

## Overall comments:

This paper presents a very interesting study. The authors have excellent overall knowledge regarding the MLD, and this is clear in this work. It provides critical new data of T & S and MLD estimations of the area.

I found it very interesting to compare the MLD and MLDt and also the use of the stratification index.

As the scientific work is very good and the information that comes out of it is of great importance, I believe that the text needs to be written better to present these nice results. And also, a more robust discussion of the results is required. First, I would suggest expanding and rewriting the discussion/conclusion sessions and proceeding with professional Editing for better results.

I would also recommend using abbreviations (like the ones you have been set in Figure 1). For example, try to replace in the text the Bering Sea basin with BSb and the Bering Sea shelf with BSs or something similar (it will make it easier to for the reader)

Also, I'm not pretty sure how important it is to keep a decimal in the MLD. I don't believe that gives extra info if the MLD is 65m or 65.21m. I would round the MLDs as they are not providing any significant scientific input differences minor like that. The international references on MLDs are in meters.

Maybe Figure 11 could be left aside and just use the ADT information only in the text. Comments regarding the Figures are following.

I would suggest that this work should be published after major revisions.

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## Especially for Sectors

### 2.2 Data

171... and dissolved oxygen: You refer to oxygen measurements, but you are not using them anywhere in this work, so you need to make that clear or remove it from the data sector. (else the reader is waiting to see some oxygen data)

Does the data from the shipborne meteorological station were used for cross-validation of the CCMP model? Please explain to this sector why you are presenting each dataset and how you will use it (Data and methods).

This is also valid for the fluxes and wave data etc. You are slightly presenting them in this section, but you are not making any comment regarding their use. So, we arrive at the discussion-conclusion, and we find results of correlations that have not been mentioned before. This section is the place that you'll explain your methodology:

For example: "To investigate the reasons of the spatial MLD variability, different cross-correlations and lagged (maybe) correlations have been done. First, with the wind regime ...bla bla bla. Then we have investigated the correlation of the MLD with the wave data...bla

bla bla". Also, regarding the wave data, maybe it is worth it to run a Lagged Correlation to see if you obtain different results.

Also, there is an extend paragraph on this sector regarding the ADCPs, but the data and a discussion on these data is minimum in the rest of the manuscript. It looks like they belong to auxiliary data but they are really expanded in this sector. Thus, depending the use and the importance of each dataset, dedicate an appropriate paragraph in this section.

### 3.1. The salinity and temperature

To make it more robust, I would suggest the authors to add a small part (as you have already start doing, just extend it a bit) more dedicated to this area's water masses. There have been some studies for the Bering Sea, so a reference to these studies, regarding the water masses of the area and a comparison with the new dataset (that the authors collected in 2019) will make the manuscript more robust and complete.

### 3.4. The relation of temperature, salinity, and MLD

The first half of this sector, as it is written, is not providing any necessary information as it is not explaining precisely the relationship between the MLD and the T/S. Part of this info is already existing in the results. The second half (lines 447 and beyond) is written much better.

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### More detailed comments line by line:

What is the CCMP reanalysis? Please add reference and link

200...obtained from the CFSv2 (Saha et al., 2011): ...what is the CFSv2, add info as you have for the Copernicus

214-228: This paragraph, as it is, is more like an Introduction part or, if better connected to the text, could be a part of the discussion regarding the paper results of estimating the MLD using different criteria, so I believe it must be or removed from the data and methods sector or rephrased in a way that will underline and explain the selected MLD estimation method of this work.

264-266: If you are referring to Kara et al. (2000), the reference depth was set at 10m, and the criterion is set as: *<the depth at the base of an isothermal (isopycnal) layer, where the temperature (density) has changed by a fixed amount of  $\Delta\sigma_\theta = \sigma_\theta(T + \Delta T, S) - \sigma_\theta(T, S)$ , where  $P = 0$  from the temperature (density) at a reference depth of 10 m. (with  $\Delta T = 0.8^\circ\text{C}$ )>*

You may want to refer also for the  $\Delta\sigma_\theta = 0.125 \text{ kg m}^{-3}$  criterion to Monterey and Levitus [1997], Global Ocean (reference level 0m), Suga et al. [2004], North Pacific (ref level 10m),

□ Monterey, G., and S. Levitus (1997), Seasonal Variability of Mixed Layer Depth for the World Ocean, NOAA Atlas NESDIS 14, 100 pp., U. S. Gov. Print. Off., Washington, D. C.

