

### 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 manuscript is quite improved with respect to the first submissions. However some parts have become too long (or the information is fragmented across the article). I am therefore suggesting again major revisions (which are however less major than the first round of revisions, and less numerous too). Most of them aim to improve the exposition and article organization (e.g. shortening and moving the content of Appendix B in the article main body text). After these are performed, I'd be happy to recommend the manuscript for publication in the CryoSphere.

### Major Revisions:

1. line 81, remove the reference to Dukhovskoy here (you already reference him at line 52, it is not necessary to repeat this), and instead add a sentence (at line 81) which explains the difference between your metric and the Hausdorff one, e.g. “, which guarantees symmetry in the distance when swapping the two compared datasets (usually an observed and a modelled feature). The distance measure introduced in this study, on the other hand, voluntarily does not aim for symmetry, since it compares the position of the same feature at two different times, hence describing the feature displacement.”
2. lines 85-88: please expand on the description and interpretation of Figure 2 and 3 for the idealized case study (either here or in the next section, at lines 104-107). I actually believe that **analysing the distribution of all distances is far more informative than analysing the maximum distance only**: this is why in my view **it is important you give more weight to this aspect of your technique**.
3. The authors moved (and expanded) the content of the original section 2.3 (in the March 2021 manuscript) to appendix B. Now the reading of the manuscript is much more difficult, because the information is fragmented everywhere. Moreover, I think the original section 2.3 (in the March 2021 manuscript) was better than the actual appendix B (which is overly-long). **I suggest putting back the material of appendix B in the text, but not as long as the appendix** (I actually already commented in March that the section 2.3 was too long). As commented for the section 2.3 of the March 2021 manuscript, I strongly suggest to:
  - a) Insert a section between sections 3.1 and 3.2, where the material of the old section 2.3 will be described (since this is a technical part of the technique, I suggest describing it within the application part) and entitle it “Open ocean boundaries and coasts”. Essentially you **split section 3 in three subsections: 3a Sea-ice data description, 3b open ocean boundaries and coasts, 3c verification results**. In this fashion the reader has also an immediate visual example (figure 4) on your need of adding these artificial ice-edges (especially when considering an Arctic sub-region).

- b) summarize the content of this section in **few** sentences, such as in Melsom 2019, page 617, left column third paragraph (“A variant ...”). Essentially all you have to say is that the ocean open boundaries as well as the coastal lines are added into the ice-edge definition. In the re-wording it is important that you explain that you expect the distances to be smaller when adding ocean open boundaries and coastal lines (because when adding these artificial “fixed” edges you automatically include in your verification some perfectly matched edges, aka trivial skill).
  - c) There are **too many equations** (in appendix B, but also in the past Section 2.3). **The only one you really need to retain is B7 (Equation 16 of the March 2021 manuscript)**, essentially you can explain in the text -simply verbally- that you add to the ice edge the coastal line and ocean open boundary, and then you re-evaluate all the statistics as described in section 2.1 and 2.2.
  - d) The example presented at lines 193-200 (lines 180-187 in the March 2021 manuscript) and illustrated in figure 6 is excellent: I suggest you insert this example in this new section 3.2, since it illustrates why you need to include the ocean open boundaries and coasts. You might want to better phrase it, and explain why the ice edges are “mis-matched”.
  - e) In conclusion, **the resulting new text should be shorter** than the current Appendix B (and possibly also shorter than the past section 2.3, in the March 2021 manuscript).
  - f) **If the authors decide to leave the Appendix B**, then they should not introduce the issue in section 2.1 (eliminate lines 94-97), but in the Section 3 (so they have the Figure 4 and 6 to refer to). As an example, after the sentence at lines 178-180 you should illustrate the example at lines 196-200 and then conclude stating “To address this issue, the ocean open boundaries as well as the coastal lines are added into the ice-edge definition (see Appendix B for details)”. (You can merge into the text of lines 178-180 also some of the text currently at lines 94-97; also, remember to explain why the ice-edges are “mis-matched”, at line 198).
  - g) I am pleased that you show in section 3 that **the results obtained adding the coastal lines and open ocean boundaries are similar to the ones you obtain without these “artificial” ice edge extensions** (e.g. lines 280-281 or 193-194): please make sure you keep stating this in the revised manuscript.
4. **I won’t recommend using the average** for describing an histogram (or a distribution) which is not gaussian (or even bimodal, as for the obs). I believe that **the “mode” value (the one with the highest frequency)**, or even the median, would be better indicators. Please change lines 185-186 accordingly (talk about the mode and eliminate the discussion about the average). similarly, at lines 216-221: retain the first two sentences as they are (I like you essentially compare the accumulated frequencies for ranks below and above the 50%ile). The subsequent lines (218-221) are not entirely clear: do you use the methods of Wilks (2019)? if so, please put the reference up front and rephrase the whole text, so that it becomes more clear. Similarly, at lines 226-229 you perform an identical analysis, but you are missing the conclusions (one sentence, stating that these findings show that the model well depicts the position of the max displacement).

### Minor revisions:

5. Some suggested re-phrasing in the Introduction:
  - a) line 18 and 19, rephrase “in their examination” (e.g. “to analyse the predictability of sea-ice edge”)
  - b) line 37-38, write “The method is described in Section 2 with an idealized case study.”
  - c) line 38, replace “in an examination of displacements” with “to analyse displacements ... ”
  - d) line 39: write “Technical details ... ”
6. rephrase lines 47-48.
7. line 60: replace “line” with “curve” (possibly everywhere, since ice edge is rarely straight).
8. Suggested rephrasing for lines 67-74: line 67, end this sentence after “respectively”; then place Equation (4) followed by the text at line 70 as “where we denote the sea ice concentration ... ( $t_0$ ).” Then you start a new paragraph introducing Figure 1: please expand a bit with respect to the text in line 68-69, and then concatenate with the text at lines 73-74. Example, start with “Figure 1 shows an idealized example where a modeled and an observed sea ice edge are displaced. The length of the dashed lines correspond to ... . We then introduce the maximum expansion displacement as ... ”).
9. rephrase lines 91-93.
10. In light of major comment 3, eliminate lines 94-97.
11. I suggest eliminating also lines 98-99, and move this comment in the conclusions.
12. lines 108-111 repeat the same concepts stated in the previous paragraph (lines 104-107). Eliminate one of the two paragraphs, but (in light of Major comment 2) I would like you to expand and describe the result of Figures 2 and 3 more in detail.
13. please rephrase lines 145-146, e.g. “we randomly subsample a fixed number of intervals from Eq (11), so that the number bins is equal across different cases and results can be aggregated”.
14. line 149, add “which reflects a forecast poor positioning of the maximum displacement”
15. eliminate lines 191-192 (it seems out of context here). Maybe this sentence is more suited in the data description, section 3.1?
16. Rephrase lines 202-203, e.g. “We consider a fix number of 10 bins for the present investigation, Hence ... nine values are randomly selected from the displacements in Eq. (11)”.
17. Lines 214-215 are not clear, rephrase (or eliminate) them.
18. Line 216: rephrase “in ranks 5-9 *than* ranks 0-4”.
19. The first paragraph of the conclusions is weak, and can be improved.
20. In the text at lines 248-252 state explicitly that ocean open boundaries and coastal lines become part of the ice edge (rather than stating “a modification to the algorithm was introduced”).
21. Figure 7: why when considering the whole domain there is a peak in the 4-5 ranks, whereas when considering the two separate domains this disappear? Are there still mismatched ice edges?