

General Comment

The manuscript addresses an important and timely topic: the recent freshening of Barents Sea waters and its implications for dense-water formation and downstream Arctic–Nordic Seas exchanges. The observational basis of the study is valuable, and the results have the potential to contribute meaningfully to our understanding of regional hydrographic variability. However, the clarity and structure of the manuscript require significant improvement. Many sentences are grammatically awkward, imprecise, or potentially misleading, which at times obscures the key scientific points. In addition, the Abstract does not clearly state what is novel about the work or how the methods lead to the presented conclusions. Several acronyms are undefined, figure elements are missing or mislabeled, and important methodological details—especially concerning data sources, section locations, and lag correlations—need to be clarified. The Results section would benefit from clearer structure, more rigorous quantification, and additional analyses (e.g., lagged correlations, trend estimates). Overall, the study is promising, but substantial revision is necessary to improve readability, scientific rigor, and interpretability.

We thank the reviewer for the positive and constructive comments. We sincerely value the reviewer's time and effort in providing feedback. We will include all suggestions and corrections pointed out by the reviewer. We are confident that the comments, corrections and suggestions provided by the reviewer will greatly contribute to enhancing the quality of our manuscript.

Specific line-by-line comments, including styling, typos etc.

Abstract – After reading the Introduction, I would say that the Abstract lacks specific mentions of the methodology used and the novelty of the results. For example, the Introduction states:

(Line 36) “The propagation of temperature and salinity anomalies from the North Atlantic through the Nordic Seas and into the Barents Sea through the BSO is well documented (references).”

A few lines below (Lines 51–52), the 2012–2016 AW freshening event and its propagation to the Nordic Seas is also described as “well documented (Mork et al., 2019).”

Then we read in the Abstract (lines 18-23): *“We present new evidence of the imprint of the extremely low saline waters in recent years in both parts of the Barents Sea resulting from the unprecedented freshening observed in the northern North Atlantic. While the salinity variability in the SBS is found to be affected mainly by the variability of the Atlantic Water salinity transported into the region, the salinity variability in the NBS is additionally influenced by the freshening due to the increased sea ice import from the central Arctic.”*

In my experience, an Abstract is more engaging when it highlights the specific methods used and the novel aspects of the results—what distinguishes this study from previous work, and what gap in our understanding of Barents Sea variability it addresses. To strengthen the Abstract, I suggest restructuring it according to the following logic:

- Briefly introduce the region and the central problem—Barents Sea freshening—as a unique feature that also reflects broader Arctic changes.
- Clarify what data or observational products were used to isolate the sources of the observed variability.
- Indicate which analytical approaches (existing or newly developed) were applied to address the problem.
- Present the key findings concisely, supported by quantitative evidence where possible.
- Conclude with the broader implication, e.g., how the recent freshening has affected the density of water masses exiting toward the Nordic Seas and the central Arctic.

Such a structure would help clarify the scope of the study and better convey the novelty and significance of the results.

I believe that this could clear the scope of the paper and engage more the reader to dig into it.

We fully agree. We will rewrite the abstract based on the above suggestions listed by the reviewer.

At lines 25-27: "is found to result in the lowest density of the dense waters exiting, respectively to the Nordic Seas and to the Central Arctic" – there's no ordered pair to map onto with "respectively". So "respectively" has nothing to attach to and it can be corrected to "dense waters exiting to the Nordic Seas and the central Arctic."

We agree. Will be corrected.

Introduction

Lines 38–40:

The phrasing "time lag of approximately 2–3 years between the inflow region to the Nordic Seas in the south and the BSO" is clumsy and unclear. I suggest rephrasing it to:

"a 2–3-year lag between the Nordic Seas AW inflow region and the BSO."

Thank you. Yes we agree

Lines 42–46:

The sequence "The freshening was attributed..." followed by "On the other hand..." reads as contradictory. It is unclear whether the mechanism is already established or still under discussion. I recommend restructuring this part starting with:

"Holliday et al. (2020) attributed the freshening to anomalous winter..."

and then introducing the contrasting view with "However/On the other hand..."

Thank you. Yes we agree

Figure 1:

The source of the SSS data is missing, as is a reference to Table 1 (which currently has no caption or numbering). Please add the appropriate citation or reference.

We will specify the source of the data. Also, we will add the Table caption and numbering. We thank the reviewer for pointing this out.

Lines 74–75:

The placement of “respectively” is unusual. I recommend moving it to the end of the phrase:

“...into the Nordic Seas and into the central Arctic, respectively.”

This construction is more standard.

Thank you. Yes we agree

Lines 87–90:

The Introduction does not clearly articulate the specific motivation for this study or explain why answering this question matters for Barents Sea dynamics. Why is it crucial to quantify the potential impact of these changes on dense-water formation and subsequent advection? A clearer statement of the study’s relevance would help anchor the reader.

Thank you. We agree, in the introduction we will add all the details suggested above.

Data and Methods

Line 93:

The text refers to “Table 1,” but the table currently has no caption or numbering. Please add a proper caption and table numbering throughout the manuscript.

Thank you for pointing this out. The mistake will be rectified.

Line 97:

The phrase should read “including such as” or simply “including”. As written, the grammar is incorrect.

We agree. Will be corrected.

Line 101:

There is a missing space between “data:” and “The CCI.” Please correct the formatting.

Thank you. We agree. Will be corrected.