□ Suga, T., K. Motoki, Y. Aoki, and A. M. Macdonald (2004), The North Pacific climatology of winter mixed layer and mode waters, *J. Phys. Oceanogr.*, 34, 3– 22.

296 ...the Bering Sea basin had the characteristics of high temperature and low: ... the Bering Sea basin had a high temperature and low...

300: Are you referring to the Bering Sea basin?

301: In the middle layer of the layer 50-200m? please rephrase it and give the depth that you are referring to

309-311: In the east, the density of high-temperature and low-salinity water was smaller, which had the characteristics of the Alaska Coastal Water.: High temperature and lower salinity results to lower density, so wordy writing. Do you mean that this water mass was similar to Alaska's Coastal Water? (do they have similar T, S)?.

The same also for the following lines.

Also, there is no reference to Anadyr Water. But it appears in the results without having any reference in the Introduction. Give some info for this water mass and maybe the other water masses of that area (see my previous comments regarding sector 3.1)

Please find another way to characterize the water masses that you are referring to. It's not so nice repeatedly referring to 'high-temperature and low-salinity water masses.'

354-356: Thus, the BS section represented the MLD under the influence of the advection of these two water masses: That's very interesting, so maybe you need to add some info in the Introduction section regarding the water masses in the area.

357 ... On the contrary, the MLDt was zero there: How is that possible? I don't think it is zero. I believe that MLD and MLDt are similar because the water column looks to me (from Figure5) homogeneous. You can check that if you plot the temperature by depth. If that's so, you'll need to change it through the whole text, discussion, con conclusions, etc.

428 ...Therefore, the shallower MLD in the Bering Sea shelf might be due to the terrain constraints and the bottom friction... please explain more or give some reference

460-461... The average difference between MLDD and MLDt was -3.25m in the northern Bering Sea and the Chukchi Sea, the absolute value of which was much greater than the 0.51 m... The absolute value what, of the MLD in the Chukchi Sea? Please refer to the station. Also, if the MLDD and MLDt difference is more or less half a meter, I'm not sure how accurate it is to tell that this demonstrated that salinity changes drive the mld. Every calculation method has an accuracy range (+- ); thus, I believe the 0.51m is in the buffer of the accuracy of the method.

491: when you are referring to the eddy, it is better to say if it cyclonic or anticyclonic

523 .. between them:...between the ccmp and the measured by the ship??

522-523...And the mean difference of the zonal wind and meridional wind between them were 0.51 m/s and 0.29m/s respectively...The mean difference between the meridional and zonal wind was 0.51....? is that what you mean?

532...It had been known that the MLD at BL01 and BL07 was mainly due to the influence of the continental slope current... Please explain better what you mean by that and try to expand it using the appropriate references.

### Some examples of editing language issues

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196: The sampling interval is 1 minute. : ...was 1 minute (try to keep the same time through the text)

197 ...The CCMP reanalysis wind data at the height of 10 m above the sea level was also used: ...were also used (it's plural the data), or if you preferer: the CCMP reanalysis wind dataset ...was also...

198 ...spatial resolution of CCMP data is: ...of CCMP dataset.

208...bathymetric data used in this paper was from: ... if you are referring to data is plural, so you use were, if you refer to a dataset you can use was

264: In what previous research are you referring to? Please specify and insert the reference.

300-304: Try to write clearer these sentences

308 ...and the salinity was significantly lower than that in the west. In the east, the density of high-temperature and low-salinity water was smaller, which had the characteristics of the Alaska Coastal Water: .... In the east, the (high-temperature and low-salinity water) density was smaller, which had the Alaska Coastal Water characteristics.

314-316: There were.... If you are describing the data in Figure 8, then you need to be more precise; for example: at stations BL... (or at latitude...) of the Chukchi Sea shelf and the continental slope, low-density waters were present in the upper layer, with a temperature range of....

Try to write the sentence the less wordy possible.

