode onset, we will then add the difference of T_CSB minus T_CF (both derived from ISMIP6 dataset) to the existing forcing field. This follows the same "anomaly idea" taken in Kreuzer et al. (in discussion, doi.org/10.5194/egusphere-2023-2737)). We will make sure to expand the explanation of these temperature adjustments within the PICO tuning process in our method section.

Once we have new estimates we will include a more thorough comparison of our temperature as well as basal melt rate estimates to findings from previous literature, specifically in the key regions that the reviewers mentioned e.g. at Ross Ice Shelf and in the Amery region (both mentioned in RC1 on page 12), the gateways we find in the Amundsen Sea (esp. Abbot Cosgrove Trough, mentioned in RC3) as well as our temperature estimates in this region (mentioned in RC2), and subsequent melt rate estimates.

We will clarify the sign convention of z vs. depth and align it with commonly used definitions (in reply to RC1) and we will provide melt estimates in Gt/yr (in reply to RC2). We will further rework our Figures as suggested by all reviewers.

We will further gratefully take up the suggested language changes to specific wording within the text (see respective point-to-point response below).

For the specific comments made by the individual reviewers, please consult the respective point-to-point responses.

Response to RC3

General comments

Nicola and coauthors identify key oceanic pathways in the major Antarctic glacier basins and estimate current and future melt rates based on the present water properties, assuming that warm waters from the shelf break reach the grounding lines. I found it interesting to see the range of access depths and ocean water properties around the Antarctic Ice Sheet in one simple figure, and it is interesting to quantify the upper limit of future melting assuming warm water intrusion through these pathways. The data were clearly visualized, making it easy to synthesize the wealth of information presented. The analyses and profiles shown for the major ice shelves were especially nice to see and will make this study of interest to a range of groups who study various components of the Antarctic ice/ocean system.

I do not have any major concerns about the approach or the conclusions, as the caveats associated with this methodology are clearly noted in the discussion. I have several comments mostly relating to the presentation of the study, so I recommend this study for publication after minor revisions. I hope the authors find these comments helpful.

Dear Anonymous Reviewer 3,
Thank you very much for your review of our manuscript and your feedback. We will revise our manuscript keeping your suggestions close in mind. In addition to the general comment to all reviewers, please find our detailed point-by-point responses (written in blue and italics) to your comments (in black) *below.*

Specific comments

1. The motivation of the study could be more clearly laid out. Ocean gateways are important for ice shelf melting, but why does this analysis help the scientific community? Rather than giving a lengthy overview of why troughs and gateways are important and then explaining the approach, I suggest making a more concise overview of the importance, state (more clearly) what the critical uncertainties are, what the approach is, and what the hypothesis is.

Thank you for pointing this out to us. We will propose a more stream-lined introduction in the revised manuscript.

2. What are the criteria for classifying something as a 'prominent gateway'? In L145 the authors state that "large portions" of the GLs need to be reached, but how was this determined?

We apologize for any confusion regarding this definition. We will clarify this in the revised manuscript (see general comment above).

3. Section 3.3.4 (Amundsen Sea) – the main gateway is identified as the Abbot Cosgrove Trough. Is this distinct from the 'Eastern Trough' commonly referred to in studies about the Amundsen Sea (e.g., Dutrieux et al., 2014 already cited in this study)? Does it feed into the PIG-Thwaites Trough shown in Fig 9a, or is it separate? It would be helpful to clarify which of the oceanic gateways identified are/aren't in agreement with the main pathways identified in previous studies.

We appreciate you bringing this to our attention. We will elaborate on this in the revised manuscript.

4. The mismatch in melt rates between the approach in this study and the melt rates of Adusumilli need to be addressed, as that is critical for gauging how reliable the estimates of future melt rates are. Some regions do better than others, perhaps due to different reasons, so I'd suggest explaining this for each of the major ice shelf regions.

Thank you for this suggestion, when revising our basal melt rate estimates (see general comment above) we will make sure to add a more in-depth discussion to it in the revised manuscript.

5. I found Section 3.3 rather hard to read. Rather than explaining the results and then reviewing various relevant literature, I'd suggest reviewing the findings from the literature and then presenting the new results within that context. It feels very scattered in its present state.

Thank you for this feedback. We will restructure this section in the revised manuscript.

Other suggestions (to improve the presentation, not necessary for publication in my opinion):

1. In Figure 2, it would be nice to see the temperature relative to the pressure melting point.

We agree that stating the temperatures relative to the pressure-melting point would be insightful, as it would show the thermal driving. In PICO, the freezing point is evaluated for

each grid cell depending on its depth, such that we cannot define a basin-wide freezing point. We therefore would stay with providing the absolute temperatures.

2. Several figures likely need larger text to for readers to see the numbers in each of the small boxes – probably fine for PDFs, but not printing. Perhaps the numbers are not critical for understanding the figures, as the colors also reflect the values.

When possible, we will increase the fontsize of the respective figures in the revised manuscript.