Dear referee,

Thank you for your helpful comments. Please find point-by-point answers below.

1) How could the effects of ocean can be separated from that due to pure ice changes?

The ocean can impact near atmospheric conditions in two ways. Directly – in areas with open ocean – by increasing heat and moisture fluxes to the atmosphere. And indirectly by melting sea ice, which acts as a barrier between ocean and atmosphere and largely reduces heat and moisture exchange. Since we do not study the processes causing changes in sea ice cover, it is not possible to exclude the indirect ocean impact as a factor influencing atmospheric conditions. The sea ice cover in our two study regions has changed drastically over the last 30 years resulting in a much larger area where the atmosphere comes into direct contact with the ocean without an insulating sea ice layer. Here, we assume that an increase of the open ocean area will have a much larger impact on air temperature and humidity than an increase of the ocean temperature of a few degrees in these specific regions and thus we do not consider the direct ocean effect explicitly.

2) Would you mind considering using a model to confirm the main conclusions of this study?

We agree, modeling would strengthen the conclusions, but this is beyond the scope and possibilities of this paper. It would require a very comprehensive analysis. In fact, one of the goals of this paper is to stimulate future modeling work based on our present results. We will add this idea to the outlook paragraph at the end of the section *Discussion and conclusions.*

3) Do the off-ice events have associations with typical large-scale atmospheric circulations? Or is there any connection with synoptic cyclones?

Events of off-ice flow in the Fram Strait region typically occur when a low-pressure system is present over or east of Svalbard and a high-pressure system prevails over Greenland (Knudsen et al. 2018), which also causes marine cold air outbreaks (Kolstad 2017). The corresponding references will be added to the paper.

Minor concerns:

P6L146-147: Is 33% double of 25%?
The size of the wind direction sectors is 60° (-45° to 15°) for GRL and 30° (30° to 60°) for WNB. This corresponds to 16.67% and 8.33% of 360°, respectively, which is roughly half of the observed frequency of occurrence of 33% and 16%. The sentence will be rephrased for clarity.

P7L69: Fig. 4e, f –> Fig.4c, f,
Will be corrected.

P7L171: not true

The sentence will be rephrased for clarity:

"For humidity, trends in the Odden region are up to 0.07 g kg^{-1} dec^{-1} larger for all other wind directions than for off-ice flow indicating that the largest humidity trends are not related to sea ice cover changes north of this region."

P7L175-176: GRL-ATM box is not in the place with the largest difference (Fig. 3 e, f)

If you refer to the WNB-ATM box, then, yes, the box should indeed be located slightly further to the north-east. Following the suggestions by referee 1, we will restructure the paper by starting with a general analysis of trends in the Fram Strait region. Based on this we will then describe in more detail how the specific study regions WNB and GRL and the placement of the ICE and ATM boxes were chosen. This will help clarify the general storyline.

P9 L180-190: These two paragraphs seem to compare the trends of air temperatures and specific humidity in WNB and GRL, respectively. If so, the sentence in L189-190 should not be placed there.
The paragraphs discuss trends of all three considered atmospheric variables in the WNB (first paragraph) and GRL (second paragraph) regions. For WNB, we start with results for temperature and humidity, followed by wind speed in L182-183: "The wind speed change is close to zero and not significant at the 95 %-level for both reanalyses." This structure is mirrored in the second paragraph for GRL and thus we will keep the sentence in L189-190 concerning wind speed trends in the GRL region.

P11L211: Typo, extent à extend
Will be corrected.

P11L214-215: "2022 was an exceptional year" Why? Explanations are only given in the discussion not here.

We rephrased this sentence to emphasize that 2022 had two periods with very low WNB fetch values, which has not been observed in previous years:

"Even though average sea ice concentrations in 2022 were not even among the 5 lowest observed years, WNB fetch values exceeded 830 km during four days in January and two days in March 2022."

For the discussion of why these periods occurred, please see our answer to your last comment (P17 L293-295).

P13L232: Three grid points are given in the reference, why the authors only show two of them?

Tetzlaff et al. (2014) presented ERA-Interim air temperatures as a function of the WNB fetch length for three points with increasing distance from the ice edge. They showed that Spearman rank correlations gradually decreased with increasing distance. Here, we replicate their method only to demonstrate that air temperatures do not only correlate with the WNB fetch length but also with the average WNB sea ice concentration and that these correlations also decrease with increasing distance from the ice edge. To increase the clarity

of Figure 9 we only show the northernmost and southernmost grid points here. To clarify this, we write now:

“For this purpose, we use a method similar to the one by Tetzlaff et al. (2014) who ...”

P15 L256: cannot see it in Fig. 10

We will add the approximate coordinates of the region with lower correlations at the west coast of Svalbard (78.5° N, 10° E) for clarity.

P17 L280-281: Repetitive info for WNB. Maybe the authors meant “for GRL”, modify the sentence accordingly

The sentence states “As for WNB” - meaning that results for GRL are similar to those from WNB. We will rewrite this sentence to:

“This is almost one third larger than trends calculated using periods with all other wind directions, which is a similar result as for WNB.”

P17 L293-295: Explanations are given here for the extreme year of 2022. Justifications or references should be given.

The corresponding lines in the paper state that:
“2022 was an extreme year since the open water fetch exceeded 800 km during two separate weeks. The event in March was a consequence of a period with strong southerly winds causing a warm-air intrusion into the Arctic across the Fram Strait region.”

During the event in March 2022 the HALO-(AC)^3 aircraft campaign took place in the Fram Strait region. A paper describing the synoptic conditions during this period is currently in preparation (Walbröl et al., in prep.) and will be added as a reference. It identifies two distinct periods of warm-air intrusions on 12./13. March and 15./16. March causing advection of warm and moist air as far north as the Central Arctic Ocean (close to the North Pole).

This effect can also be seen from the following maps of temperature, humidity and wind vectors from ERA5 for a day during this period:

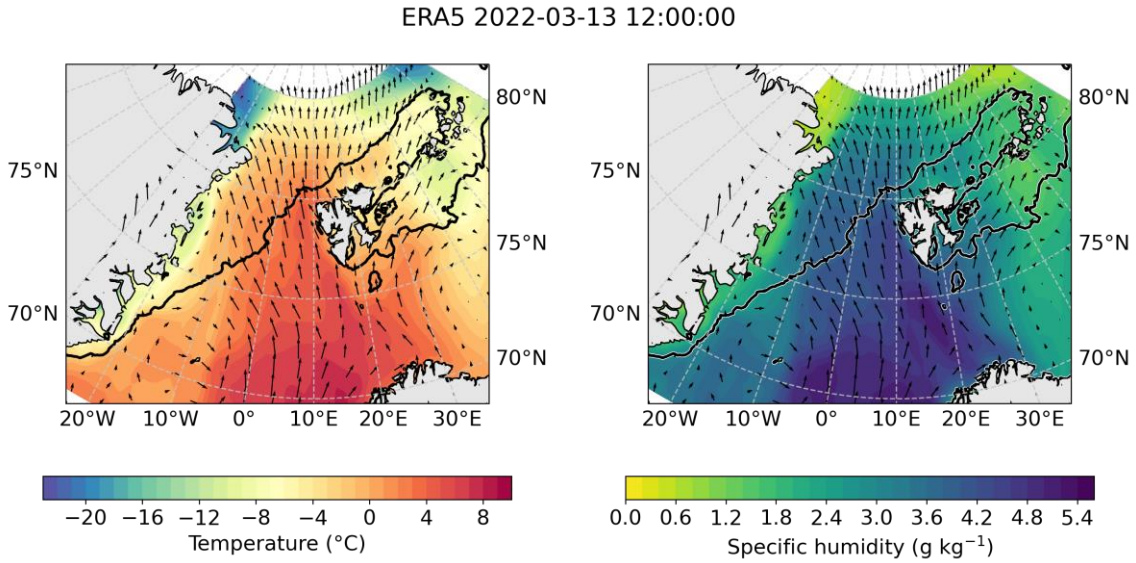

Figure: Contours of air temperature (left) and specific humidity (right) at about 10 m height from ERA5 reanalysis data on 13 March 2022. Arrows denote wind vectors at the same height. The black line denotes the 80%-sea ice concentration contour from the same day.

Such maps could be added as an appendix or supplement to the paper.

References:

Knudsen, E. M., Heinold, B., Dahlke, S., and 14 Co-authors (2018). Meteorological conditions during the ACLOUD/PASCAL field campaign near Svalbard in early summer 2017. *Atm. Chem. Phys.*, *18*(24), 17995-18022, https://doi.org/10.5194/acp-18-17995-2018

Kolstad, E. (2017): Higher ocean wind speeds during marine cold air outbreaks, *Q. J. Roy. Meteor. Soc.*, 143, 2084–2092, https://doi.org/10.1002/qj.3068

Walbröl, A. et al.: Meteorological overview of the HALO-(AC)³ campaign, in preparation