

## **Response to RC1**

Thank you for your time and constructive comments on the manuscript “Impacts of anomalies in Arctic sea ice outflow on sea ice in the Barents and Greenland Seas during the winter-to-summer seasons of 2020”. We would consider each comment carefully and incorporate practically all of them in the revised manuscript.

### **Major comments**

1 Title:

I would like to see a better title. The current title read: “Impacts of anomalies in Arctic sea ice outflow on sea ice in the Barents and Greenland Seas during the winter-to-summer seasons of 2020” When I look the following text, I felt the manuscript is mainly dealing with the factor that create the Arctic sea ice outflow anomalies, as author stated in the abstract (L9): “the impacts and feedback mechanisms on a seasonal scale of anomalies” So, I suggest authors to speak out what “impacts”, e.g. atmospheric circulations. One possibility could be: The impact of atmospheric circulations on the anomalies of sea ice outflow and their feedback mechanisms in the Barents Sea and Greenland Sea

Reply: Thank you for comments. We will revise the title to “The impact of atmospheric circulations on the anomalies of sea ice outflow and their feedback mechanisms in the Barents Sea and Greenland Sea” following this suggestion, to emphasize the impacts of atmospheric circulation on sea ice outflow.

2 Abstract:

There are totally 322 words. I think it is too long, please compact it to e.g., 250 words. However, if TC accepts a long abstract, so be it, but please add some compact analyses/statement to echo latest state of the art findings. I am sure there are papers dealing with Arctic sea ice outflow

Reply: Thank you for pointing this out. We will abstract and add some key analysis results from our study.

3 Introduction:

This part is largely ok, but as I have stated in previous point, please consider echoing your work with UpToDate finding. I recommend authors to check Sumata et al., 2022. This paper should be cited in your work. Some comparison would be even better in results/discussion section. The language can still be improved. This comment valid for entire manuscript.

Reply: In the revised manuscript, we will quote some latest literature to echo our work, especially Sumata et al. (2022). Through comparing the results derived from this paper, it is conducive to further enriching our research conclusions. In section 4.3, we will add some analysis to compare the scenario with the relatively low Arctic sea ice outflow discussed by Sumata et al. (2022). We will further improve the expression and language throughout the manuscript.

#### 4. Data and method:

I am quite impressed that such comprehensive data sets are used in this work, well done. I wish authors could make further elaborate on data accuracy and comment/assess the data consistency, for example, authors wrote “Here, we used the CryoSat- 122 2/SMOS SIT from December to April, and the PIOMAS SIT from May to June in 2011–2020 to estimate the anomaly in SIT during the study year of 2020”. Do I need to worry about the inconsistency of the data sets applied here?

Reply: According to this comment, we will further elaborate on the accuracy of the data and assess its consistency, especially for the sea ice thickness products we used.

Line: 180-182: “We note,,,”. So, this do suggest that in study deals with the impact of the atmosphere on sea ice not ocean at all. I suggest authors express this argument explicitly already in the beginning, e.g., introduction.

Reply: In the revised paper, we will follow this suggestion and state in the introduction what our study focuses on.

#### 5 Results:

Figure 2 is very comprehensive and informative, yet in the main text, I see only once Figure2 (the first column of Figure 2), please add more instruction on what text explain/analyses other columns of the Figure 2.

Figure 3 is also very informative; I suggest you separate last row of each panel to make it clearer and easier to distinguish from others. Furthermore, any patterns can be extracted from this figure?

3.3 section is very interesting. However, in order to prove the effectiveness of the reconstructed results of the ice floe backward drift trajectory, it would be interesting to compare the ice floe backward drift trajectory with forwarded observed buoy drift trajectories for example, under the scenarios of AO+, AO-, CAI+, CAI – and see whether the buoys’ drift trajectories are consistent with the reconstructed results. If not, any impact on your results and conclusions

Could you elaborate further whether or not the abnormal AO and CAI would have impacts on sea ice thermodynamics, e.g. total ice mass balance before ice floes reached the Fram Strait? I would like to see more discussions.

Reply: Thank you for the constructive comment, the following is the corresponding response:

