Response to Review Comments

We thank the editor and reviewers for their efforts in making constructive remarks on our revised manuscript. Below you can find point-by-point replies to minor comments from Referee #1 (*font in gray and Italic*) and the corresponding revisions to the manuscript. In the revised manuscript ("Tracked-changes" version), revisions are highlighted by blue color. We hope that all the reviewer's concerns have been addressed adequately.

Referee #1:

I appreciate the authors' efforts in addressing my previous comments in the revised manuscript. I believe the manuscript is now close to being suitable for publication. I would appreciate it if the authors could consider the following minor points for further improvement.

We thank the reviewer for the overall constructive comments on the revised manuscript, and please find our pointwise response to the comments below.

Minor comments:

Introduction L 67: Another paper also conducted numerical experiments to examine the response in the Ross Sea to increased meltwater in the Amundsen Sea.
Kusahara and Hasumi (2013) "Modeling Antarctic ice shelf responses to future climate changes and impacts on the ocean", JGR-Oceans, doi:10.1002/jgrc.20166

We thank the reviewer for suggesting this reference relevant to our study, and we have added it in the revised manuscript (Line 67).

Section 2.3: The values of the parameters are missing. Please consider adding a table to specify the values for ρ_i, ρ_w, C_pw, L_f, γ_t, and γ_s. Additionally, could you clarify the type of formulation used for γ_t and γ_s?

We added the values for ρ_I, ρ_W, L_f and C_{pw} in the text explaining Equation (1) (Lines 186–187 in the revised manuscript). For the transfer coefficients γ_T and γ_S, we mentioned that "γ_T and γ_S are specified following McPhee et al. (1987) that assumes a viscous molecular sub-layer adjacent to the ice–ocean boundary." (Lines 195–196).

Quantitative Assessment of DSW/AABW: In my previous comment, I suggested a quantitative assessment of DSW/AABW. The authors responded that this was not addressed due to the difficulty in observation. However, considering that the model in this manuscript has been thoroughly validated with observation-based data, I still believe it would be meaningful to include model-based estimates in the manuscript.

We agree that adding quantitative estimates for the DSW/AABW production/transport will provide useful information for the scientific community. In addition, recently we found a few literatures providing rough estimates of the DSW (or HSSW) production rate in the Terra Nova Bay polynya (TNBP) , based on limited mooring observations or model simulations. In the revised manuscript, we computed the annual average production rate of DSW in the TNBP using the RAISE model simulation from 2003 to 2019, and compared our result with estimates from earlier studies. Such comparison results are added in Lines 391–395 of the revised version as "The annual average DSW production rate in the TNBP estimated from the RAISE model simulation is 0.33 Sv, which is between the estimate of 0.28 Sv from Jendersie et al. (2018) using a coupled ocean-sea ice model for the Ross Sea and the estimate of 0.43 Sv from Miller et al. (2024) using observations from a mooring in the TNBP. The estimated annual average DSW production rate in the RISP from the model is 1.23 Sv.". In addition, we added a figure showing the time series of DSW transports at the slope through the major three passages (troughs, Figure 12 in the revised manuscript), and derived the annual mean transport across each trough. We added these information in Lines 402–407 of the revised manuscript.

References

McPhee, M. G., Maykut, G. A., & Morison, J. H.: Dynamics and thermodynamics of the ice/upper ocean system in the marginal ice zone of the Greenland Sea, Journal of Geophysical Research: Oceans, 92, 7017-7031, https://doi.org/10.1029/JC092iC07p07017,1987.

Jendersie, S., Williams, M. J. M., Langhorne, P. J., and Robertson, R.: The Density-Driven Winter Intensification of the Ross Sea Circulation, Journal of Geophysical Research: Oceans, 123, 7702 – 7724, 10.1029/2018JC013965, 2018.

Miller, U. K., Zappa, C. J., Gordon, A. L., Yoon, S. T., Stevens, C., & Lee, W. S.: High Salinity Shelf Water production rates in Terra Nova Bay, Ross Sea from high-resolution salinity observations, Nature Communications, 15, 373, https://doi.org/10.1038/s41467-023-43880-1, 2024.