Dear Editor,

Hereby, we would like to submit a revised version of our manuscript and a response to the referee letter. We hope that the revised manuscript now is qualified for publication in The Cryosphere.

Response to Anonymous Referee #3

We appreciate the comments of referee #3. We are responding to the comments in the following way:

l. 87: "The station is situated on the 200-meter thick Ekström ice shelf" This is the local ice thickness, ice shelf thickness typically increases strongly towards the grounding line.

Corrected as requested. Revised manuscript, Subsubsection 2.1, line 87:

The station is locally situated on a 200-meter-thick ice shelf (Ekström) approx. 42 m above sea level. This ice shelf with the thickness that increases strongly towards the grounding line, has a homogeneous, flat surface slightly sloping upwards to the south (Klöwer et al., 2013).

l. 98: "These low-pressure systems move toward west around Antarctica" Generally, low-pressure systems move eastwards with the westerly circulation around Antarctica.

You are right, thanks. We correct the sentence. Revised manuscript, Subsubsection 2.1, line 99:

These low-pressure systems move towards east around Antarctica with cyclonic circulations (clockwise).

l. 113: "In this study, temperature, relative and specific humidity…" Temperature and relative humidity are measured directly, after which specific humidity is then calculated, also using pressure.

Corrected as requested. Revised manuscript, Subsubsection 2.2, line 114:

In this study, temperature, relative humidity, pressure, wind speed, and wind direction data, measured 50 meters away from the station at 2-meter height above the surface, are used. Additionally, we calculated specific humidity based on the measured relative humidity, temperature, and pressure.

l. 228: "Daily relative humidity fluctuates between 59.95 % and 96.71 % with a mean value of 80.42 %." Suggest changing to "Daily relative humidity fluctuates between 60 % and 97 % with a mean value of 80 %."

Corrected as requested. Revised manuscript, Subsubsection 3.1, line 230:

Daily relative humidity fluctuates between 60 % and 97 % with a mean value of 80 %.

l. 232: "-15.81◦C and -15.65" -> "-15.8◦C and -15.7"

Corrected as requested. Revised manuscript, Subsubsection 3.1, line 233:

The average 2-m temperature for the year 2017 and 2018 is -15.8°C and -15.7°C, respectively.

l. 258-260: Use one decimal for temperature.

Corrected as requested. Revised manuscript, Subsubsection 3.2.1, line 259:

The average 850 hPa temperature for the year of 2017 and 2018 is -14.5 °C, which is about 1 °C warmer than the observed 2-meter average temperature. Daily values of the 850 hPa temperature vary between -31.1 °C and -3.0 °C, showing a smaller amplitude compared to the 2-meter temperature values at Neumayer Station.

l. 268: "In winter, clouds can be much warmer than the surface, which leads to a strong temperature inversion. However, changes in wind speed and direction might change the cloud cover and thereby weaken or destroy the inversion layer, in short time."

Suggest to change to:

"Especially in winter, clouds warm the surface, limiting or destroying a temperature inversion that may have been present under clear skies. Similarly, increases in wind speed may also weaken or destroy the inversion layer, in a short time."

Corrected as requested. Revised manuscript, Subsubsection 3.2.1, line 270:

Especially in winter, clouds warm the surface, limiting or destroying a temperature inversion that may have been present under clear skies. Similarly, increases in wind speed may also weaken or destroy the inversion layer, in a short time.

l. 272 and further: "As sea ice can strongly limit the heat flux between a relatively warm ocean and the atmosphere, sea ice coverage variations close to Antarctica's coastal stations can primarily affect the near-surface temperature at the stations (Turner et al., 2020). Decreasing sea ice variability close to the Neumayer Station in summer compared to other seasons, which is true for most other coastal stations in Antarctica, may also lower the temperature variability. Another reason for the reduced temperature variations in summer can be a stronger heat loss, which prevents temperatures above zero. At Neumayer Station, the largest sources of heat loss in summer are sublimation and snow melting (Jakobs et al., 2019). The sublimation is primarily temperature-controlled and is only significant at Neumayer station in summer. About 19% of the annual snowfall at this location is removed by sublimation (van den Broeke et al., 2010). The second source of heat loss at the station is snow melting. In summertime, when the air temperature can rise above 0 ° C, the surface snow will reach its melting point and start to melt. For the melting process, the incoming radiative energy is partly used for latent heat uptake, keeping the near-surface temperature close to the melting point."

Suggest to change to:

In summer, interdiurnal temperature variations are strongly reduced. The primary reason is that absorption of solar radiation prevents the formation of near-surface temperature inversions, limiting the above-described processes. As sea ice can strongly limit the heat flux between a relatively warm ocean and the atmosphere, sea ice coverage variations close to Antarctica's coastal stations can primarily affect the near-surface temperature at the stations (Turner et al., 2020). Decreasing sea ice variability close to the Neumayer Station in summer compared to other seasons decreases spatial regional temperature gradients, which is true for most other coastal stations in Antarctica, may also lower the temperature variability. Finally, in summertime, the air temperature sometimes can rise above 0 ° C, and the surface snow will reach its melting point and start to melt. For the melting process, the incoming radiative energy is partly used for latent heat uptake, keeping the near-surface temperature close to the melting point."

Corrected as requested. Revised manuscript, Subsubsection 3.2.1, line 274:

In summer, interdiurnal temperature variations are strongly reduced. The primary reason is that absorption of solar radiation prevents the formation of near-surface temperature inversions, limiting the above-described processes. As sea ice can strongly limit the heat flux between a relatively warm ocean and the atmosphere, sea ice coverage variations close to Antarctica's coastal stations can primarily affect the near-surface temperature at the stations (Turner et al., 2020). Decreasing sea ice variability close to the Neumayer Station in summer compared to other seasons decreases spatial regional temperature gradients, which is true for most other coastal stations in Antarctica, may also lower the temperature variability. