Response to Reviewer 2:

Dear Reviewer 2,

we are grateful for your constructive suggestions and positive assessment of this manuscript. In the attached file, we respond to all comments. In the revised version we give a better insight into the uncertainties associated with the individual parameters and provide a table that lists investigated parameters and their spatial and temporal resolution.

Once again, we thank you for the time you have taken for this review.

With best regards,

The author team

Summary

This paper provides an overview of the sea ice and atmospheric conditions along the Polarstern drift track during the first phase of MOSAiC. An impressive number of satellite data products are used to achieve this. While the manuscript isn't the most exciting from a scientific perspective, I appreciate that it wasn't intended to be. It will act as great reference material for anyone interested in working with MOSAiC data and I would be very pleased to see it published. However, I have some comments to be addressed first.

General Comment

The manuscript contains a huge amount of information, and I strongly feel that readers would benefit from having the highlights presented in a more accessible way. I suggest including a synopsis/summary table, which includes:

1. Satellite datasets evaluated
2. Spatial and temporal resolution of each dataset (raw, and when averaged for this analysis)
3. Statement of which datasets were analyzed close to the CO, i.e. not just within the 50 and 100 km radius, and what "close" means (as it varies for each dataset)
4. Key results (as summarized in the conclusions)

Point 3 above would also address the general inconsistency in the paper around what "close" means with respect to the CO

Reply: Presenting applied sensors and specifications is a good idea. A new table was included that highlights 1) sea-ice parameters investigated in this study, 2) the respective sensor/satellite and data distributor, 3) spatial and temporal resolution, and 4) the different radii that we investigated. Furthermore, the terms (close, medium, far range) are defined which we use in the manuscript. However, we believe that listing the Key Results in this table would duplicate the Summary chapter. We have therefore not implemented the latter.

Specific Comments

Title: The title would be more descriptive if it were "The MOSAiC Drift **first phase**…"

Reply: We agree: We now make clear in the title that the manuscript is about the first phase (October to July) only.

P1L26: Climatological mean over what period?

Reply: We now define the reference period in the sentence before. Note that the reference period was missing in the conclusion and in a few other sentences too. We now ensure that the term "previous" and "climatological mean" is defined, when it is used in the text (e.g. past 14 years, period 2005/2006 - 2018/2019, etc.)

P1L32: "…divergence**/convergence**…" i.e. be explicit that convergence is included in their definition of divergence. I don't feel it's widely assumed that divergence, when negative, can be used interchangeably with convergence.

Reply: Thanks for your comment. We now state everywhere explicitly in the manuscript and the figures whether we mean divergence or divergence and convergence.

P1L33-34: You state that 5 km is "close" the CO and that 50 km represents the "wider surroundings", but then that 50 km is "near" to the CO. Maybe just state the distances, to avoid ambiguity on what is close/near and what is not.

Reply: We agree. We now just state the distances in the abstract.

P2L46: Could you comment on whether the chosen floe was representative of the pack ice in general, or was an anomalously large floe selected? That strikes me as a big floe, especially for the Laptev Sea, and that's an important factor when considering differences in e.g. ice drift compared with previous years.

Reply: The selected floe wasn't anomalously large. We found several floes of same size that did survive summer 2019. In the paper https://tc.copernicus.org/articles/14/2173/2020/tc-14-2173-2020.html we investigate the initial conditions at the start of the expedition.

With respect to the ice drift: More than 50 GPS trackers were installed on the surrounding floes. Some of the surrounding floes were larger, but some were smaller. However, until Fram Strait was reached, no significant differences in drift speed were observed.

P2L56: The wording here is confusing. It would make more sense just to say "… were able to follow the ice floe back to its place of origin".

Reply: Thanks, sentence was changed

Section 2: Throughout this section I would have liked references to the relevant figures for each paragraph (e.g. sea-ice tracking, sea-ice concentration etc.) I'd also suggest changing the order of your figures so they better fit the flow of the text and make it easier for the reader to familiarize themselves with the datasets before moving to the discussion.

Reply: In the first version, most of the figures listed in chapter 2 were put into a supplement. These are now part of the manuscript again, as the TC has a strict regulation regarding the sequence of figures and the supplement content.

We agree that Chapter 2 is now somewhat overloaded. However, we fear that providing references to figures from Chapter 3 makes the manuscript more difficult to read. We have therefore decided to leave the sequence as it is and hope that it is sufficient.