Line 101:

ESA, CCI, and SSS appear for the first time here and should be defined upon first use. The same applies to SMOS and SMAP (Line 104) and EASE (Line 106). To avoid repeated explanations and potential confusion, I strongly recommend adding a table listing all acronyms (SBS, NBS, AW, BSO, SAT, etc.) and their definitions. This would greatly improve readability.

We agree. The table listing all acronyms will be added.

Line 110:

ICES is also introduced without definition. Please define it at first mention and/or include it in the acronym table suggested above.

Thank you for pointing out. Definition will be added

Table 1:

As noted earlier, the table lacks a caption. Please add one, along with a clear description of the variables, datasets, or products included.

Thank you. We agree. The caption will be added.

Results

Line 121: Is the division of the Barents Sea into NBS and SBS commonly used in prior studies? If so, please provide an appropriate reference. If not, please add a brief explanation of why these particular boundaries were chosen—e.g., whether they are based on bathymetry, circulation features, or another criterion.

We agree. We will add a brief explanation

Line 123: More specificity is needed regarding the described trends. Please clarify:

an increasing trend *until when?*

and/or

a decreasing trend *since what year?*

Are these computed trends or a visually analyzed from the plot?

We agree. Trends are computed. Details will be clarified in the revision version of the manuscript.

Line 129: The Svinøy section appears without sufficient context. It is not shown in Figure 1 (the map does not extend south enough), and it is introduced only briefly earlier (Line 110).

Figure 1 will be redrawn with location of the Svinøy section added.

Please add the location of the Svinøy section to a figure and describe it in more detail in the Methods section.

As it stands, the reader lacks the necessary information to understand the results shown in Figure 2.

Thank you for pointing out the mistake. We agree. Figure 1 will be redrawn with location of the Svinøy section added.

General comment on the page 6: Including a lagged correlation analysis between SBS, NBS, and BS salinity anomalies and the observations at BSO and Svinøy would help quantify differences in connection strength between SBS and NBS. Testing different lag times would also allow comparison with previously reported 2–3-year lags (Lines 37–38) and provide measurable, interpretable metrics.

Yes, we agree. We will perform a lagged correlation analysis as suggested by the reviewer.

Line 163: I believe you meant Figure 2a, not 2b. Please check.

Yes, that's correct. Thank you for pointing out the mistake.

Line 170 – The description of SSS acronym appears too late in the text. This reinforces the need for an acronym table introduced early in the manuscript.

Yes we agree. Will be corrected.

Lines 174-178 – Please consider adding a plot showing decadal SSS trends from 1992 to 2024. The variations discussed in Lines 174–175 seem to represent part of a decadal

pattern rather than a true trend over a short interval. I also note a distinct freshening event around 2013 in the CCI dataset, which should be addressed.

We will include the recommendations of the reviewer, and the manuscript will be revised accordingly.

General comment: It would greatly improve clarity to divide the Results into subsections, for example:

- **1 SBS (Lines 113–150)**
- **2 NBS (Lines 157–189)**
- **3 Downstream effects (Line 190 onward)**

This structure would make the narrative easier to follow.

Thanks for the suggestion. Yes, we agree and we will divide the results into subsections.

Lines 179-183 and Figure 5: In the caption for panel (a), a key word such as “difference” seems to be missing. As written, it is unclear what is being shown:

“Winter mean sea ice drift velocity (difference?) ... between the time periods...”

Panel (b) strongly suggests that the metric is the difference between two periods. Please clarify this explicitly.

We agree with the reviewer. We will clarify the details mentioned above.

Lines 196-197: The phrasing here is awkward. “In the last ten years ... to unprecedented low levels in the 1993–2024 period” implies that the unprecedented lows span the entire period, which is contradictory.

A clearer alternative would be:

“In the last ten years, however, the decrease in salinity has further reduced density to levels unprecedented within the 1993–2024 record.”

Yes we agree. Thank you for the suggestion.

Figure 6: The temperature, salinity, and density axis labels are too small to read easily. I recommend enlarging them, as well as increasing the size of the colored circles to improve visibility.

Yes we agree. The figure will be redrawn.

Summary and discussion

Line 217: "... 1980s) during when ..." *during* can be eliminated without losing sense.

Yes, we agree. The sentence will be corrected.

Line 219: The expression "move in concert" is too informal for the scientific context. I suggest replacing it with a more formal phrasing such as:

"...temperature and salinity changes were previously in phase."

or

"...temperature and salinity previously co-varied."

Yes, we agree. The sentence will be corrected.

Line 235: The proposed mechanism requires further justification. Additional discussion of advection pathways or supporting transport estimates would strengthen this argument.

Thank you. Yes we will add an additional discussion to this part

Line 237: As mentioned earlier, a correlation analysis with a clearly defined lag would substantiate this statement. Without such quantitative support, the conclusion appears speculative.

Yes we agree. We will perform a lagged correlation analysis

Line 242: A trends figure is needed to support the discussion and referenced trends. Please include a dedicated figure showing the relevant temporal evolution.

We agree. We will add the figure

Lines 279-281: Is the underlying mechanism already established in Midttun (1985)? If so, please clarify the connection and cite the result explicitly. If not, this needs to be explained more clearly.

We will clarify the connection

General comment for this section: I missed the metric computation and strict comparison, such as lag time, correlation – to show the difference in connection strength, trends, which are discussed but not presented.

We agree. We will perform the analysis recommended by the reviewer and the manuscript will be revised accordingly.