Ocean Science Discussions

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Comment on os-2021-43

Anonymous Referee #2

Referee comment on "On the circulation, water mass distribution, and nutrient concentrations of the western Chukchi Sea" by Jaclyn Clement Kinney et al., Ocean Sci. Discuss., https://doi.org/10.5194/os-2021-43-RC2, 2021

This paper scrutinizes the observations made in 2008 and 2014 (especially in Herald Canyon) and attempts to explain the behavior of WW, BSW, nutrients, etc. using numerical models. The numerical model has been developed and improved vigorously by the authors, and I believe that it is one of the most reliable models applied to the Arctic Ocean. However, even though the model output is provided, it is no different from the description of the observation results, and the details of the mechanism are not mentioned. It is recommended that the paper be improved by examining the results of the numerical model more closely.

~Major points~

Line 227 (Westward shift in boundary between northward & southward flow) : Why did the westward shift of the boundary eventually occur, the mechanism would need to be explained since it affects the flow rate of WW. Line 271-272 says that it is strongly affected by wind stress because of forward pressure. The cross sections of the 9-km resolution model (Figs. 10 and 11) do not show a westward shift. Isn't it necessary to show the wind stress field (field and model) during the observation period? In Fig. 4, the WW seems to be constrained by the topography. What are the results of the 2-km resolution model?

Figs 6 & 7: Are you using the 2-km resolution model output only to explain the faster flow speed, the greater number of eddies in the ocean basin and more complex circulation north of 100m isobath? First of all, the authors should add the 100m isobath (there may be one, but I can't see it.). If the average velocity field or cross-sectional view does not change the results much, then I think only 2-km is sufficient. "source from flows across Herald Shoal" can be said for 2008, can't it?

Figs. 8 & 9: The model output of T, S, and velocity shows a fundamentally different structure from the observation: in 2008, the WW is unevenly distributed to the west in the observation, but not in the model output. The structure of the surface layer (up to 20 m depth) is also completely different in 2014. Why is the northward velocity distribution split into two in the model?

Discussionï¼☐The authors mention heat loss and residence time to explain the fresh WW in 2014. However, these explanations are only speculations at present. Since the model output is available, heat loss and residence time (and impact of brine rejection) can be calculated explicitly by tracer experiments. It should also be possible to study in detail the water mass properties and their sources of variation in upstream and downstream areas with the model output. My personal impression is that WW freshening cannot be explained by local phenomena alone.

Since data assimilation is not applied, when explaining the reproducibility of the model, etc., the snapshot of the model output will naturally show some differences from reality. For example, how about using the Ensemble mean of the results from a year with a north wind and a year with a west wind to illustrate how much the velocity structure and WW flow rate changes with wind stress?

~Minor points~

Figs 4. 5, 9 & 10: Please improve the diagram so that we can see the distances between the points.

Line 93:ã☐☐The observation period of SMMR is 1978-1987, so it must be SSMI.

Line 109:ã☐☐Isn't the frequency of RDI ADCP 300 "kHz"?