P3L106: "…drift of the CO **and other buoys**…"

Reply: Thanks, changed

P3L199: How was the 6.25 km dataset averaged to get conditions close to the CO?

Reply: The ice concentration dataset has a grid resolution of 6.25 km. The satellite footprint of AMSR-E is 5 km and the AMSR2 one 4 km in diameter. Thus, these are the smallest scales we can resolve. This information is added to the section.

P4L130: Have you validated that the multi-parameter approach is more accurate, or is this statement just based on what's expected? Please specify.

Reply: We describe the OEM ice concentration dataset in more detail now in this section. The ship-based observations confirm that the OEM dataset is in better agreement. That is discussed in the results section 3.3.

P4L157-158: On average how many CS2SMOS SIT observations were averaged? It must be quite a small number.

Reply: We added the information to the manuscript:

"The number of CS2SMOS SIT observations selected may depends on the position of the CO relative to local grid cell coordinates. The number varies between 10 and 14 grid cells for the 50 km and between 47 and 52 for the 100 km search radius. However, we do not expect this variability to cause a selection bias due to the smoothness of the CS2SMOS SIT data."

P5L169-170: Do you mean that snow depth can only be retrieved for MYI, or that it's only MYI that has these limitations?

Reply: Thank you for the comment. We clarified that in the manuscript: Snow depth over MYI is limited to March and April. Over first-year ice, snow depth can be retrieved November to April.

P5L178: State what "MOY" and "MOD29" stand for

Reply: The MOD/MYD was unnecessary and is removed.

Reply: Data is available from NOV to APRIL. The daily lead data can only be derived for winter months as the retrieval relies on a significant surface temperature contrast between leads and sea ice. Text is added accordingly.

Reply: The resolution of the product is 1 km. Previous statement was wrong and is removed.

Reply: Between January and March, Polarstern exceeded the northern limit of the satellite coverage which is at about 88 °N for Sentinel-1. Occasionally, there were Sentinel-1 scenes available covering Polarstern at the end of January, but there were large temporal gaps and not sufficient spatial overlap to calculate reliable sea ice drift.

Reply: We have updated Figure 4; the arrows depicting the monthly drift should now be better visible. Regarding the wind directions, note that the figure shows wind anomalies whereas the drift path is the actual drift. Combined with the climatological winds, the anomalies indeed lead to prevailing westward winds during those months. We have added a note of caution to the text to prevent that confusion.

Reply: We agree that our formulation was misleading and we reformulated it:

"Averaged from October to July the ice concentration along the MOSAiC drift trajectory agrees well with the long-term 2005/2006 to 2019/2020 average (both have a mean of 97%). However, on shorter time scales there are significant differences: During the first half of the drift (October until end of February) the MOSAiC ice concentration was with 99.5% about 1% higher than the long-term average (compare black with blue line), while during the second half (March until end of July), it was lower than during the long-term average and shows higher variability than the first half. High ice concentration like the 99.5% are not unusual (compare to the grey lines) and can be expected in winter in the Central Arctic (e.g., Kwok, 2002). The

second half with lower (actually false) ice concentration is more unusual and will be discussed further in the following."

Reply: The daily values are based on the all SIT retrievals along the ground track of CryoSat-2 on a particular day. The thickness retrieval in the CryoSat-2 data is done for each waveform that is available at a rate of 20Hz and with a spacing of approximately 300 m on the ground. Thickness data from individual radar waveforms has substantial noise, thus we only use spatial averages here. We achieve the almost daily coverage because MOSAiC was located very close to the maximum orbit density of CryoSat-2 at 88 degrees north. There are a few days without CryoSat-2 l2p data coverage within the 100 km search radius in the beginning and the end, where the Polarstern was at lower latitudes. We expanded the description of the l2p data in section 2.3 to better explain the properties of this data set.

Reply: Word was replaced by "to some extent".

Reply: We have adapted the manuscript in the way you suggested and stated always whether we mean positive divergence or divergence and convergence.

Technical Comments

P1L30: "month" -> "months"

Reply: Thanks, changed

P2L78: "…CO prior **to** departure…"

Reply: Corrected

P3L104: "number" -> "assess/gauge/quantify"

Reply: Corrected

P4L152: Remove the duplicate "sea" before "sea-ice"

Reply: Corrected

P7L264: "westerly" -> "eastward"

Reply: Changed

P7L276: "…radii, **we** will limit…"

Reply: Changed