Response to Reviewer 2's comments

We thank Anonymous Referee #2 for their review of the manuscript. In this response letter, our comments are written in purple (this font), and the Referee's comments are shown in black Arial. For the final revision, we will add more details in the response letter and include a version of the manuscript with tracked changes.

In the presented manuscript the Authors propose a future pathway of Atlantic Water towards the Barents Sea, taking place across the channel between Edgeøya and Hopen islands. As it appears to be smaller than other existing AW pathways, the Authors emphasize the role of this inflow on the Olga Basin, reservoir of the coldest and thickest Arctic Water layer, and impact on East Spitsbergen Current important for the shelf and fjords west of Svalbard. Under this assumption, the Authors provide a comprehensive analysis of interannual and seasonal variability of hydrographic conditions in the region based on historical and new data during late autumn as well as year-long data from mooring.

The paper addresses important aspects of the Barents Sea region, being a hot-spot in Arctic picture and falls very well in the scope of OS. The data are novel and provide crucial information on largely unexplored region. The study site description is comprehensive, data and methods are carefully selected to extract as much information as possible to provide valuable results and discussion. However, sometimes it appears to be overloaded and difficult to receive, and some things need to be rephrased/restructured to reach a broader audience. Nevertheless, I believe that this paper is valuable for scientific community and can serve as an important input to understanding the Atlantification of the Barents Sea. Below, I suggest some minor corrections before publication.

Thank you for your review. Your constructive feedback helped improving our manuscript substantially. In the revised version, we have improved clarity and readability. Please see below where we address each comment.

Introduction

I find the Introduction very accessible, readable and comprehensive. The only suggestion is to rephrase/create the hypothesis or state research questions to make the goal of the paper more emphasized. From Introduction it appears that this small area (the channel between Edgeøya and Hopen islands) is largely unexplored, which makes your data novel and of great importance. We also know, that AW in Storfjordrenna is becoming warmer and is observed at shallower depths, so first you can hypothesise that due to the above observations the

expansion of AW through the channel may increase leading to the formation of a future pathway of AW (persistent?) into the Arctic Ocean. Then, you can write about the role of this inflow, e.g. the sentence in line 72 and I think it is also worth mentioning, that increased AW inflow here can be of great importance for ESC (you mentioned it in Discussion: line 462), which on the other hand, is crucial for the marine and coastal environment of west Spitsbergen.

We are pleased to hear that the Introduction was positively received, and appreciate your suggestions to emphasise the hypothesis and research goal. In response, we have incorporated comments in the Introduction on the effects of AW inflow on sea ice and stratification in the Olga Basin, the ESC, and the environment along the west of Spitsbergen.

Figure 2: Red dots across the saddle are not clearly visible, which makes wrong first impression, that the transect in 2019 is only made along the channel. Please fix this. Are the dots representing the transect from Storfjordrenna to Olga Basin the same as the transect shown in Figure 3?

Thank you for pointing this out – we agree that this should be clearer. We have increased the size of the dots across the saddle and adjusted the colours to make them more distinguishable from each other. The transect indicated by the red dots in Figure 2 is not exactly the same as the transect marked in Figure 3. To facilitate easier comparison, we have added dots to indicate the climatological section in Figure 2 as well.

Data and methods

This section includes a lot of details, which is good and proves that the Authors carefully and thoughtfully selected data and analysis methods to defined scientific problems. However, the description, despite specific information, makes this section available for rather narrow audience. This is especially true for mooring data. To clarify, I suggest stating clearly at the beginning of the paragraph in line 114, what the mooring data are used for, that those data are utilized to investigate variability in ocean currents and temperature associated with a) let's say direction of the flow, b) selected time scales, including semidiurnal tides, weather-band processes (explanation/example?) and low-frequency activity (explanation/example?). Therefore, for a) the coordinate system was rotated with -42°… and for b) -28°… . This small rephrasing will help more clearly see and remember how the data will be analyzed. Then you can write about cutoff frequencies for different time scales.

Thank you for this suggestion. We have revised this part along the lines you suggest.

Line 120-121: I think this needs a little explanation of the method and the purpose/justification for its application.

We have included a sentence in the beginning of this paragraph to clarify the purpose: “In order to identify the time scales of variability, we used spectral analysis.” We also reformulated the choice of parameters for the wavelets to “gamma = 3 for symmetric wavelets and beta = 5 to resolve the variability on time scales between semidiurnal and a few weeks reasonably in both frequency and time”.

