

## General Comments

This manuscript presents a well-executed and valuable contribution to our understanding of Atlantic Water intrusions onto the West Spitsbergen Shelf during winter. The authors are commended for their thorough analysis, detailed discussion of mechanisms, and extensive reference list. The modeling work is clearly presented and captures a range of relevant cross-shelf exchange processes with appropriate nuance and attention to seasonal variability. That said, several key methodological details currently placed in the appendices—particularly those relevant to the identification of the Atlantic Water core and diagnostics of shelf-slope dynamics—should be moved to the main methods section to ensure clarity and reproducibility. Some discussion of mixing processes and their role in modulating heat transport and density structure would further strengthen the work. Overall, I find the manuscript well-prepared and recommend publication after technical corrections.

- ⇒ Thank you for this positive and very encouraging feedback. Especially the fact that there is a strong agreement between the comments from you and the other referee review, provides a good basis for the revision of the manuscript. Besides moving information on the data processing from the Appendix to Section 2.2 (Data Processing and Analysis Methods) in the main manuscript, we have added some discussion on the effect of mixing for the intrusions. We hope that we could satisfactorily address all points raised.

## Specific Comments

**Title:** Consider adding “Mechanisms of...” to the beginning

- ⇒ Thank you for this suggestion, we believe it adds valuable information to the title and makes it more interesting. We have adjusted our manuscript accordingly.

**Line 4:** What is "access heat"? Excess? Please clarify or revise.

- ⇒ Yes, it should be “excess”. Thank you for spotting this.

**Figure 1:** The blue vectors along the West Spitsbergen Shelf are difficult to distinguish—consider making them thinner. Also, please bold the abbreviations for improved readability, particularly for colorblind readers.

- ⇒ We have added boxes around the labels to increase the readability and adjusted the arrow thickness as suggested.

**Line 69:** Is it possible to label the STC on the map in Figure 1? It seems to correspond to vectors branching onshore from the WSC, but this wasn't immediately clear until Section 3.2.

⇒ We have added a label and try to connect it with the respective arrows on the map using a black connection line (as suggested by the other review addressed in the same process)

**Line 137:** The phrase “expansion of multiple and relatively warmer isotherms... at several latitudes” is vague. Please consider quantifying this statement. Relevant details in Appendix B should be moved to the methods section.

⇒ We have moved the explanations on how we identify a warming event to Section 2.2 in the main body of the manuscript and rewritten the sentence in question to be more specific.

**Line 149:** Current properties are in the appendix too, please move relevant details to the methods section.

⇒ Yes, we have moved this into Section 2.2 in the main body of the manuscript as well.

**Line 154:** This equation is important and should be included in the manuscript body.

⇒ The equations for the calculation of the drag coefficient as well as the subsequent calculation of the wind stress and the Ekman transport have been included in the manuscript.

**Line 168:** Please include the standard deviation alongside the mean value.

⇒ Done.

**Line 191:** Can you quantify the tilt mentioned here?

⇒ We have added values for this into the text.

**Figure 7:** As with Line 149, it's unclear how the “core” is defined. This information should be relocated from the appendix to the methods. Also, subplots (b) and (c) are on log scales—please indicate this in the caption.

⇒ The caption has been updated to indicate the log scales of the two subpanels. The information on how current branch and core position were defined has been moved into Section 2.2 in the main body of the manuscript.

## Technical Comments

**Line 21:** The sentence on the cold vs warm pathways is a monster. As someone not intimately familiar with this region, I needed to go back and forth between the text and Figure 1 a lot. It would be helpful for the reader to break this up into 2 sentences. Particularly, consider breaking it where you go into further details on where the West Spitsbergen Current originates/divides.

⇒ Very valid feedback. We have improved the readability of this part by dividing it into smaller parts and shorter sentences.

**Line 165:** Did you mean to write “actual”? Please revise for clarity.

⇒ This part has been re-written, and we hope the content is clearer now.

**Lines 187 & 197:** “Subside” might be better replaced with “subduct,” depending on the intended physical process.

⇒ Yes, this is exactly what we mean. Great to get such detailed input from somebody with English as mother tongue, thank you.

**Line 277:** This sentence is overly complex, largely due to excessive parenthetical phrasing. A revision is recommended, and incorporating the appendix details into the main text would reduce the need for such parentheses.

⇒ This part has been rewritten and simplified, and the relevant details on the current identification can now be found in Section 2.2 in the main body of the manuscript.

**Line 328:** “Increase” should be “increases” to maintain subject-verb agreement.

⇒ Again, thank you for such detailed feedback on the grammar.

**Figure 9:** It would make more sense for all lines representing slope water to be colored the same and solid, and all lines representing shelf waters to be colored the same and dashed. Label the panels after naming them in the caption.

⇒ Thank you for your valuable suggestions. We have revised this figure accordingly and also added a small legend for improved readability.