

Review of “Sea-ice thickness on the northern Canadian polar-shelf: A second look after 40 years”

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Submitted to The Cryosphere – tc-2021-393

Author’s response to tc-2021-393-referee-report-2:

Line 8-10: Can this sentence be revised to clarify that data was collected from August 31 to December 10, and the instrument was recovered in May. It might help provide more detail than the general “winter 2009-2010”.

The text has been modified in response to this comment.

Line 16: revise to read “ ... When prior data are available for comparison”.

The referee’s suggested revision has been implemented.

Line 21-22: Thank you for adding in this part to clarify that MYI area has declined.

No response necessary.

Line 47-50: consider revising to read something like “...because they are estimates from satellite altimeters that suffer from issues relating to snow depth, infrequent measures of sea level height, and a relatively large footprint (20-70 m diameter); in situ validation has been minimal (Kwok et al., 2020).”

The text has been modified in response to this comment.

Line 59: Consider revising to “More recent studies of ice in this area have focused on...”

The referee’s suggested revision has been implemented.

Line 86: remove “become”.

Done.

Line 103: replace “in-drift” with “import”

“in-drift” has been replaced by “inflow” .

Line 108: “... when the Arctic climate...”

Done.

Line 131-132: Were the IPS ever deployed in Byam Martin Channel? Perhaps this text can be updated and suggested as an area of future work in the Discussion section.

The sentences “We chose Penny Strait for the first year of 130 observation with an eye further west on Byam Martin Channel in future years. Because inter-annual variation was likely to be appreciable, we planned to sustain observations over several years” have been replaced with:

“We chose Penny Strait for the first year of observation. Comparable data have since been collected elsewhere along the margin of the last ice area, in Byam Martin Channel and in Nares Strait. Because inter-annual variation was likely to be appreciable, we sustained observations in these channels for several years”.

Line 154: “...south-western side of Penny Strait...”

Done.

Line 185-186: Can you provide examples in brackets of what moderate and weak drift speeds are?

This sentence actually documents the speed of wind, not ice. The referee’s recommendation has been implemented. At the same time a previously overlooked error in the documentation of directions has been corrected.

Line 213 and 215: revise to “southeasterly winds” and “northwesterly winds”.

Done.

Line 238: Suggest adding “... and the assumption of no snow”.

The text has been modified in response to this comment.

Line 364: revise to "... minimal change in multiyear ice thickness here during the last four decades". Population is a little misleading as there is less MYI than previously.

Done.

Line 372: It would be worth adding reference here to Kacimi and Kwok (2022) who recently showed amplified thinning of multiyear ice in the Arctic Ocean over the ICESat-2 time period (2018-2021). This would show greater thinning since the Kwok and Untersteiner work in 2011.

Kacimi, S., & Kwok, R. (2022), Arctic snow depth, ice thickness, and volume from ICESat-2 and CryoSat-2:2018–2021. *Geophysical Research Letters*, 49, e2021GL097448. <https://doi.org/10.1029/2021GL097448>

I have chosen not to adopt this suggestion by the referee. My rationale is that the Kwok and Untersteiner paper is that most relevant to the 2009 observations presented in my paper. The 2022 paper would of course have been the best if the sonar data were available for the years 2018-2021 which are the focus of the paper by Kacimi and Kwok.

Line 461: Remove "the" from "... area of ice within the which was thicker than 4 m..."

The referee's suggestion has drawn my attention to this unclear sentence, although the correction suggested was not appropriate. The text has been revised.

Line 504: replace "within" with "downstream of".

This suggestion depends on how the geographic extent of the "last ice area" is defined, which is vaguely. In reality the enigmatic nomenclature ensures that, to borrow from Joni Mitchell, "we won't know what we have got 'til it's gone". Clearly, any definition is time dependent. I chose to consider that, at present, the "last ice area" is the domain in which multi-year ice is dominant. Therefore, the observing site is, at present, at the southern margin of the last ice area. I have adjusted the text accordingly.

Line 524-526: Can these two types be referred to qualitatively as well as quantitatively based on thickness and chord length? Perhaps something like: Type 1, large conglomerate pans of MYI, and Type 2, smaller fractured ridges or rubble fields.

The text has been modified in response to this comment.

Line 530: suggest replacing "thermal wastage" with "loss".

I have replaced "wastage" with "ablation".

Line 539-541: I really like this revised conclusions section. I think it expands the implications of this work, but I would suggest revising the last part of the sentence to read "hundreds of kilometers in down-drift directions across the Canadian Polar Shelf and in the Beaufort Sea (via the Beaufort Gyre), Baffin Bay (via Nares Strait) and Greenland Sea (via Fram Strait).

The text has been modified in response to this comment.

Line 541: replace "they" with "the".

Done.