

Dear Jenny,

Thank you very much for your suggestions that were really helpful. We implemented them as described below. In addition, we asked a native speaker for his comments on grammar and style, which has hopefully improved the clarity of expression.

Line 3: "The closing corresponded to". As a native English speaker I would not choose to use "corresponded to" here. While this word is technically okay I would choose "presented" as this word invokes that you used a natural event as an opportunity to investigate the ice dynamics.

Done

Line 40: Do you mean to include precision of 2.01m? Also, what is mean maximum sail heights? The length scale over which you average is important. Sails can be much taller than this. I am off the opinion that this information is not actually needed here, and even a little hard to unpack.

We have removed it and only cited the papers where more information can be found.

Line 69: Kwok (2002) is singular, so change "have shown" to "showed" or "has shown".

done

Section 2

"We quantified the large-scale thermodynamic growth and thickness changes in the FYI zones, the latter from the decrease of FYI area during the closing of the polynya"

... this is not completely sensical. Do you need to replace thickness changes with "thickness redistribution"? It would also help to specify if this is quantified from observations or a model.

We rephrased this to "We quantified the thermodynamic growth from a model simulation and the large-scale dynamic thickness increase in the refrozen polynya from the decrease of the area covered by the refrozen polynya."(L85)

line 125: "is base on the strong conductivity difference between seawater and ice used to determine the vertical distance" Grammar is off a bit here, perhaps simplify the sentence. " AEM thickness retrievals find the distance to the strongly conducting seawater under the ice.

We rephrased this to "AEM thickness retrievals find the distance to the strongly conducting seawater under the ice."(L99)

line 130: I do not understand what you mean by "the effects compensate for the mean thickness". Rephrase. I think you mean "The two effects compensate each other such that the mean thickness is found to be in close agreement with drill-hole measurements." Do you need to specify this is for ridges, or are the effects only compensated with you include level ice?

We rephrased this and clarified it in the text (L104): "When averaging over longer distances of ridged ice, the two effects compensate each other such that the mean thickness is found to be in close agreement with drill-hole measurements."

line 149: We seperated MYI from the newly formed FYI

Done

line 162: You have not defined the variables in the Equation. Also, I think you want to specify you perform the fit to the ice thickness distribution.

We rephrased this to (L132) "We characterized the tail of the ITD by the e-folding lambda of an exponential fit to all the ice categories of the ITD thicker than the modal thickness h_{mode} . The exponential fit has the form $f(h) = a \cdot e^{-\frac{h}{\lambda}}$ "

$\text{trm}\{h\}_{\text{trm}\{\text{mode}\}}\{\lambda\}$ where h is the thickness of the different bins and a is a fitted parameter.

line 172: along which profiles? Specify Polar-5 or icebridge.
We specified this in the text (L137).

Section 2.2: How different are the answers for the growth rate based on the model you used and freezing degree days? The reason I ask, is it is important to understand the magnitude of the volume error that thermodynamics growth might present.

The thermodynamic thickness stated by Ludwig et al. (2019) on March 31 differs by 23-28 cm from ours (see their Fig. 10). Ludwig et al. (2019) discussed the difference between their modeled results and the modal ice thickness and attributed the differences to insufficient heat flux assumptions in the models (esp. ocean heat flux) or rafted level ice. We refrained from discussing the difference between their and our estimates in our paper because our thermodynamic growth was in very good agreement with the observations of the level ice thickness. Even though we cannot rule out that our level ice filter sometimes erroneously detects rafted ice as level ice, we still think that the majority of the level ice was undeformed and hence representative of the thermodynamic growth.

line 209: I would remove the sentence about not accounting for the reduced ice growth as the mean thickness increases, because the model does this for the level ice and is reducing the ice growth rate as the mean ice increases dynamically. Unless you are using the model to only track level ice thickness, and have turned off the dynamics.

The estimates of the thermodynamic growth (from the MITcgm) is uncoupled from the dynamic changes, because dynamics were switched off. Therefore, we regard this sentence as important information to our reader.

In general you need to define variables in your equations. Equation 2 define y for example.
Thanks for the advice. We added the missing definitions (e.g. L. 178, 180, 246, 262)

line 349: $-\text{div}(vh) = -h \text{div}(v)$

We were not sure whether you comment referred to Equation (4) (L244) or the inline Equation (L248) that follows shortly after when we explain that we work in a Lagrangian framework. We have changed the inline question (L248) according to your suggestion. In case of Eq 4, we would like to quote the "basic" Equation that could still be used in an Eulerian framework as well.

line 365: only very locally
done

line 390: "quantify the thickness change from the large scale" does not make sense to me. Do you mean "for the large scale"?

We rephrased this to (L270) "In this section, we first quantify the large-scale dynamic thickness change, that is linked to the decrease of the refrozen polynya area"

Table 1: Check formatting. It is overrunning a margin.

Luckily, that was only a problem of the track-changes. In the revised version, the table fits again.

Line 546: I am not sure quoting the mean trajectory length means anything here.
We removed it.

line 551: I think you need a "that" in front of dominated. This sentence is quite long, consider splitting it to easy readability.

We have rephrased this to (L349) "For example, the ice parcels of the Shear Zone experienced divergence in the early deformation phase (March 3-6). During the main deformation phase, convergence along the coast dominated their deformation history (March 16-20)."

Line 619: Specify what "it" is in "it lacks the frequent occurrence ..."

done

Line 647: "notions of the importance of the ice dynamics" What notions? Personally I would either not choose to use this word or I would clarify "notions of the ice dynamics being significant to the thickness distribution". Notions is really just a wishy-washy word. You can quote Rothrock, Thorndike or Wadhams on the importance of redistribution in the thickness distribution.

Thanks for the hint on the word "notions". We have rephrased this whole section (see also below) to (L414s): "This large contribution of sea ice dynamics is consistent with Kwok and Cunningham (2016) who attributed approximately 42–56% of the seasonal changes in mean regional ice thickness to dynamics in the Canadian Arctic Archipelago. In the light of a future Arctic ice cover which is expected to be thinner and more dynamic than now, our results may improve predictions on the impact of sea ice dynamics on future ice thickness changes, and if stronger and more frequent deformation could partially compensate for the expected increase in sea ice loss. For example, Itkin et al. 2018 concluded that divergence in winter followed by new ice formation is currently responsible for an ice volume increase of 7% in the sea ice north of Svalbard."

Line 650: " if stronger and more frequent deformation can contribute to could partially compensate for the expected, continuing sea ice losses. " If you are going to claim this as motivation for your study you do need to give some indication as to how unusual your results are that 50% of the thickness increase is due to dynamics. I think you just need to be more quantitative in the comparison of the three studies.

We added more information and rephrased this (see above).

line 655: flight -> flights

Done

line 665: as a linear function

Done

Section 4.2: This testing of theory is actually some of the more interesting outcomes of your work, in my mind. I wonder if it deserves some mention in the abstract.

We hoped to have summarized the results of this section in the abstract by "Results show a linear proportionality between convergence and thickness change that agrees well with the ice thickness redistribution theory. We found a proportionality between the e-folding of the ITDs' tails and the total deformation experienced by the ice."

Figure 3: You show the exponential fit, not the e-folding value. Change caption to reflect this.

Done

Figure 4: "By March 1, 2018, the thermodynamic thickness amounted to 0.38 m" Perhaps a better sentence is "The new ice that grew in the polynia was 0.38m thick by March 1, 2018."

Done