Responses to referee #2

Interactive comment on "Multi-model based estimation of sea ice volume variations in the Baffin Bay" by Chao Min et al.

General Comments:

The sea ice volume variations within the Baffin Bay is investigated using model-based sea ice thickness and NSIDC sea ice drift product. Since field measurements of sea ice thickness is scarce, this study presents the best way to estimate the sea ice in-flow/outflow of the bay. Moreover, the volume amounts in associated with freezing and melting processes are also quantified. Generally, this is a good attempt to conduct the studies related to sea ice volume, which is a better indicator, in relative to area, to interpret the current rapid climate changes.

Dear Reviewer:

We would like to thank you for the helpful comments to improve this manuscript. Following your suggestions, we calculated the correlations between NAO/AO and sea-ice volume and sea-ice volume fluxes in Baffin Bay. As suggested by another referee, we further added the locally merged SIT observations and OSISAF ice drift to improve the estimation of the volume fluxes. We also revised the spelling mistakes and grammatical errors.

Below, we repeat each comment and insert our replies in the text where revisions were made. All responses are in blue font for clarity.

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Specific comments:

Point 1: L77, ". . .in Fram Strait and obtained" to "..in Fram Strait to obtain..'

Response: We realized that it was ambiguous in the previous version. We changed this sentence to *'Additionally, CMST is successfully applied to obtain a relatively accurate estimation of the year-round sea ice volume export through the Fram Strait (Min et al., 2019).'*

Point 2: L79 "2.2…" L88 "2.3"

Response: Thanks for your conscientious review of this manuscript. We revised this in our revised manuscript.

Point 3: L101 ".. the years…" to " the short period".

Response: Following your advice, we changed this sentence to: *Since the TOPAZ4 reanalysis data cover a short period from 2014 to 2018, the TOPAZ4 SIT and SID are only used for inter-comparison with the other sea ice data but not for any volume or*

flux calculations in this study.

Point 4: L110 " … full filled…" to "… fully filled'
Response: We have changed the "… full filled" to "… fully filled".

Point 5: L114 "date" to "data"
Response: We changed the "date" to "data".

Point 6: L140 " are a typical representation" to " typically represent"
Response: Thanks for your comments. We modified this sentence: *'We have chosen these months as they typically represent the seasonal cycle'.*

Point 7: L166 the sentence for " A fairly … ice drift". Make it to two short sentence in order to clarify your description.
Response: Thanks. Following your advice, we split this sentence into two short sentence: *'A fairly similar cycle of SID is shown by CMST, TOPAZ4 and satellite-based observation. However, both CMST and TOPAZ4 present a higher ice velocity than that from satellite-based observation while NAOSIM and PIOMAS underestimate the monthly mean ice drift'.*

Point 8: L181 "Originate" to "Originates".
Response: We modified this as suggested.

Point 9: L186-189, this sentence is too long to follow the content. I recommend the authors to make it short or by dividing it to two sentences.
Response: Thank you for this suggestion. We modified our description as follows:
Landy et al. (2017) developed a 14-year SIT data in the eastern Canadian Arctic (ECA) from ICESat, CryoSat-2 and passive microwave (PMW) snow depths, then merged with SMOS where the mean CryoSat-2 thickness is <1 m. This satellite-based data is successfully utilized to calculate the local sea ice volume variation in the Baffin Bay while the sea ice volume fluxes and thermodynamic growth are not involved (Landy et al., 2017). Here we further calculated the SIV inflows, outflows and thermodynamic SIV growth from 2011 to 2016 with the usage of sufficiently validated CMST, widely used PIOMAS, parameter-optimized NAOSIM and satellite-based SIT data.

Point 10: L197, remove ", respectively".
Response: We removed ", respectively" as suggested.

Point 11: L199 "In average" to "On average"
Response: Thanks, we have changed the "In average" to "On average".

Point 12: L210 "invested" to "investigated"?
Response: We have modified this sentence: *In this study, the locally thermodynamic processes are further investigated with the consideration of sea ice freezing, melting*

and volume fluxes (Fig. 5).

Point 13: L214, “in average” to “on average”
Response: We changed the “In average” to “On average”.

