

The Cryosphere Discuss., referee comment RC1  
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## Comment on tc-2022-246

Anonymous Referee #1

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Referee comment on "The impacts of anomalies in atmospheric circulations on Arctic sea ice outflow and sea ice conditions in the Barents and Greenland seas: case study in 2020"  
by Fanyi Zhang et al., The Cryosphere Discuss.,  
<https://doi.org/10.5194/tc-2022-246-RC1>, 2023

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Review on "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" by Zhang et al.

The Arctic sea ice reacts strongly to climate change. The common and well-recognized features are thinning of sea ice thickness and the shrinking of sea ice extent. On a local or regional scale, especially for those areas that are either associated with 1) the major sea ice formation, e.g., the northern coast of Greenland, the Lincoln Sea or 2) the major sea ice outflow transportation, e.g., the Fram Strait are of the great research interests. Because any perturbation or anomalies occurring in those areas are likely to have a major impact on the total sea ice budget and the downstream marine environment and the ocean circulation in general.

This paper focuses on sea ice outflow in two regional seas (the Barents Sea and the Greenland Sea). The topic belongs to the second category of great research interests (in my own opinion) stated in the first paragraph above. So, for this reason, I am very pleased to see such research has been carried out. The study subject fits well with the scope of TC. I recommend this work to be accepted by TC but with a precondition that the authors will carry out further improvement following my comments below because I do see there are still rooms to improve this work:

### 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 looked at the following text, I felt the manuscript is mainly dealing with the factor that creates the Arctic sea ice outflow anomalies, as the author stated in the abstract (L9): "the impacts and feedback mechanisms on a seasonal scale of anomalies" So, I suggest authors 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

#### 2 Abstract:

There are 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/statements to echo the latest state-of-the-art findings. I am sure there are papers dealing with Arctic sea ice outflow

### 3 Introduction:

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

### 4 Data and method:

I am quite impressed that such comprehensive data sets are used in this work, well done. I wish the authors could make further elaborate on data accuracy and comment/assess the data consistency, for example, the authors wrote "Here, we used the CryoSat- 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?

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

### 5 Results:

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

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

The 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 on 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.

### 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 seasons, 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 the Greenland Sea?

### 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 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.

Minor comments:

- Line 50: "plays a crucial role in shaping the icescape in this region"-- change the "shaping" to "proving the preconditions"
- Figure 1: There is no need to define 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.
- 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.
- Line 205 "regulating the sea ice outflow from the TPD region to the BGS" changes to "regulating the sea ice outflow from the Arctic Ocean to the BGS"
- 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.
- Line 266 "was insensitive to the changes in the TPD intensity or the CAI pattern" delete "the TPD intensity" because you did not directly quantify the strength of TPD.
- Line 309 "the monthly surface heat fluxes" (and also other text) changes to "the monthly atmospheric surface heat fluxes"
- Line 323 "sea ice during winter and early summer 2020." change to "sea ice during spring and early summer 2020."
- Line 370 "the absorption of incoming solar radiation" delete the "incoming".
- Line 376 "are larger in the southern BGS (76°–80°N) than in the northern part (72°–76°N)"-- this should be a mistake.
- Line 395 "the complex interactions between SST, SIC and Chl-a" change to "the complex interactions between SST and SIC".
- Line 401 "the year" changes to "the study year".
- Line 403 "the abnormal Arctic sea ice flow" changes to "the abnormal Arctic sea ice outflow".
- 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?

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

Reference:

Sumata, H., de Steur, L., Gerland, S. et al. Unprecedented decline of Arctic sea ice outflow in 2018. Nat Commun 13, 1747 (2022). <https://doi.org/10.1038/s41467-022-29470-7>.