Response to community comments on Kolås et al. EGUSPHERE-2023-2864*, The Polar Front in the northwestern Barents Sea: structure, variability and mixing.*

We thank Dr. Maria Dolores Pérez-Hernández for the constructive comments and useful suggestions, which helped to improve the manuscript. Below we provide a point-by-point response to all comments. Community comments are reproduced in *italic type in red* followed by our response in regular type in black color. The future tense refers to our plan to address the comments when preparing the revised version.

Response to community comments by Dr. Maria Dolores Pérez-Hernández

This study focuses on understanding the Polar Front over the sill between the Hopen Trench and Olga Basin, one of the four areas where AW meets Polar Water in the Barents Sea. The Polar Front is important for biological activity and mixing in the area. The results arise from two detailed fieldworks where hydrographic data from ship and glider sections are analyzed with altimetry, wind, and sea ice concentrations. This study is very interesting and highlights the high variability that the Polar Front has in terms of existing in location, shape, forcings, and time. The dataset used is available, and the study is relevant to the field. I suggest publishing it after some changes.

Thank you for your valuable feedback!

My main concern is Section 4.2, 'Polar Front structure and seasonal variability.' Here are some comments to help improve it:

- *The way it is written reads more like a general variability than a seasonal cycle, and it finishes with an average view. Results will be better understood if the section starts with the average view and, from there, moves towards seasonality.*
  We agree. The section could benefit from a different structure, starting with the average/seasonal change and moving on to short-scale variability. We will improve on this.
- *The seasonal cycle cannot be fully resolved with the available dataset. Nevertheless, a section in August could be used as representative of summer, 11 sections can be combined into a fall average section, and 4 sections can be averaged as a winter section.*
  Thank you for suggesting this. We will attempt to divide the different synoptic sections into seasonal averages and discuss the results. However, the number of figures in the manuscript is already at a limit. We will add three new rows to figure 5 to show what you suggest.
- *This section also has some minor issues, like using the term 'Atlantic-origin water' instead of 'modified Atlantic Water' as stated in Table 3.*
  The reason for using the term "Atlantic-origin water" is that it includes all the water masses originating directly from the BSO and the Norwegian Atlantic slope current, not only the "modified Atlantic Water". That is, it is not only mAW reaching the front. No changes made.
- *It is not said whether negative distances are located north or south of the sill in the caption of Figure 3.*
  Indeed. We now insert a sentence clarifying this.

- *At some point, it is stated that the velocities from altimetry match the DAC, and while that is true for October 19, the agreement is not as evident on the other two dates.*
  We agree. The barotropic geostrophic velocity calculated from SLA is a good indicator of eddies, their presence and their strength. However, it may differ from the depth average current measured by the glider as the DAC also measures the frontal current. We will elaborate on this in the text.
- *Transport estimations are only given for the average section (Figure 5). You could also estimate seasonal transports or, if not, a table with the transport for each time frame.*
  We will add a table to include the transports from both the individual and seasonal transects.
- *Overall, the text between lines 306 and 317 should be carefully revisited as they had some misleading errors.*
  - *Line 306-307. AW is separated from the surface by a warm and fresh layer; it is not cooler but fresher in the upper 60m.*
    Indeed. What we tried to communicate was that the subsurface AW core is separated from the surface layer (which is warm and fresh) by a colder interleaving layer between the AW core and the surface layer. We now clarify this in the text.
  - *Line 312. I don't see a cooling from December to February, as the years don't match. I see cooling on the glider dataset for November and December 2019 and the ship dataset for February 2021. These colder sections are relative to the August 2019 and October 2020 sections.*
    We agree. We rewrote to clarify this.
  - *Line 314-315. In February, AW is not present (being AW defined with temperatures higher than 2ºC and salinities higher than 35.06). From what is visible in Figure 3 a, lower 2 subplots, the northern side of the Front fits better with the description of modified AW given in Table 3.*
    Indeed. Only mAW and wPW is present on the Atlantic side of the front, both a result of AW cooling and mixing with PW. This is why we name them Atlantic-origin water, because it is not AW but a product from AW. We rewrote these sentences to clarify.
  - *Line 317. Assuming that negative distances are south of the sill, the average position lies 10km north of the sill, where the core of the positive velocities is found (Figure 5). Yet, it can reach as far as 10 km south of the sill in the 50 m depth and narrows from there to the bottom.*
    We agree. This was our point, but we will further clarify it.

