

The Cryosphere Discuss., referee comment RC2
<https://doi.org/10.5194/tc-2021-284-RC2>, 2021
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Comment on tc-2021-284

Anonymous Referee #2

Referee comment on "Reassessing seasonal sea ice predictability of the Pacific-Arctic sector using a Markov model" by Yunhe Wang et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-284-RC2>, 2021

General Comments:

The authors present a regional sea ice forecasting method using a linear Markov model. The methodology is variation of an established pan-Arctic version of this model. The novelty is a focus on the Bering Sea and the Sea of Okhotsk and using varying predictors by season. The method shows good prediction skill compared to the pan-Arctic version and to an anomaly persistence model.

Overall, this is a good study and is worthy of publication, but some additions would make this paper more compelling. I would like to see more discussion on the choice of predictors. There have been many studies on sea ice forecasting, only a couple of which are referenced here. A more in-depth literature review could be a good place to start when discussing the choice of predictors. The study area is also a bit confusing. It is stated that this method forecasts in the Bering Sea and the Sea of Okhotsk, but Figures 1, 2, 6, & 7 show forecasting in most of (if not all) of the Chukchi Sea as well. Maybe redefine your study area or clarify your delineation of sea ice regions more clearly.

Specific Comments:

Literature Review: You've listed a couple previous studies of sea ice forecasting methods, but I think you are missing out on a lot of work that has been done, even quite recent publications. I think lines 57-87 could benefit greatly from a more in-depth discussion of previous forecasting methods. Section 2.1 would also benefit from this when discussing your choice of predictors. See references below:

Andersson, Tom R., J. Scott Hosking, María Pérez-Ortiz, Brooks Paige, Andrew Elliott,

Chris Russell, Stephen Law, et al. "Seasonal Arctic Sea Ice Forecasting with Probabilistic Deep Learning." *Nature Communications* 12, no. 1 (August 26, 2021): 5124. <https://doi.org/10.1038/s41467-021-25257-4>.

Chi, Junhwa, and Hyun-choel Kim. "Prediction of Arctic Sea Ice Concentration Using a Fully Data Driven Deep Neural Network." *Remote Sensing* 9, no. 12 (December 2017): 1305. <https://doi.org/10.3390/rs9121305>.

Horvath, Sean, Julienne Stroeve, Balaji Rajagopalan, and William Kleiber. "A Bayesian Logistic Regression for Probabilistic Forecasts of the Minimum September Arctic Sea Ice Cover." *Earth and Space Science* 7, no. 10 (2020): e2020EA001176. <https://doi.org/10.1029/2020EA001176>.

Horvath, Sean, Julienne Stroeve, and Balaji Rajagopalan. "A Linear Mixed Effects Model for Seasonal Forecasts of Arctic Sea Ice Retreat." *Polar Geography* 0, no. 0 (October 15, 2021): 1–18. <https://doi.org/10.1080/1088937X.2021.1987999>.

Wang, Lei, Xiaojun Yuan, Mingfang Ting, and Cuihua Li. "Predicting Summer Arctic Sea Ice Concentration Intraseasonal Variability Using a Vector Autoregressive Model." *Journal of Climate* 29, no. 4 (December 8, 2015): 1529–43. <https://doi.org/10.1175/JCLI-D-15-0313.1>.

For instance, in lines 116-117, is there a reason 850 hPa geopotential height and winds were chosen over other pressure levels?

Methodology:

Lines 94-99: Here you differentiate the Bering Sea and the Chukchi Sea, but as mentioned above it looks like you are indeed forecasting in both areas. More clarification here is needed.

How are you detrending the model in Section 3.4? Removing the trend from the data prior to running the model? Detrending the predictions with the observed trend? With the predicted trend? It is difficult to assess how well the detrended model is actually doing without knowing this.

Other:

Lines 324-328: Similar results were found in Horvath et al., 2020, namely that forecasts made in March showed worse skill than those made in January and February. Perhaps this warrants further analysis.

Technical Comments:

LN 303-305: The fact that more modes are needed during the cold season is repeated. I suggest combining these sentences to clarify.

LN 505: remove 'the'. "In other words,..."