Example for 316-322:

The temperature and salinity were gradually decreased, moving from the south to the north. At the surface, the temperature drops from 10 to 1 °C and salinity from 30 to 28. While in the bottom layers, the temperature decreased from 4 to -1.8°C and the salinity from 32 to 30....

318 ... The temperature of the bottom water decreased from 4 to -1.3 °C from south to north, while the salinity also decreased from 32 to 30...: The bottom water temperature decreased from 4 to -1.3 °C from south to north, while the salinity also decreased from 32 to 30

321-322: There was a middle cold-water mass with a core temperature of -1.8 °C in the depth range of 40m ~ 150m below the surface warm water in the Chukchi Sea slope.

What was the salinity of this water mass? If you can, please give a more exact position.

333 ....was shallower than 15 m. And the minimum...: Moreover, the minimum...

335 ...BL14 station was located in the northwestern Bering Sea: ...located on the...

338 ...which was located in the continental slope: ... on the continental slope

344 ...than all the MLD in the Bering Sea shelf: ...on the Bering...

350 ...stations in the Bering Sea shelf:...on the Bering...

352-353: The western BS section was under the influence of the water mass named Anadyr Water ... The western BS section was under the influence of the Anadyr Water

355 ... the MLD were all larger:...the MLDs were larger..

362 ...The MLD in the continental slope of the Bering Sea was significantly:... The MLD in the Bering Sea's continental slope was significant...

384 ... The Chukchi Sea is on the north of the Bering Strait:... is north of the Bering Strait:...

388 ...  $4.5 \times 10^{-6}$  m

390 ... The MLD at stations BT13-BT16 was all greater than:... BT13-BT16 was greater than

430 ...The isothermal and the isohaline showed a trend of deepening:... The isothermal and the isohaline showed a deepening trend in the Bering Sea slope,

431 ... than that in the Bering... than in the Bering

444 ... advection of the low salinity water:...In what low salinity water are you referring to?

452 ... The changes of MLD in the Chukchi Sea slope: ...MLD changes in the....

459 ... caused by the change in temperature:...caused by temperature changes

468 ... The contribution from salinity to:...The salinity contribution...

479 ... research (Johnson et al., 2012): ... research of Johnson et al. (2012),

500-501 ... The current velocity at BL01 was about 0.2m/s and was larger than that in the basin, which was smaller than 0.1m/s, according to our ADCP observations:... The current velocity at BL01 was about 0.2m/s, while in the basin was measured less than 0.1m/s according to the ADCP observations.

503-505...On the basin scale, the dominant cyclonic circulation might lead to the MLD in the central part of the Bering Sea basin smaller than that in the continental slope in the rim of the basin... might lead to a smaller MLD in the central part of the Bering Sea basin, than that in the continental slope in the rim of the basin

520-521:The wind observed by the shipborne automatic meteorological station was used to assess the CCMP wind product -> this is not to be here

527 ...and the north:...and in the north

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Figures-Tables

Figure 1 or 2: It would be helpful for the reader to show in one of these figures (probably the second) the areas of the Bering Sea shelf & basin, Chukchi Sea self & slope, and the transition zone that you are referring to later in the text. Also, please show the Anadyr Water in the Figure.

Figure 3: panel c: what are the two red boxes? Please write it to the caption.

Figure 4: Does this Figure includes all the stations? If not, it should. I suggest making one panel only, including all the stations (maybe on the vertical axis) and all the MLDts (on the horizontal axis). Also, I don't see the MLDt equal to 0 for the stations BS01-03.

Figures 5 and 9: every panel has a different depth, so please clarify the Labels for the depth (m) in each panel. Also, I would recommend adding the MLD line in every plot in these figures to make it easier for the reader to understand the MLD variability in each station.

Figure 10: it is challenging to follow. The axes' colors are mixed; in one panel the left is blue and in the next panel is black. There are the two magenta lines (explained under), but there is a red dashed line in panel a and another dashed line (probably blue) in the rest of the panels without explanation. Please make the Figure better and the captions complete.

Figure 13: ...Scatter plot of the wind speed and the MLD in all the stations. ...The solid blue line is the regression line of? And the red solid line? Please rewrite the caption

Figure 12: the figure and the caption are confusing, try to make them clearer.

Figure 14: explain in the caption of the Figure what is the yellow box

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