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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.

Anonymous Referee #4

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General comments:

I agree with the other reviewers: the paper presents a useful, well-supported tool for measuring the probability of certain scenarios taking place at a particular location in the Hudson Bay region. For example, one can look at the probability that a location will be ice free by a certain date, and evaluate the shortest or longest ice-free season at a location. The probability of occurrence for any scenario that can be defined in terms of ice concentration at a location can be investigated.

My main concern has to do with the limitations of passive microwave sea ice concentration data for this sort of high temporal and spatial resolution probabilistic modeling.

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Discussion paper

My concern was alleviated somewhat by the comparison with the Canadian Ice Service (CIS) product, but it would be very helpful to have more details about the CIS product used, and more background on the OAI-SAF sea ice concentration product.

Would this tool be equally useful for locations outside the HBS? I'm guessing that would depend on how steep the trend needing removal, how extreme the variability, and of course how accurate the passive microwave-based or other SIC data the tool is built upon are, but it would be good to have the authors briefly address this in the paper.

I agree with other reviewers that it would be very helpful to have more discussion on trend removal: why it is necessary, how it changes results, or the utility of the results, etc. With this, 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 good copyedit job is called for.

Regarding "melt" or "meltdown", it should defiantly not be "meltdown". "Melt-out" has been used in contrast to "freeze-up" and can have a precise meaning with passive microwave SIC data. Melt-out has been used to mean when the ice concentration at a given grid cell (not pixel) location becomes less than 15%. One can further stipulate that the concentration stay below 15% for a certain amount of time.

Regarding "pixel", it is much more correct and precise to say "grid cell". "Pixel" properly refers to images, and "grid cell" to gridded data. While there is overlap, and opportunity for confusion (when gridded data are displayed as images), I think it's especially important to use "grid cell" for passive microwave SIC, because it helps readers remember and keep in mind that each grid cell has a SIC percentage in it that is the result of an algorithm working on 3 or 4 bands of input data, each having a different ground sampling size and shape (field of view).

Specific comments:

Lines 50-52: "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 analyse the probability of occurrence of a specific sea ice condition."

I'm not sure this is true. The ice services generally draw polygons around areas that are given attributes that include 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. For example, this product consists of gridded ice charts that could be used in statistical analysis:

National Ice Center. Compiled by F. Fetterer and C. Fowler. 2006, updated 2009. National Ice Center Arctic Sea Ice Charts and Climatologies in Gridded Format, Version 1. Boulder, Colorado USA. NSIDC: National Snow and Ice Data Center. doi: https://doi.org/10.7265/N5X34VDB.

The NIC product above is not current, but it at least points to how operational ice analyses can be used in the same way as the passive microwave derived SIC.

Lines 82-84: "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.

Lines 108-109: While the SIC data may have a 12.5 km grid cell size, I think it's erroneous to say it has a 12.5 km resolution. I am not familiar with the OSI-409 SIC data, but if it uses SSMI(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.

Lines 129-134: 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?

Around Line 250: 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,

Good to see lines 262-264..

Section 4.2, the comparison with the CIS atlas, is important. It's good to see these convincing results.

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