Point 14: L224 “found” to “identified”
Response: We changed “found” to “identified” as suggested.

Point 15: L226 what “these areas” represents for? Please clarify.
Response: We changed our expression to: *We thus speculate that the thick ice is exported from the Arctic since the higher ice velocity is also found in the corresponding area of the thick ice located (i.e., Nares Strait), and the faster ice is usually deemed to be a proxy for higher ice flux.*

Point 16: L240 “with of the usage” to “with the usage”.
Response: Thanks. We changed “with of the usage” to “with the usage”.

Point 17: Does the author have considered the impacts of large-scale atmospheric circulation, such as NAO, on the variations of sea ice volume in Baffin Bay? The NAO may be associated with the inflow/outflow, as well as the freezing and melting processes. Therefore, through the analysis of the correlation between NAO and sea ice volume changes owing to these processes may give us a preliminary understanding of the role of the large-scale atmospheric circulation in modulating the Baffin Bay sea ice volume variations.
Response: Thank you for this constructive advice. We added an analysis on the correlation between NAO/AO and sea ice volume changes as suggested. The correlation coefficient (CC) between NAO/AO and SIV inflow and outflow for seasonal data are shown in Figure 1. The CCs between NAO and SIV inflow and outflow are 0.67 and 0.58, respectively. For AO and SIV inflow, the CCs are 0.31 and 0.37, respectively. However, we know that the long-term (climatic) time series of sea ice fluxes are required to substantiate these findings.
As suggested, we added this discussion in the discussion section.

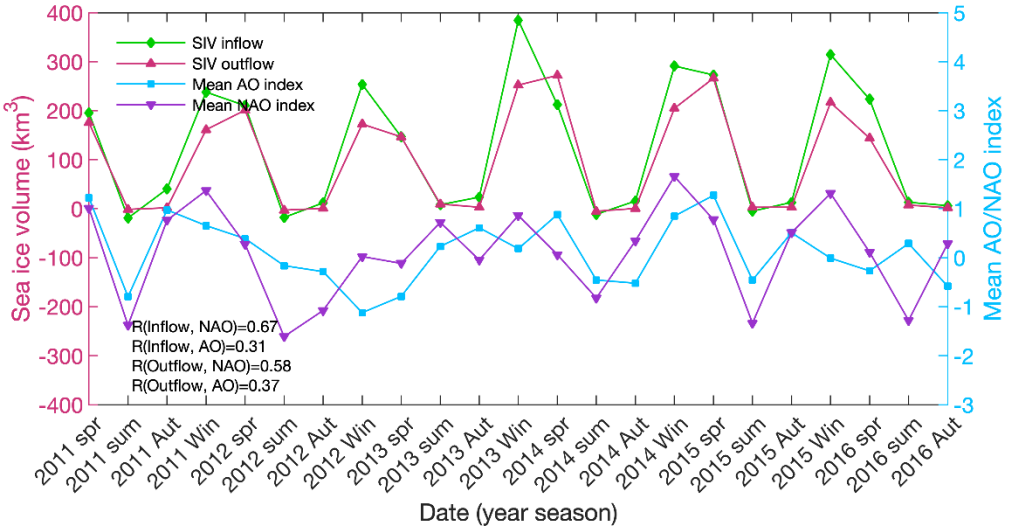

Figure 1 Time series of seasonal mean sea ice volume (SIV) inflow (green line), outflow (violet red line) in the Baffin Bay. The NAO (purple line) and AO (cyan line) indexes are averaged in the same period. R represents the correlation coefficient between NAO/AO and inflow and outflow.

Reference

Landy, J. C., Ehn, J. K., Babb, D. G., Thériault, N., and Barber, D. G.: Sea ice thickness in the Eastern Canadian Arctic: Hudson Bay Complex & Baffin Bay, Remote Sens. Environ., 200, 281-294, doi: 10.1016/j.rse.2017.08.019, 2017.

Min, C., Mu, L., Yang, Q., Ricker, R., Shi, Q., Han, B., Wu, R., and Liu, J.: Sea ice export through the Fram Strait derived from a combined model and satellite data set, The Cryosphere, 13, 3209-3224, doi: 10.5194/tc-13-3209-2019, 2019.