- 1) In fact, section 3.1 contains some instructions for Figure 2, but does not indicate the corresponding columns of the figure. We will add the corresponding column indications of Figure 2 after the corresponding text.
- 2) We will separate the last row of each panel of Figure 3 to make the image clearer and easier to understand. We will add some summary text extracted from Figure 3 in section 3.2 to highlight the knowledge obtained from Figure 3.
- 3) We will add some analysis in Section 3.3 to verify the validity of the reconstruction results of sea ice backward drift trajectory. We plan to use the observed buoy data for validation. For the selection of buoy data, we choose buoys with drift trajectories in January–June during the years with the AO+, AO-, CAI+, and CAI- atmospheric circulation patterns.
- 4) To further check whether there are some influences of the atmospheric circulation pattern with abnormal AO and CAI on sea ice thermodynamic process, we will add the corresponding discussions. First, we calculate the average trajectory of the sea ice backward trajectory for the AO+, AO-, CAI+, and CAI- cases during January–June. After obtaining the reconstructed trajectories, we will compare the Freezing Degree Days (FDD)—the integral of air temperature below the freezing point over the freezing season, and the reanalysis data of atmospheric surface heat flux obtained along the reconstructed trajectories in the years with different atmospheric circulation patterns to assess the influence of AO and CAI on the changes in sea ice thermodynamic process. In addition, we note that Sumata et al., (2022) found that the sea ice in the region south of 82°N near the Fram Strait was affected by strong heat supply from the ocean and thus melted rapidly. Therefore, we will compare the lengths of time that the reconstructed trajectory within the region south of 82°N before the floe reached the Fram strait in the case of abnormal AO and CAI to further illustrate the effect of atmospheric circulation patterns on the thermodynamic mechanism of sea ice.

## 6 Discussion:

Please strengthen the linkages of your work with the latest state of the art of research e.g., Sumata et al., (2022). In such extreme season, what are the possible impacts of Arctic sea

ice outflow on the a) sea ice state and b) marine hydrographical and c) ecological conditions in the Barents Sea and Greenland Sea?

Reply: In order to strengthen our links with the latest research, we will add some comparative discussions in section 4.3. We selected 2018, mentioned in Sumata et al. (2022), to obtain the effects of abnormally low Arctic sea ice outflow on sea ice state, marine hydrographical and ecological conditions in the Barents and Greenland Seas. The results will be compared with that given by Sumata et al. (2022).

## 7 Conclusions and recommendations

I suggest you drop recommendations because you merely “recommended to further collect the in situ observation,,,, in the study region” which is not necessarily entitled as recommendations, unless if you recommend some specific concrete parameters/variables or some specific instrumentation to be observed or to be used and further to be linked to each other.

Reply: We will drop the recommendations and revise the section title as the suggestion.

### **Minor comments**

2) Figure 1: There is no need to define a geometrically regular study regions for the BGS. Its northern boundary can be consistent with the defined passageways, and the area bordering Greenland and other islands can be consistent with the shoreline.

Reply: Good point. We will change the defined study area of the Barents and Greenland Seas in Figure 1 as the suggestion.

3) Line 107 “In addition, we used data from the NSIDC Sea Ice Index version 3 (Fetterer et al., 2017) to obtain monthly SIA changes in the Northern Hemisphere in 2020.” The purpose of using this data is unclear. In addition, data from the Arctic should be used instead of data from the Northern Hemisphere.

Reply: We will correct this description mistake of the data and add the purpose of using the data in the revised manuscript.

14) Section 4.3, 1) also consider the scenario with low Arctic sea ice outflow, 2) Does North Atlantic Oscillation have a significant regulatory effect on the marine environment of BGS?

Reply: We will add some discussions on the impact and feedback under the scenario of abnormally low Arctic sea ice outflow. We will also further test the synchronous and

lagging correlation between the North Atlantic Oscillation and sea ice and oceanographic parameters in the BGS region.

- 1) Line 50: “plays a crucial role in shaping the icescape in this region”-- change the “shaping” to “proving the preconditions”
- 4) Line 205 “regulating the sea ice outflow from the TPD region to the BGS” change to “regulating the sea ice outflow from the Arctic Ocean to the BGS”
- 5) Line 234 “resulting in relatively low SIAs of” change to related to..., Arctic sea ice outflow is only one of the factors affecting the reduction of Arctic sea ice.
- 6) Line 266 “was insensitive to the changes in the TPD intensity or the CAI pattern” delete “the TPD intensity or” because you did not directly quantify the strength of TPD.
- 7) Line 309 “the monthly surface heat fluxes” (and also other text) change to “the monthly atmospheric surface heat fluxes”
- 8) Line 323 “sea ice during winter and early summer 2020.” change to “sea ice during spring and early summer 2020.”
- 9) Line 370 “the absorption of incoming solar radiation” delete the “incoming”.
- 10) Line 376 “are larger in the southern BGS (76°–80°N) than in the northern part (72°–76°N)”-- this should be a mistake.
- 11) Line 395 “the complex interactions between SST, SIC and Chl-a” change to “the complex interactions between SST and SIC”.
- 12) Line 401 “the year” change to “the study year”.
- 13) Line 403 “the abnormal Arctic sea ice flow” change to “the abnormal Arctic sea ice outflow”.
- 15) Tables in Appendix: consider using simple expressions to indicate different significant levels, e.g., text in bold, or *Italic*.

It would be nice to apply professional language service for the entire manuscript

Reply: Thank you for your careful advice. All grammatical mistakes and inappropriate expressions will be revised as suggestions. We will apply for professional language services to improve the language throughout the entire manuscript.