

# ***Interactive comment on “IcePAC – a Probabilistic Tool to Study Sea Ice Spatiotemporal Dynamic: Application to the Hudson Bay area, Northeastern Canada” by Charles Gignac et al.***

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Received and published: 4 December 2018

ICEPAC – A PROBABILISTIC TOOL TO STUDY SEA ICE SPATIOTEMPORAL DYNAMIC: APPLICATION TO THE HUDSON BAY

Reviewer #4, We thank you very much for your valuable and helpful comments on our work. As suggested, more details were added regarding the importance of trend removal and how it is handled in IcePAC. We made all the suggested modifications to our manuscript. CG

R = Reviewer comments A = Author response and B= manuscript modifications

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A modified version of the manuscript is found as supplementary file.

## GENERAL COMMENTS

R: “Limitations of passive microwave sea ice concentration data for this sort of high temporal and spatial resolution probabilistic modeling should be stated. More details about the CIS product used and more background on the OSI-SAF sea ice concentration product are needed.”

A: Done.

B: Limitations of the passive microwave data for its usage in probabilistic modelling exercise were stated in section 3.1 “Sea Ice Concentration Dataset” from line 154 to 180. The CIS products were described in more details in section 4.2 “Comparison with the Canadian Ice Service Atlas” from line 415 to 430.

R: “Would this tool be equally useful for locations outside the HBS?”

A: Yes it would be.

B: A new section (lines 464 to 474) addressing this question was added as section 4.3 “Applicability of the IcePAC approach to other location and data sources”

R: “More discussion is needed on trend removal, why it is necessary, how it changes the results. The addition of a simple figure showing a decade or so of the weekly SIC at one of the coastal locations would be good”

A: We agree.

B: Numerous details about the trend removal process and its impact on the results and how it is managed in IcePAC were added (lines 233 to 243). We also justified the fact that we use a systematic removal. A new figure (Figure 3) presenting an original coastal SIC% series and its de-trended version was added.

## SPECIFIC COMMENTS

R: “Nevertheless, these datasets do not carry information on the nature of the underlying statistical distributions of sea ice parameters, such as sea ice concentration (SIC), at any given point and nor do they permit to analyze the probability of occurrence of a specific sea ice condition.”

A: We are not sure that we understand your comment. The ice services generally draw polygons around areas that are given attributes including a range of concentration values within the polygon, and usually more information like the form of predominant ice and its stage of development. Because the ice charts are not generally available as SIC in gridded form, it may be inconvenient to use them for obtaining statistical distributions of SIC, but it is not impossible.

The confusion could come from the last part of the sentence from the previous version of our manuscript “[. . .] and nor do they permit to analyze the probability of occurrence of a specific sea ice condition”. We agree that others sources, such as the NSIDC dataset, would be relevant to analyze the probability of occurrence of specific sea ice conditions. We did not want to suggest that it was not the case in our phrasing.

B: We modified this paragraph (from line 61 to 63) to make clear that the IcePAC product is different from existing products as it is based on a “description” of the underlying distribution (Beta in our case) of the SIC% for every grid cell in the HBS domain.

R: “Sea ice extent has displayed an important decline [. . .] as it can be observed with remote sensing images acquired since 1978.” Suggest changing to “as is observed with passive microwave remote sensing data acquired since 1978.” This because there was passive microwave before 1978, as well as VIS and IR, so the sentence can be misleading as it is.

A: We agree.

B: The sentence was modified accordingly.

R: “While the SIC data may have a 12.5 km grid cell size, I think it’s erroneous to say

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it has a 12.5 km resolution. I am not familiar with the OSI-409 SIC data, but if it uses SSIM(S) instrument data and Bootstrap algorithm, it is using the 19GHz channel which has an elliptical spot size of as large as about 75km in one dimension. It could be that the OSI-409 processing includes some measure to improve the effective resolution. Please add more information about how the algorithm improves effective resolution, if this is what it does, and information on the accuracy estimates for the algorithm SIC values.”

A: We agree that we used erroneously the word resolution, it is the pixel grid.

B: A new paragraph was added to section 3.1 “Sea ice concentration dataset” describing the procedure used to represent data from the 19GHz and 37GHz channels with large footprints (respectively 56 and 33 km) into 12.5 km grid cells.

R: “I didn’t understand Figure 3. A more complete figure caption, or a figure legend, would help. Are the dots yearly averages? What points (grid cell locations) are the three plots from?”

A: Other reviewers have the same comment.

B: Figure 3 as it was in the original version was removed from the paper as it didn’t bring pertinent information for the understanding of the method.

R: “OFB is a point where OSI-430 validation data show less ice, and the greater ice in the statistical model prediction is traced to erroneous ice detection due to the land spillover effect. (OSI-430 used for validation. OSI-409 is used in the statistical model development. Both are passive microwave SIC data sets.) I’m surprised that land spillover isn’t more of a problem for the other coastal locations”

A: As it turns out, the error does not appear at other coastal locations since the OSI-409 and 430 algorithms used a coastal correction approach that we described in the manuscript. The OFB error is caused by a combination of two factors. First, we did identify an error, specific to Frobisher Bay area and west Southampton Island (Roes

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Welcome Sound) in a NSIDC climatological mask that the OSI-409 algorithm uses to ensure that no ice is detected in area where it is not likely to appear. The mask falsely declares that ice presence in these two areas is plausible during all summer months. Given the fact that the climatology mask states that there is possibly ice in Frobisher Bay at that date, the algorithm attempts to measure it, with erroneous results.

B: The above information was also added to the manuscript (from line 343 to 351) to ensure the readers understand that this is not an error that affects the entire coastal area which is prominent in our simulation domain.

Please also note the supplement to this comment:

<https://www.the-cryosphere-discuss.net/tc-2018-178/tc-2018-178-AC4-supplement.pdf>

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Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2018-178>, 2018.

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