

Earth Syst. Sci. Data Discuss., author comment AC1
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Reply on RC1

Mario Hoppmann et al.

Author comment on "Mesoscale observations of temperature and salinity in the Arctic Transpolar Drift: a high-resolution dataset from the MOSAiC Distributed Network" by Mario Hoppmann et al., Earth Syst. Sci. Data Discuss.,
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RC1: 'Comment on essd-2022-66', Anonymous Referee #1, 09 May 2022 reply

Review of Hoppmann et al., "Mesoscale observations of temperature and salinity in the Arctic Transpolar Drift: a high-resolution dataset from the MOSAiC Distributed Network" submitted for publication in Earth System Science Data.

This is a solid manuscript that I recommend for publication after mildly major revision. The writing and figures are generally very clear. There are some confusing explanations that could use some attention.

#We thank the reviewer for the positive feedback. We tried our best to improve the explanations based on the detailed and very much appreciated comments. We hope that the new version is much clearer.

My major comment concerns a disconnect that I see between the Introduction, which has a significant discussion of the submesoscale, and the rest of the paper, which lacks analysis on these scales. See my comments near the end. The manuscript's title has the word "mesoscale" and the eddy analysis supports this. But why is there so much discussion of the submesoscale in the Introduction?

#This issue was also caught by another reviewer, and actually we very much agree to this. Presumably this is because for quite a while we weren't sure how much science should go in the paper, and in the end there was a mismatch between the intro and the preliminary analysis. To resolve this, we now moved a significant part of the intro in the discussion part, put a little bit less focus on the submesoscale, and included a new figure to illustrate better the mesoscale aspect of the dataset.

Line 61: Perhaps change "mesoscale scales" -> "mesoscales"
#Done

Lines 93 and 101: "upstream in the Transpolar" ie insert "in"
#Done

Line 101: "2019/20" -> "2019", yes?
#Done

Line 114: cut the word "already."

#Done

Line 116-117: "the measurements ensued away from the inflow of warm Atlantic Water through the Fram Strait and as close as possible to the Siberian continental slope" I am not sure what you mean by this. Also, I suspect that "ensued" might not be the best choice of verb.

#The expedition was meant to capture local processes at different locations within the Tranpolar Drift system. The drift originates on the Siberian shelves and reaches to the Fram Strait and the Canadian Arctic Archipelago. The conditions contrast those parts of the Nansen Basin dominated by the warm and salty inflow of waters of Atlantic origin, where conditions near the surface are significantly less salines than in the Transpolar Drift. We have rephrased the sentence to better explain that idea.

Line 119: "to achieve that aim" What aim?

#The focus was to measure conditions and resolve processes in the upper mixed layer, seasonally deepening and subsequently restratifying, as well as the underlying stratification (upper halocline). We clarified by changing the text.

Line 129: An egg has a pointy end; this buoy hull looks more oval, or perhaps "flattened oval"?

#changed "egg-shaped" to "oval"

Line 133: Your buoy naming convention is a bit odd, ie the use of the capital letter "O" instead of the number zero "0." But it is your choice. As noted below, this gets sloppy in the section about the eddy, when both "O" and "0" are used.

#The sloppiness has hopefully been corrected. The naming convention of these buoys is rooted in the larger context of the AWI buoy programme and the MOSAiC expedition, in which all the different buoy types are identified by the deployment year, a designated buoy-type dependent letter, and a running number. Actually, we should have included this description in the Methods part in the first place, which we have done now: "Following the naming convention of the general AWI buoy programme, which was also implemented for all MOSAiC buoys, we identify the individual buoys by an ID consisting of the deployment year (in this case "2019"), followed by a buoy type-specific letter (in this case "O") and a running number (here, "1" to "8"). This resulted in buoy IDs 2019O1 to 2019O8."

Paragraph starting at Line 135: I got a bit confused here. I thought perhaps the CTDs recorded 2-minute data, and then every 10 minutes, all of these data were sent to the satellite. I think instead, the satellite gets only a subsample of the 2-minute data, i.e., 10-minute sampling, is this correct? I wonder if you can make this clearer.

#This is partially correct. The buoy doesn't transmit a subset, it actually takes an additional measurement. We rewrote the paragraph substantially to make it clearer.

Lines 153-158: This material confused me. The CTDs have pressure accuracy of 0.02 - 0.002 dbar, but the transmission limitation degraded this to 0.1 dbar. So this is a significant reduction in data quality, right? Your text seems to indicate that it's no big deal.

An accuracy of 0.1 dbar implies a potential error of max. 0.09 dbar , given the deprecated pressure values. That kind of change in the top 100 m effects negligible changes in practical salinity and potential temperature (likewise, conservative temperature and absolute salinity). The error in salinity and potential temperature is always 10^{-4} or less (using the corresponding standard units). The maximum error in depth is 0.09 m , which, again, is negligible, given that standard CTD profiles by highly accurate systems are usually averaged at 1 m or 1 dbar intervals. The basis of these calculation is the Gibbs Seawater Toolbox, based on TEOS10.

While the deprecation of pressure to one decimal place is unfortunate and was not known to us when ordering the units, the problem will be alleviated by the manufacturer in any

future production of those units.

Further, Table 2 indicates that the pressure accuracy is always 0.1 dbar, even for the CTD data. Why? I thought a direct download could give you 0.02-0.002 dbar. I guess I'm missing something.

#Well, you are correct. The 0.1 is the most conservative accuracy, but yes, not representative for most of the dataset. We changed this to 0.1 / 0.02*, with an additional comment in the table caption. We would prefer not to give any higher accuracy, because the availability of pressure sensors was limited at the time when the CTDs were built, so for example 1000m rated pressure sensors ended up in some instruments.

