

Interactive comment on “Long-term variation of sea ice and its response to thermodynamic factors in the Northwest Passage of the Canadian Arctic Archipelago” by Xinyi Shen et al.

Anonymous Referee #1

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Long-term variation of sea ice and its response to thermodynamic factors in the Northwest Passage of the Canadian Arctic Archipelago

Shen and others investigated the spatiotemporal characteristics of sea ice extent and thickness in the Northwest Passage regions of the Canadian Arctic Archipelago from 1979-2017 and also looked at the forcing links from SAT and SST. The Northwest Passage does represent an important region worthy of scientific investigation but there are significant problems with this manuscript that are as follows:

The first problem is the quality of the data used in this study which has major implications for the results they present and the conclusions they draw. The qual-

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ity of AO’s FVCOM sea ice thickness estimates within the CAA has not been assessed/validated and therefore it is unknown how much uncertainty there is and how much the results can be trusted. I looked at the Zhang et al. (2016b) JGR paper and I noticed all the in situ measurements were outside the CAA so in fact, there was no sea ice thickness validation done in the CAA. There are in fact in situ measurements of ice thickness as well as airborne EM induction data which could be used for validation (e.g. Haas and Howell, 2015; Howell et al., 2016). Furthermore, there have been major recent assessments of model performance in the CAA which have not been cited (e.g. Howell et al., 2016; Kushner et al., 2018; Laliberté et al., 2018). These uncited studies the authors have missed relate the problem with state-of-the-art climate models having difficulty resolving sea ice thickness within the CAA (Howell et al., 2016; Laliberté et al., 2018). In short, the authors have not provided enough evidence to state that the AO’s FVCOM is any better than other models whereby large over estimation in the trends was found to be problematic in the CAA. Another data quality problem not discussed by the authors is from altimetry sea ice thickness estimates within the CAA. Sea ice thickness retrievals from satellite altimetry are highly uncertain within the majority of the CAA (certainly the NWP) because there no leads (see Landy et al., 2017).

The second problem is the lack of new information on sea ice conditions within NWP. For example, the authors are incorrect to state that “only a few studies have focused on the sea ice conditions in the NWP”, “sea ice conditions in the NWP rarely have been examined based on subregional divisions” and “only sea ice concentration has been taken into account in most previous research.” Almost every study the authors cite and the numerous they do not cite (because they missed a lot) all do this (e.g. Howell et al., 2008; Tivy et al., 2011; Derksen et al., 2012; Haas and Howell, 2015; Mudryk et al., 2018) and as a result, the justification for this study very weak and then when I got to the results I found that there was not really any new information that is not already known. For example, they boldly state that “Furthermore, exploration of the driving mechanisms that influence the sea ice variation in the NWP was insufficient in prior research because atmospheric and oceanic thermodynamic factors exert significant

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effects on the sea ice conditions.” I do not think the author’s have immersed themselves in the literature sufficiently to make this bold statement and their results are certainly less rigorous than previous studies (see Tivy et al., 2011 for links to SAT). Moreover, there is not one reference to previous studies in Section 3-4 of this manuscript and there is a vast body of work on CAA trends/variability which should have at least been compared to. Another is example of a lack of understanding is evident when discussing why the correlation between SAT and sea ice thickness is low. The author’s completely ignored (or missed) that the reason is because snow thickness has been found to be the primary driver of ice thickness within the CAA not SAT (see Brown and Cote, 1992 and Howell et al., 2016).

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