

Revision CryoSphere-tc-2020-361

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Overall general comments:

This study introduces a new distance-based approach for assessing the quality of the representation of the displacement over time of the sea-ice edge. The methodology introduced is innovative and scientifically sound, the exposition is clear and the article well organized. I suggest some very minor revisions, after which, I recommend the manuscript for publication in the CryoSphere.

Very Minor suggestions:

line 71: write “ ... for one product, and as illustrative example, we focus on the ice edge ... ”

line 98: replace “introduced” with “analysed”.

line 99: write “ ... to compare model displacement distances with ... ”

line 102: write “ ... that span each ... ”

line 104: after describing the shift, add “, indicating an overprediction of the sea-ice displacement”.

line 169: I suggest replacing the last sentence of this paragraph by a sentence stating that “Hence the sea-ice edge observations are estimated with a not-known uncertainty” (or similar).
Section 3.2 I thank you the author for introducing this section. I have some suggestions for rewording it:

“For some cases, the algorithm described in section 2.1 does not describe properly the true displacement. This particularly affects the maximum value as defined by Eq. (5). We illustrate this issue with a case study displayed in Figure 5, showing the 24-hour change in the ice-edge position from the 23rd to the 24th of October 2001. In this case the ice edge was displaced into the verification domain across an open boundary to the north. The general algorithm in Section 2.1 mis-matches the ice edge grid-cell (since cannot see the ice beyond the open boundary), and leads to an unrealistic maximum ice edge displacement of 285km, as given by the thick black line close to the sub-domain’s north border.

In order to address this issue, a modification of the algorithm was implemented, in which ocean open boundaries are considered as “continuation” of the ice edge. The modified algorithm is described in full details in Appendix B. For the illustrated case study, the maximum ice edge displacement calculated with the modified algorithm becomes 79 km, and is indicated by the red line in the eastern part of the verification domain.

It must be noted that if the ice is advected into the domain, the distances associated with such a displacement will be underestimated, since the real position of the ice edge outside of the analysis domain at t_0 is unknown. Other situations where unrealistic representations for displacements may also arise are when ice freezes along the coast, e.g. due to colder air in the vicinity of continents, or less salty water masses close to the coastline. This issue is treated analogously to advection across an open boundary, by considering coastlines as continuation of the ice edge (see Appendix B for details).”

line 208-209: replace “results are underestimations” with “are underestimated”.
line 215: remove “Moreover”; line 216: replace “.” with “:” and write “only 235 ... ”.
line 227: write “ ... indicate some skill for SVIM in detecting the location ... ”.
lines 243-244: write “Note that the distribution peak at ranks 4-5 for the full domain disappears when considering the rank frequencies for the two subdomains.”
line 246: start the sentence with “Whereas, the ranges ... ”
line 247: replace “become” with “are”.

I suggest re-wording lines 250-252 as follow: “The algorithm computes different attributes of the ice edge displacement, such as the maximum and the distribution of the distances. Then, different methodologies for comparing these attributes are introduced. The method introduced enables the assessment of the forecast quality for the displacement of the ice edge, and expands on existing validation metrics ...”

lines 261-262: write “ ... perimeter of any physical variable or feature that can be represented by a spatially continuous binary field. Stratiform precipitation is an example of another physical variable for which the method presented here could be suitable.”

line 267-268: write “ ... the original algorithm described in section 2.1 and 2.2 can sometimes mis-match ice cells, and hence diagnose unrealistic ice edge displacements, which may yield to mis-leading results.”

line 269: write “open boundary” (eliminate “model domain” ... you could add “ocean”).

line 271-272: write “ ... as shown by the case study illustrated in Figure 5.”