Line 191: "an upper threshold of 0.8 m s⁻¹ was applied" Why?

#Actually, no single drift speed data point was removed based on that threshold. So this statement was removed to not confuse the reader.

Line 220: what is "sim"? I suspect it is some kind of word processing code.

#Great point, it should have been \sim , which is the LaTeX code for \sim . (Fun fact: the LaTeX code in our MS was \sim sim.) This is corrected now.

Line 222: How do you define "suspicious?"

Line 227: How do you define "questionable?"

#Beyond the defined range checks and moving average filters, a manual spike flagging was performed that was not based on a strict and stiff definition, but rather on a subjective (expert) judgement to the best of our knowledge. Examples are obvious isolated spikes (that still didn't fail the other tests, and therefore can't be considered "obvious" outliers), or suspicious "episodes" that for example weren't accompanied by a change in any other parameter.

In that context, there are other flagging schemes that even distinguish between suspicious and questionable (which we don't), or that categorize into "probably good" and "probably bad" etc. We don't feel comfortable in using that level of differentiation, and therefore decided to flag everything that "looks odd" or inconsistent with the -questionable- flag.

Line 233: "When CTD data was available..." This caused me some confusion, because the buoy has CTDs. Perhaps you can add a sentence like this to make it clearer: "Buoy data" means all data uploaded to the satellite from the buoys, including from the CTDs, at 10 min sampling, while "CTD data" refers to the directly downloaded CTD data from recovered buoys at 2 min sampling. Is that right?

#This is correct. This part has been altered to be much clearer, also based on the feedback by reviewer 3 who had the same issue.

Table 2: Is the surface temperature thermistor really accurate to 0.01 degC? I think these are usually not so good, e.g., 0.1 or 0.05 at best.

#This is correct, this should have read "0.05", and has been changed accordingly. This accuracy is also only valid when in water apparently.

Line 395: The MLD is not evident to me from this figure. How was it computed?

#see comment below on MLD in Figure 4.

Line 397: Perhaps change "a corresponding decrease in temperature" -> "a corresponding decrease in temperature along the freezing line"

#Good suggestion, this has been changed accordingly.

Lines 399-400: Perhaps change this text to: "...partly explained by a combination of upward mixing of deep salty water from below and salt rejection during ice formation from above, both forced by two February storms (with wind speeds up to 16 ms⁻¹ and air temperatures of XX degC)."

#Good suggestion, this was changed accordingly.

Lines 400-401: why is "vertical mixing properties" in quotation marks?

#We're not sure why. This has been changed now.

Line 403: I can't see MLD in Figure 4.

#This is correct, a continuous MLD evolution naturally can't be derived from our fixed-depths dataset. However, when CTD records from different depths "join each other", one can infer that the MLD has deepened at that time (i.e. the upper 100m have the same physical properties). This has been modified to become clearer.

Line 404: What is "air-line distance?"

#This was changed to "straight line distance", which is hopefully more clear.

Line 413: "The position of the eddy remains approximately the same" The same as what?

#This sentence has been removed.

Lines 417 & 419: check your velocity units. m-1 is wrong, yes?

#This has been corrected.

Line 417: "estimated diameter of the eddy" estimated how?

#The estimate was based on the buoy drift distance.

Line 421: Here you are using zero "0" instead of capital "O." There are several other examples in this eddy section.

#This has been fixed now.

Line 426: "by a factor of" i.e., add "a"

#Done.

Line 428: "radii" -> "radius"

#Done.

Lines 431-432: Great point!

:)

Line 439: "measured the the upper ocean quasi-synoptically over submesoscales" Two comments: (1) cut one "the" (2) Your introduction has a lot of material about submesoscales, but the paper itself has no corresponding analysis. I suggest you either cut / trim down the introduction material on this subject, or do more work to follow up on it. For example, you could create a histogram for one or all the buoys with a horizontal axis of Δx = the distance travelled by a buoy over 2 or 10 minutes. If you have a lot of sampling between 100 m – 10 km (or maybe shorter? Your introduction implies that Arctic submesoscales are shorter) then yes, you can justify this statement on Line 439 and the extensive discussion of this subject in the Introduction.

#Thank you for this comment, it makes a lot of sense. As mentioned further up, we have removed the mismatch between the intro and the analysis by moving a lot of the submesoscales material to the discussion part, while also alongside this including a new Figure 8 that is in principle similar to the histograms the reviewer suggested. We hope that the match is much better now.

But I would also ask this question: Did you really need to sample at 2 or even 10 minutes? What if you sampled hourly, or even daily? What would this histogram look like? I suppose I am suggesting that you do some analysis to find the right time interval for buoy data recording to adequately sample the submesoscale, as you claim without proof that you are doing now.

#The choice of 2 and 10 minute sampling was based on a power budget calculation of the CTDs and buoys, and optimized towards the ideal duration of the MOSAiC experiment, which was one year.

Furthermore, resolving various processes, such as internal wave variability, requires sampling intervals of a few minutes. We have added an exemplary figure and a discussion on what time and space scales are resolved in our dataset in Section 5.3.

Line 473: code is available "upon request." Is this sufficient for this journal? Should it instead be available on github or equivalent?

#Since the processing code doesn't include any particularly innovative techniques and is only tuned towards this particular data set, we decided that there is not enough added value to putting the project on Github or similar repositories. If this is a requirement for the journal though, we might reconsider this.