

Interactive comment on “Satellite-observed sea ice area flux through Baffin Bay: 1988–2015” by Haibo Bi et al.

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The paper investigates sea ice area flux through Baffin Bay from 1988–2015, using satellite observations of sea ice motion and sea ice concentration (NSIDC). In particular, the authors calculate the ice area flux at three gates in the north, middle and south of Baffin Bay. They evaluate variability and trends of ice area flux as well as links to sea level pressure (SLP) and the North Atlantic Oscillation (NAO) index.

Response: According to the comments of reviewers, we rework the study with the primary focus on the subject regarding the sea ice inflow and outflow through Baffin Bay (Figures 1 and 4). Hence, three fluxgates are considered in the revision, including the North Gate, South Gate, and Lanscater Sound. The Gates were renamed with

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a reference to geographic location to facilitate the direct understanding of readers. Moreover, the inflow components from different ice sources is examined, including sea ice area flux from Smith sound (Nares Strait), Lanscater Sound, as well as ice grown in North Water Polynya (NWP) (Section 5.1). The interannual variability is connected to the cross-gate sea level pressure (SLP) difference (Section 5.2). The linkage with NAO is not held in the new submission, since reviewer 2# suggests a fragile relation between NAO and sea ice flow in Baffin Bay exists because the effects of NAO is likely kept away from Baffin Bay by the high elevation of Greenland ice sheets. Furthermore, causes for the increased sea ice area flux are related to the sea ice thickness decline associated with a warmer climate. Therefore, the new submission represents for a substantial revision of the initial work.

General Comments: I don't really see that the paper is following a particular thread. The formulation of the goals in the introduction is very brief and general. The authors should make clear if this is rather a method paper, introducing a new data set, or a scientific study to investigate sea ice fluxes and related processes in the Baffin Bay.

Response: In the new submission, we make a straightforward attempt of this study to investigate the sea ice inflow and outflow through Baffin Bay and related causes for the observed interannual variability and the trend in sea ice area flux over the nearly 40-yr time series record (Section 1).

I find many motivations and conclusions questionable. For example, what is the motivation to compare the derived Baffin bay fluxes with the fluxes in the Fram Strait? I don't see why this is relevant. At most, one could compare the net fluxes of different gates in the Arctic and estimate the total sea ice export. But the mechanisms in both regions are very different. The Fram Strait ice flux is characterised by multiyear sea ice, which is advected by the transpolar drift and exported through the Fram Strait. In contrast, the Baffin Bay ice fluxes are characterised by first-year ice in winter, when no multiyear ice is exported through the Nares Strait due to an ice bridge. During summer, this ice bridge is collapsing, and multiyear ice can be exported through the Nares

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Strait. These processes are not well explained in the paper, but are very relevant to understand ice fluxes in this region. Another debatable point is the decadal change around the year 2000. This seems arbitrary. The interannual variability seems to be quite substantial and therefore I don't think that there is a significant change in SIF between those particular decades (see Figure 2).

Response: These comments are very insightful. Following the suggestions, the comparison with Fram Strait is not saved in the revision. The importance and effects of sea ice bridge to block ice inflow are reiterated in the manuscript (Section 2.1.3). For instance, Figure S1 gives a typical case of ice bridge formed in Nares Strait. However, due to the coarseness of NSIDC ice motion data (25km), compared to smith sound (~30 km), it is unlikely to accurately estimate sea ice flux in such a narrow gate. For narrow fluxgate like Smith Sound, land contamination would be a severe problem to satellite observations. Instead, in reference to a published result of between 1996/97 and 2008/2009 about ice flux via Nares Strait that was derived high-resolution satellite observations (such as SAR in Kwok (2007), with a spatial resolution of several hundred meters), we get an estimate of ice grown in North Water Polynya (NWP). That is, by subtracting the inflow from Nares Strait and inflow from Jones Sound from the ice inflow across the North Gate, the part of sea ice grown in NWP is then obtained. Based on the suggestions, the simply separation in 2000 do not have scientific implications. Rather, the results about the decadal changes with respect to the annual month-to-month variability for four different decades are described in section 4.1 and shown in Figure 10.

Another major concern is the presentation. There are too many figures, sometimes of low quality, and with too little significance. I strongly recommend to revise the figures in order to better support the findings and main messages of the paper. For example, Figures 8, 9 and 10: It is neither explained the meaning of the lower case letters in the brackets, nor the meaning of the rows (i guess the different gates + Fram Strait?). I would also suggest to better separate results and discussions. In the results section,

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findings are often discussed. Considering all these concerns, I suggest very substantial revisions. Actually, I think that many parts of the paper need to be rewritten, and also the analysis and conclusions need to be reconsidered, before it may be suitable for publication.

Response: Thanks for these valuable suggestions. In the revision, we remove lots of figures and rewritten most of the parts. The results and discussion are further adjusted for a clearer separation. Indeed, the new submission represents for a reworked version of the study. The analysis and conclusions are considered after a prudent consideration.

Detailed Comments: P3L1: What is the motivation to consider three passages at the chosen locations?

Response: The fluxgates are reselected in the revision. The North Gate and Lancater Sound are chosen to stand for ice inflow while the South Gate is selected to represent the ice outflow via Baffin Bay. The middle gate is not useful to convey new knowledge and not held then. The North Gate is different from the first submission for its relocated place toward a further north position. This gate is designed to provide valuable information about ice inflow from different ice sources, including Jones Sound, Nares Strait, as well as NPW.

Please add some explanation. Figure 1: There are Chinese (?) letters in the figure.

Response: Modified as suggested

P5L21: What do you mean here (and in other places) with "grid"? Do you mean grid cells, pixels? This needs to be explained better, i.e. use grid cells or pixels.

Response: Corrected as suggested

P10L6-7: can you proof that this change is significant? In view of Figure 2, I would doubt. See my major concern above.

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Response: Please refer to the relevant response to the major concern

Figure 2: Make the figure larger, please!

Response: Modified as suggested. See Figure 5 in the revision

Figure 3: The scaling of the arrows changes between 0.1 km/day and 10 km/day.

Please use a uniform scaling. Otherwise, the different months are hard to compare.

Response: Modified as suggested. See Figure 7 in the new submission.

Figure 7: What are a, b, c and d? There is no information in the figure caption.

Response: This Figure is removed but other Figures with multiple panels are all added with the figure caption (For example, Figures 10, 13, and 14).

Figure 14: Make the figure larger, please!

Response: This Figure is removed

P17L3: "For passages A and B, the increasing SIM trend (Figure 10b and f) is primarily caused by a positive SIF trend" : : : This doesn't make sense. SIF is derived using SIM.

Response: This is a wrong sentence and has been reformulated.

P24L4-5: "However, Figure 16 suggests that the monthly SIF is only slightly 5 correlated with the NAO index for the three passages through Baffin Bay ($R = 0.23$ – 0.32)" : : : Why should they be correlated? See my major concern above.

Response: The NAO effects are kept away due to the height of Greenland ice sheets. Therefore, we remove the concerning discussion of the linkage with it.

Please also note the supplement to this comment:

<https://www.the-cryosphere-discuss.net/tc-2018-136/tc-2018-136-AC3-supplement.pdf>

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Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2018-136>, 2018.

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