- *Lines 415-416 and 420. The seasonality of the isopycnals is arguable. It says that the isopycnal tilt is flat in winter, while in Figure 3, the February sections have quite a tilt. Although the Glider sections of December have flat isopycnals, some of the October sections also present nearly flat isopycnals. So, this goes again with Section 4.2; perhaps a seasonal composite could be a better approach to assess seasonality or just blend it all under 'variability'.*
  We agree that the seasonality of the isopycnals is difficult to assess based on the current figures. We now produce seasonal composites to better show the change.

Some other minor issues:

- *Line 86 to 87. This sentence is confusing; I suggest rephrasing or avoiding mentioning Figure 1b. Here, the text refers to the data used in the study, while Figure 1b introduces a larger area.*
  Agreed. We rewrote it as "An overview of the data coverage across and near the front is shown in Figure 2.".
- *Line 94. Please explain how salinity was calibrated (AUTOSAL, Portasal,other?)*
  Bottle samples are analyzed at IMR with a Guildline Portasal 8410 salinometer. Salinity and

conductivity values measured by the Portasal for each sample are compared with the corresponding CTD data. Following the procedure recommended by UNESCO, only data within the 95% confidence interval are used to correct the calibration of the CTD conductivity. We now add a sentence on this in the text:
"The CTD system was equipped with a SBE 32 Carousell fitted with bottles for collecting water samples at all stations. Bottle samples were analyzed using a Guildline Portasal 8410 salinometer and used to calibrate salinity."

- *Section 2.2. Two paragraphs above, it said that the cruises will be referred to as fall and winter cruises, but in this section, the names of the vessels are used. You could recall the season after the cruise name at the beginning or go with the seasonal names.*
  Agreed. We added the seasonal names.
- *Line 121. 'of the PF location (Figure 2)'.*
  Agreed.
- *Line 201. EUMETSAT OSI-SAF (2017).*
  Corrected.
- *Line 291. AW depth exceeds 200m depth? Do you mean that the entire water column is AW? or that it spreads to waters shallower than 200m?*
  We only address the surface signature of the AW in this sentence, and state that the surface signature of the AW (warm water) is confined to the waters where the seafloor depth exceeds 200 m. In shallower total depths, the surface water tends to be colder waters. We clarified this by rewriting as "The surface signature of the AW inflow is confined to the waters where the seafloor depth exceeds 200 m, both during fall and winter.
- *Lines 297-298. Between November and December 2019, in Figure 1e, the sea ice rose to 10%. So perhaps you should extend the time frame to the end of January 2020.*
  Indeed. We will correct and clarify this.
- *Line 330 is the 'maximum' southward 'extension' of the 'PF.'*
  The southward extension of the PF on 17 October is not the maximum southward extension. It extends further south on 6 November and arguably during the February transects.
- *Line 407. This increase in salinity during winter is not mentioned in Section 4.2.*
  Indeed. We inserted a sentence about this in section 4.2 as well.
- *Lines 410-411, in Figure 3, a northward progression of the AW/mAW is observed near the bottom.*
  Thank you for pointing this out. You are right, but it is not really a seasonal change as it occurs during October when the eddy is passing through. Between 17 October and 16 February there is hardly any change. We now comment on this in section 4.3.
- *Figures*
  - *Figure 1 The caption should state which SST and sea ice product is used, as the references to Figure 1 start in the introduction.*
    Done.
  - *Figure 2. The caption should state what the blue, orange, and yellow triangles are.*
    Done.
  - *Figure 5 could benefit from having a lower row where the standard deviation section is shown to understand in which depths the front varies more.*
    Per your main concern about section 4.2, we will revisit this figure, adding seasonal composites.
  - *DACs are integrated in the figure with altimetry? Which depth range?*
    Glider DACs cover the entire dive. For most of the mission the glider dives to within 10 meters from the seafloor.