

Interactive comment on “The recent amplifying seasonal cycle of the Arctic sea ice extent related to the subsurface cooling in the Bering Sea” by Xiao-Yi Yang and Guihua Wang

Anonymous Referee #2

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Review of “The recent amplifying seasonal cycle of the Arctic sea ice extent related to the subsurface cooling in the Bering Sea” by Yang and Wang

Summary

This paper presents an analysis of Bering and Chukchi Sea ice, showing contrasting decadal variability with decreases in the summer-autumn and increases in the winter-spring. Sea ice, atmospheric reanalyses, and ocean temperatures and velocities are examined to explain this behavior. The authors find that the pattern is likely due to subsurface cooling in the northern Bering Sea.

General Comment

C1

Overall, this is well-written paper and the analysis is competent. However, I have a few notable issues, listed below. The second issue in particular is critical and is the major reason for the decision of Major Revision.

1. The authors generally treat the Bering and the Chukchi Seas (B-C) as one system, but I'm not sure if this really appropriate. For example, they say that the B-C shows decreases in the summer-autumn and increases in the winter-spring. However, the Bering is ice-free during summer-autumn, so the decrease is in the Chukchi, not really the B-C. Similarly, the Chukchi is completely ice-covered during winter-spring, so the increase there is really in the Bering, not the B-C.

During the analysis, they do start to treat the two more separately, but their approach is generally that these are two closely inter-connected systems and I'm not convinced that this is the case. There is indeed connection through the Bering Strait, and though that is narrow and shallow, there has been much research demonstrating that inflow of warm Pacific waters have contributed to summer ice loss in the Chukchi. But the Chukchi is also connected to the rest of the Arctic Ocean, particularly the neighboring seas – the Beaufort and the East Siberian. For example, the Beaufort Gyre circulation transports ice into the Chukchi and much of that ice is thicker, multi-year ice. This aspect seems to be ignored in the paper – particularly the role of changes in multi-year ice, which has been rather dramatic in recent years.

And while the Bering influences the Chukchi, I don't think the reverse is generally true – the ocean waters flow into the Chukchi. There can be some sea ice outflow, but this is pretty rare and ephemeral. So, when talking about the B-C, it's really more of a one-way street, not an interacting system. The main connection would be through the atmosphere where circulation patterns can affect the transport of heat, etc. between the two regions.

Maybe this is more semantics on my part. In the body of the paper, the authors seem to be clearer and focus more on the Bering Sea and then interaction with the Arctic

C2

Ocean in general. So maybe some changes in phrasing in places would help here.

2. The other main issue is, unfortunately, the timing of this paper. As the authors are probably aware, the situation in the Bering has completely reversed over the last two winters. Both 2017-2018 and 2018-2019 were record or near-record lows over most of the winter-spring. I recognize that things can change and that papers have to be published at some point and new data will come in after submission. However, this paper stops with 2015, so after the last two winter-springs, it feels particularly out of date. I know data isn't necessarily immediately available, but for example sea ice data is provided in near-real-time, as is ECMWF. I'm not sure about the ORAS4 ocean temperature and velocity data, but it appears more recent data is available: <https://www.ecmwf.int/en/research/climate-reanalysis/ocean-reanalysis>. Even without updated ocean data, at least some of the analysis could be updated.

Because the change is so substantial, I feel the authors should really redo the analysis through at least 2018. As noted above, I recognize that at some point, analysis has to stop and a manuscript must be prepared and submitted. But this paper just feels too out of date to be particularly relevant. At the very least, if the authors can't update their analysis, they should thoroughly discuss the recent changes in the Bering Sea ice cover and the implications for their study.

3. Overall, the analysis is rather cursory. The authors pull together the right data sets and the analysis that they do is reasonable. But it doesn't seem enough to really substantiate their hypotheses - particularly in light of #2 above. The paper is <6 pages long and while I enjoy short, concise papers, the analyses are not very deep and they don't dig into the data enough to definitively support their conclusions.

4. The final issue is several grammar errors – not major, but occur occasionally throughout the manuscript. Some are note below in Minor Comments, but a thorough proofreading for English grammar would be helpful.

Specific Comments (by page and line number)

C3

5, 16-17: "significant" and "insignificant" are each used. Do these refer to statistical significance? If so, the significance level should be specified. If not, then I would suggest different wording, e.g., substantial, notable, etc. to avoid confusion over the use of "significant".

Figure 1b: I find this figure a bit confusing. The 120W-60W is not labeled – that's the Canadian Archipelago. I recognize this isn't terribly relevant to the study, but odd to have just that longitude range unlabeled. More relevant though is: where is the Laptev? I think it's included in what is labeled "East Siberian" – if so, that should be noted. Maybe what would help is a map that has the seas labeled and the longitude boundaries outlined.

Minor Comments (by page and line number)

1, 9: "in recent decade" – a minor grammar issue, but it makes things ambiguous: is it "in the recent decade" (i.e., the last 10 years), or is it "in recent decades" (i.e., 20+ years)? This is repeated elsewhere in the manuscript as well.

1, 27: "transit" should be "transition"

2, 10: "urgent" not "urgently"

2, 11: remove "the" before "Arctic climate change"

5, 22: "decline" not "descent"

6, 15: as noted above, I don't think you can any longer say "lengthening sea ice seasons" for the Bering – certainly not for the last two years. 6, 29: In light of the last two years' worth of data, I think the question of whether the "amplifying seasonal cycle of Arctic sea ice cover will [be] sustained" has been answered, at least in terms of the Bering Sea: no!

Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2019-37>, 2019.

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