Results

Lines 148-149: What is the reason for choosing this particular isoline (34.7 g kg^{-1})? Can it be representative for “pure” or Atlantic origin water? As you mentioned in the Introduction, that you investigate the Atlantic origin inflow in this area, it would be useful to define this somehow and follow the idea.

The salinity of this isohaline is slightly too low to represent pure AW. If the study site had been more dominated by pure AW, using the salinity threshold for AW would have been more informative. Instead, we chose a less saline isohaline representing a mixture of AW with fresher ambient waters, illustrating how this Atlantic-origin water has expanded. For further details about the water mass definitions, please refer to the comment below.

Line 151: Could you more specify Atlantic origin water? I understand that this is rather challenging, especially when you describe seasonal evolution, where water undergoes significant modification and AW just provides heat and salt to the region. However, maybe it would be appropriate to define it/add some description (one sentence) in the Introduction? Or when you say about, for example, “pure” AW, then in brackets you can give some values stating this.

We agree. In the Data and Methods section, we have added a definition of Atlantic Water (Conservative Temperature exceeding 2 degrees and Absolute Salinity exceeding 35.06 g/kg following Sundfjord et al., 2020) and also clarified what we mean by “Atlantic-origin water” by adding the sentence “We define the Atlantic-origin water as the AW that is modified or transformed en-route from the WSC through Storfjordrenna into relatively warm and saline water compared to the surrounding water masses but colder and less saline than pure AW”.

Line 155-157: Figure 5 says that all measurements (Nov 2019, Oct 2020, Nov 2021) were performed across the saddle. However, from Figure 2 I kept in mind (I was pretty sure), that Nov 2019 was preformed from Storfjorden to Olga Basin (red dots). As I mentioned red dots across the saddle in Figure 2 are not clearly visible, which makes a wrong first impression. Please fix this.

We agree that this was not clear enough. We have adjusted the size and colours of the transect markers in Figure 2. It is now visible that the transect across the saddle was done in all three years.

Line 176: “close to the pure AW properties” means what exactly? This water hasn’t been defined in the manuscript before.

We have added the water mass definition for pure AW in the Data and Methods section and further clarified the temperature and salinity observed here.

Line 258: Here you give some examples of analyzed time scale, which should be clearly stated in section Data and methods.

We have clarified in the Data and Methods section how we identified these time scales by modifying the paragraph about band-pass filtering:

“The spectral analysis revealed the frequency bands with the dominant variability. To study the fluctuations in these frequency bands, which we associate with semidiurnal tides, "weather-band" processes, and lower-frequency activity, the time series were band-pass filtered. We selected cutoff frequencies based on the spectral analysis results, with corresponding periods of ten hours to 14 hours for the semidiurnal tidal band, 28 hours to 10 days for weather-band processes, and seven days to six weeks for lower-frequency activity.”

Figure 7: Dotted lines representing cutoff frequencies for the semidiurnal tidal band are hardly seen. Is it possible to make them more visible?

We increased the size of all dotted lines for the semidiurnal tidal band.

Discussion

This section is also overloaded with information and sometimes it is hard to follow. I propose to make some corrections for better reading of the text.

In section 4.1 you want to discuss interannual and seasonal variability in hydrography of the region with asking a question if 2018 – 2019 was a typical year. I suggest to start from discussing only a mooring year, comparing autumns 2018 and 2019, explaining AW inflows. Then you can make a comparison with other years (transect across the saddle and time series from Figure 12). At the end you can address the question asked.

Thank you for the suggestion. We agree that it improves the flow of the section. In the revised manuscript, we have reorganised Section 4.1 to begin with comparing the autumns of 2018 and 2019. We then describe and discuss the warm water intrusions in the mooring year, followed by

a discussion on the transects on the saddle together with the time series in Figure 12, before finally addressing the main question.

Line 333: “However, the mean SST in 2018–2019 was higher than all years between 1981 and 2006” - Does it add anything significant to the discussion?

Thank you for pointing this out – it is indeed not significant to this section of the discussion. The intent was to show that 2018–2019 was a “normal” or relatively average year in the context of the new warmer era. We moved this sentence and much of the rest of the paragraph to Section 4.4, where it fits better.

Figure 12: Please add to the figure caption, that this is from the mooring location.

Thank you – we have adjusted the caption.

Figure A1 and A2: please add to the captions what the magenta diamond indicates.

We added “The mooring location is indicated with a pink diamond.”