

Dear Dr. Willmes et al.

Thank you for addressing the comments raised in my first review of the manuscript. I agree with the authors on the new structure starting more generally with the lead variability and trends after moving to the link between lead patterns and ocean bathymetry. It has a nice flow and feels more coherent now. It is also nice to see that you have tried to highlight the potential shortcomings in the abstract. Overall, with these new added changes, I think the manuscript is suitable for publication. I only have a few minor comments before the manuscript is finally accepted.

General comments

I agree that the data shows a compelling argument for the influence of ocean bathymetry on observed lead patterns. I also acknowledge that providing a detailed mechanistic understanding of the sea ice – ocean bathymetry interaction is perhaps too much to cover in this paper. Personally, I think it should be clearer that you're presenting this as a hypothesis (in the abstract) and that we don't understand the driving mechanisms in detail yet. I think this could help enhance the impact of the paper by inspiring future research (as you pointed out as a motivation in your response).

When it comes to potential mechanisms, I recently came across this paper (<https://onlinelibrary.wiley.com/doi/full/10.1029/2022JC019469>), which shows how ocean currents and subsurface eddies can potentially imprint the sea ice cover mechanically. I think this would be a nice addition to the discussion (Section 4.2).

In your discussion about the trends, you mention the paper by Hoffmann et al (2022) showing a small increasing trend in Arctic leads. You mention that the discrepancy could be due to a large uncertainty and different lead climatology. That's all good. However, I would still like to see a very short discussion (1-2 lines) on some of the limitations of the ArcLeads product. Is it possible that uncertainties in LAF (e.g. from clouds) could be masking potential trends?

Specific comments

L5: *"... influence of ocean bathymetry and associated currents on the mechanic weakening of sea ice"*

I am not entirely convinced you actually show this. In order to strengthen that argument you would need to analyze the sea ice stresses from FESOM, and show a link between ice deformation rates and ocean currents. I would rather use "preconditioning" because we are not really sure how it works, right? Could be both mechanical or thermodynamic processes in play.

L76: have --> has

L79: The Ocean data section I would still like to have 1-2 sentences explaining why FESOM is a good choice when it comes to representing ocean currents in the Arctic. You need to convince the reader that the model is appropriate for your specific study.

L102: I am still confused about the deformation derived from the C15 wind data. "Total deformation" makes me think of sea ice, not winds. As I understand it, you're calculating the total deformation (div+shear) of the wind (not the sea ice?). However, I don't think you need to mention the total deformation since it's just the sum of shear and div?

L135: You should specify that the trend is for the entire winter season.

L149: *"is generally characterized by a variability that is less pronounced than in other sectors."*

A bit unclear what you mean by less pronounced variability. What about: "Generally shows less (interannual/monthly?) variability compared to the other sectors"

L156-159: This would fit better in the discussion. I would also consider moving the paragraph on monthly trends (from L160) to after you talk about absence of interannual trends on seasonal timescales (L135)

L167: Explain briefly why you compare lead patterns to model data, e.g. "to understand the role of the ocean..."

L187: *"which means that the sea ice in this region is covered by leads in more than 40% of the time in the winter period from November to April."*

I would use this phrasing already in the first section (L112) because it helps the reader understand what the LFQ means.

L243: Your comment to R2 that using daily atmospheric data doesn't make a huge difference compared to monthly data should be mentioned explicitly in the text (Section 3.2.5).

L244-245: The first two lines belong in the previous section. Here it sounds like you are about to talk about the ocean impact on leads, instead of summarizing the results of the previous section.

I suggest starting this section by: "To understand the role of winds in driving the observed patterns in lead formation we look at ..."

L313: *"However, we could not observe trends in wintertime lead fractions in the period between 2002 and 2021 (see Figure 2)"*

Please clarify that you're talking about pan-Arctic here since you find trends on regional scales.

Here I would also like to see a sentence on the uncertainties in ArcLeads product and its effect on the reported trends (or absence thereof), e.g. due to clouds. See my general comment.

L353: Add a reference to

L369: What do you mean by *"dynamic weakening through changing water masses"*? Please clarify

"... while positive trends in ..." Please clarify trends in what (sea ice?, ocean heat?)

L380: This section reads more as a conclusion. In particular, the last part highlighting open questions. If I may, I would suggest moving the "open questions" to the Conclusion as "suggestions for future work" (e.g. for the modelling community) in order to foster and inspire more in-depth research.