

Review of revised version of Ludwig et al. “The 2018 North Greenland polynya observed by a newly introduced merged optical and passive microwave sea ice concentration dataset”.

I would like to thank the authors for their thorough revision work and the answers they provided to my earlier comments and reviews. The manuscript is now much better balanced between the introduction of a new AMSR2+MODIS merged SIC product, and the discussion of the specific Feb 2018 polynya. The polynya part still stands stronger than the merging part, but this is much improved with respect to the first version.

I can recommend the publication of this manuscript in The Cryosphere. I provide below some comments and suggestions that I hope the authors can consider while working on their final revision. I also report some typos.

Comments and suggestions for further analysis

The manuscript is quite thorough (not lengthy) in its analysis of the polynya event. I would however suggest to put slightly more efforts on the climatological context (Figure 1).

The first suggestion is to move from using OSI-401 (the operational SIC product of OSI SAF) to using OSI-430-b (the newly released Interim Climate Data Record – ICDR). OSI-430-b is built with a main objective to be consistent with OSI-450 from January 2016 onwards. Since OSI-430-b has a 16 days latency, it fully covers your time period. You can find OSI-430-b information and data from http://osisaf.met.no/p/ice/ice_conc_cdr_v2.html. It should not be much additional work, and would save you from commenting the consistency between OSI-450 and OSI-401 in section 2.2.1 and 4.1. On that topic, the sentence “The time series of both products is consistent at the transition (Lavergne et al. 2019)” (p. 6 lines 12-13) is very far fetched, since Lavergne et al. 2019 does not deal with neither OSI-401, nor OSI-430-b. The consistency of OSI-450 and OSI-430-b at the transition is -at time of writing- only documented in the Validation Report for the OSI-450 and OSI-430-b products (<https://osisaf.met.no/docs>).

The second suggestion for Figure 1 starts as a question: is the 1979-2017 average computed from the “ice_conc” variables in OSI-450 data files, or does it also use “raw_ice_conc_values”? Variable “ice_conc” only contains SICs up to 100%, while “raw_ice_conc_values” gives access to the full error distribution of retrieved SICs, that is including values retrieved above 100%. A suggestion is thus to combine variables “ice_conc” and “raw_ice_conc_values” to prepare a non-thresholded SIC field before averaging. Using the non-thresholded is the correct way to prepare Figure 1, as otherwise the average curve can only be below 100%. The impact on the curve is not known, but it might raise the mean level to something closer to 100% (as expected). If you implement this change, please add a sentence to describe that you did combine the two variables before averaging. If you do not implement this change, please add a sentence stating that your average did use the thresholded SICs, and thus must result in lower SICs than could have been the case.

Finally, I would invite you to include in your discussion a dedicated paragraph on the difference between lead fraction products, and SIC products. You have elements of this in your text, but it would be an added value of this paper if you could wrap this in a “discussion” paragraph. In effect, you consider your merged SIC product is better because it shows more leads (at the beginning of the event). However, as you note, these leads might well be already refrozen when observed by MODIS (and AMSR2). In that case, a perfect SIC product should not show them at all. I understand the thrust towards showing high-resolution features such as leads in coarser resolution products, but should they all really be shown as reduced sea-ice concentration? Are there other ways the lead information could be shipped to users? Please discuss shortly.

Minor edits and typos

Throughout the text. It is a widely accepted convention to use “sea ice” as a noun (“sea ice froze rapidly”), but “sea-ice” when qualifying one of its characteristics (“the sea-ice concentration dropped”, “sea-ice edge moved ...”). Consider fixing throughout the text.

All the maps: you consistently have your Greenland filled with green (!). However many of your colormaps contain the color green (e.g. Figure 5, Figure 9). Consider finding a better color for filling Greenland.

P. 1, line 14 : “Two estimates of thermodynamic ... of 60 and 65 cm at the end of March in the area opened by the polynya”.

P2. line 3: “the fraction of a given ocean area which...”

P2. line 16: “from 40-50 km from 19 and 37 GHz channels....”

P2. line 19: “prevents accurate monitoring of the sea ice edge” (or any better word that does not repeat resolution/resolve).

P2. line 21: replace “which are typically” by “and are typically”.

P3. line 11: “The benefit of merged SIC with respect to single-sensor...” (or compared to).

P3. line 12: “during the formation of a polynya...”

P3. line 24: “Single latent heat”... what does “single” means here. Remove or clarify.

P5. line 5: “Sect. 9 lists...” or “provides”...

P5. line 15: Find a more explicit heading. Maybe “Input SIC data to merged product”?

P5. line 17: “It’s orbit has an inclination...”

P6. section 2.2.1: specify that the OSI SAF SIC OSI-450 and OSI-430-b uses “coarse” resolution instruments (SMMR, SSM/I, SSMIS).

P6. line 19: you so far only introduced SIC, so it is not optimal to list new atmosphere and drift variables in the opening of this section.

P7. eq for FDD: please use index “n” inside the sum ($T^{\text{air}}_{\{n\}}$?).

P8. line 9: what “passive microwave sea-ice concentration” must be beneath 50%? ASI? Please clarify.

P8. section on the NOASIM model. This section is much more detailed than the other. It can be justified because it is the only model, but please consider if this section can be shortened and the interested reader referred to publications about NAOSIM (e.g. the initialization of the model since 1980)?

P8 section on the NOASIM model: are the runs free runs or runs with data assimilation? Clarify, and shortly describe the assimilation (methodology, variables assimilated) if the model is not in free run.

P10, line 21: “80% of the pixels were covered at least once”. What does “covered” mean here? Cloud-covered? Covered by the product (hence cloud-free)? Clarify.

P10, line 25-26: move the discussion about the A-train and the Aqua/Terra platform to section 2.1.2.

P11, line 29: “visual observations showed”... where do these come from? During the flights? In-situ on sea-ice? Visual interpretation of satellite/aerial images? Please clarify.

P13, line 24: “The reason is again that they are more sensitive to newly formed sea ice”?

P13, line 28: define “open water extent”. Does it use a 15% threshold?

P15, Figure 3: consider choosing another color scheme (blue and green and red can easily be mixed-up by color-blind persons).

P16, Figure 4: it is not obvious what the two lower panels bring. Would one of them (the difference) be enough? Or a third one: (Merged-AMSR2)/AMSR2?

P18, Figure 5 (right column). What is the unit? Could the colorscale be changed to show more contrast?

P21 replace “This year” with “During the polynya event,..”

P23: it is not clear if, e.g. +90, is westward or eastward drift.

P27, line 5-6 “Our statement is even stronger...” consider another formulation, e.g. “We confirm and further strengthen the findings of ...”

P28, line 14-15 “Also, refrozen leads with are covered by snow ...” Exactly the type of argumentation that could enter a discussion paragraph about high-resolution features (refrozen leads) into sea-ice concentration products (as suggested in my comments earlier).

P29, line 29: remove the last sentence (or merged with that line 25).

P31, line 10: “SIC shows closed”

P31, line 27: “showed more SIC values between ”

P32, line 6: “Events like this have occurred before ...” add “but not with the same magnitude” ?