__**Answers to reviewer 2**__

We thank the reviewer for his/her constructive remarks. In the manuscript we identified all changes in response to the reviewer in **blue bold.**

__**General comments:**__

Point 1:

We followed the suggestion of the reviewer and described anomalies of the atmospheric MOSAiC observed parameters along the drift trajectory (10 m wind, 2m temperature, sea level pressure) compared to the climatology 2010-2019 in section 3.1.1 and **Figure S4** and meridional sea ice velocities together with the 10 m zonal and meridional wind components in **Figure S5.**

The text was changed accordingly:

Krumpen et al. (2021) **analysed atmospheric MOSAiC in-situ measurements of 10 m winds, 2m air temperature and sea level pressure and other parameters along the MOSAiC ice drift trajectory together with ERA-5 data for the time period 2005-2020. Fig. S4 compares the 10 m wind, 2m temperature and sea level pressure along the MOSAiC drift trajectory based ERA-5 data for the climatology 2010-2019 applied in this study. Strongest deviations from the climatology occur in the time period January-March 2020. In mid-February a low surface pressure anomaly is determined by a strong synoptical cyclone event with values down to 985 hPa. This low pressure anomaly is connected with warmer temperatures and higher wind speed. Contrary high pressure values at the beginning of March 2020 are connected with cold temperatures and lower wind speed, indicating the important role of warm or cold advection for temperature changes.**

Lei et al. (2016) **investigated the sea ice motion from the central Arctic to the Fram Strait with ice-tethered buoys between 1979-2011 and showed, that sea ice drift was determined mainly by near surface winds. They detected an accelerated meridional sea ice velocity following the Arctic Dipole (AD) pattern and a reduced meandering of the ice trajectories during the positive AD phase. The drift of the central MOSAiC Observatory was closely correlated with the ERA5 zonal and meridional components of the 10m winds (blue and red curves in Fig. S5). Compared to previous years, winds tended to have anomalies toward the Fram Strait, in particular in January, February, and March (compare red and black curves in Fig. S5, bottom), in line with corresponding sea-level pressure patterns (Fig. 2). Moreover, while the ice drift speed amounted to about 2% of the 10m wind speed on average, the drift component toward Fram Strait was positively offset compared to the winds. In particular from mid-February until the end of March, several short periods of wind toward eastern Siberia (negative values in Fig. S5, bottom) did not result in accordingly reversed drift, but only prompted the transpolar drift to pause (values close to zero in Fig. S5, bottom), likely due to the continued action of ocean currents and/or internal ice stress. From mid-June onwards, the ice drift was superimposed by pronounced inertial motions (Fig. S5), hinting at a looser ice cover (e.g., *Gimbert et al, 2012*). A close relation between the 10 m wind speed components and the sea ice velocity during the positive AO months January-March 2020 is visible. The MOSAiC drift**

showed a fast accelerated drift from the central Arctic to the Fram Strait without meandering. These results underlines, that the direct fast southward MOSAiC drift towards the Fram Strait during January-March 2020 was a result of the permanent positive AO phase accompanied by a prevailing positive AD phase.

Point 2:

We agree about the importance of the Arctic Dipole for the Transpolardrift, shown by some authors and discussed this point as follows.

Besides the AO, the Arctic Dipole (AD) pattern is important for the Arctic circulation and sea-ice motion (*Wu et al., 2006; Cai et al., 2018; Watanabe et al., 2006; Zhang, 2015*). The AD pattern in its positive phase is connected with a negative pressure anomaly over the eastern Arctic and a positive pressure anomaly over the western Arctic and leads to an acceleration of the transpolar drift in agreement with *Lei et al. (2016).* Previous studies on the AD pattern, either in summer (*Cai et al., 2018*), or in winter (*Wu et al., 2006*) often used a rather small domain (60°-90°N or 70°-90°N) and defined the AD pattern as second EOF of monthly mean SLP fields. For these small areas the domain boundaries do induce an artificial preference of particular pattern structures as discussed by *Legates (2003)* and *Overland and Wang (2010)*. Since neither EOF2 nor EOF3 of the above described analysis for the large domain 20°-90°N reveal an AD pattern, an additional EOF analysis of monthly mean SLP over the smaller domain 60°-90°N was performed, over the same 1979-2000 period as before.

Fig. S2 shows the respective first EOFs and their daily indices. The first EOF displays again the AO pattern, and the daily indices over the MOSAiC period Nov 2019 to May 2020 are highly correlated (0.95) with the AO index based on the EOF1 for the large domain (Fig. 1a) In this analysis, the AD pattern appears as third EOF, which indicates that the AD pattern is less stable than the AO pattern. The explained variances are 15 % for the second EOF and 13.6 % for the third EOF (AD). The positive AO phase from January-March 2020 is accompanied by a prevailing positive phase of the AD pattern (Fig. S2). The histogram of the daily AD indices for the period January to March 2020 indicates a higher variability of the AD index compared to the AO index (compare Fig. S1, right and S3). Whereas the AO index remain positive over the whole period January to March 2020, the AD index shows a prevailing positive phase, but with a smaller shift of the distribution towards positive values compared to the shift in the distribution of the AO index. The time series of the AD index reveals more positive values in January and March, but a shift to more neutral and negative values in February (see time series for EOF3 in S2). This behavior of the AO and AD indices explains to a large extent the differences in the monthly mean SLP pattern over the Arctic for January, February and March, displayed in Fig. 2.

We added additional citations in the references.

<u>Specially comments:</u>

1) These results have been described in a recently submitted paper Krumpen et al. (2021) and cited here.
2) We found it difficult and prefer to keep our wording with thermodynamic processes and combined effects of thermodynamical and dynamical changes.
3) LN 310: Changed to “**the SIT distribution in a region**”.
4) LN 330: Changed to “**the climate mean of 2010-2019**”.
5) LN 389: Changed to ”**Compared to the short daily atmospheric time scales the longer time scales of ocean and sea ice processes provide memory effects for seasonal sea ice forecasts…”**
6) LN 430: Changed to “**losing heat to the atmosphere**”