The Cryosphere Discussions

Interactive comment on "Thermodynamic and Dynamic Ice Thickness Changes in the Canadian Arctic Archipelago in NEMO-LIM2 Numerical Simulations" *by* Xianmin Hu et al.

Anonymous Referee #1

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Thermodynamic and Dynamic Ice Thickness Changes in the Canadian Arctic Archipelago in NEMO-LIM2 Numerical Simulations

Hu and others developed and presented a high resolution model to look at simulated sea ice thickness in the CAA from 2002-2016. They compared their model output to ice thickness from the Canadian Ice Service. From the title, I was expecting the authors to look at thermodynamic and dynamic processes contributing to variability and change but they only scratched the surface. Overall, I feel the authors did not really use the model to its full potential. I think some additional analysis and interpretation is required and I offer the following suggestions:

1. I was very surprised the authors chose not to look at the entire CAA ice thickness time series separating out dynamic and thermodynamic from 2002-2016 similar to their Figure 4 site specific plots. Doing this would probably illustrate when (and then where) changes in these processes are occurring over the longer term record and this certainly would allow for more discussion. Also, related to thickness distribution changes they could investigate if the model can identify the regions of very thin ice (i.e. invisible polynya's) similar to Melling et al. 2015 and look at longer term variability.

2. Section 3.2.1 provides useful information by separating the dynamic and thermody-namic component of ice thickness but it would also be better use the model to identify locally grown MYI from MYI advected from the Arctic Ocean. It would be also be use-ful to spatially illustrate changes in the source of MYI. Furthermore, why not construct an ice mass budget for the CAA and look at how it changes from 2002-2016? These additions would give more substance to the manuscript.

3. Why did the author's chose to start the study in 2002? I would think looking at longer term changes would provide more useful information to the readers and provide more opportunity to compare to Sou and Flato (2009).

Specific comments: Page 1, Line 1: "Sea ice thickness evolution within the Canadian Arctic Archipelago (CAA) is of great interest." Why?

Page 2, Line 5 National security issues?

Page 2, Line 5 Replace "opening" with "using"

Page 2, Line 13 The dates of that study are from 1979-2008. Does this statement still hold true? Looking at recent work posted on The Cryosphere Discussion appears to indicate large changes have occurred in the last 10-years which could negate that statement. Rephrase. See Mudryk et al. (2017) in The Cryosphere Discussions.

Page 2, Line 23 Replace "export" with "transport" and replace "in the past" with "known to occur."

Page 6, Lines 9 to 18 I think it is important to state that the sites are all on landfast sea ice.

Page 6, Table 2 I think the reader could better identify with actual place names and not an acronym.

Page 8, Line 10 It would be useful to include some correlation coefficient values for comparison.

Page 24 Could you confirm this by looking at a long time series? I'm puzzled by the 2002 start date.

Page 11, Line 5 It is been shown MYI flows down into these regions. How much is convergence compared to thick MYI?

Page 12, Section 3.3 A lot of methodology and techniques are being introduced the results section. Suggest moving to methods.

Figure 2. There are no y and x-axis labels.

Figures 4-6 No y-axis labels. Also, why not produce this figure for the entire CAA? That would be more useful and also show changes in ice thickness (dynamic versus thermodynamic) over a 15-year period. I don't feel the work reflections the title. See major suggestion 1.

References:

Mudryk, L., Derksen, C., Howell, S., Laliberté, F., Thackeray, C., Sospedra-Alfonso, R., Vionnet, V., Kushner, P., and Brown, R.: Canadian Snow and Sea Ice: Trends (1981–2015) and Projections (2020–2050), The Cryosphere Discuss., https://doi.org/10.5194/tc-2017-198, in review, 2017.

Melling, H., C. Haas, and E. Brossier (2015), Invisible polynyas: Modulation of fast ice thickness by ocean heat flux on the Canadian polar shelf, J. Geophys. Res. Oceans, 120, 777–795, doi:10.1002/2014JC010404.

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Interactive comment

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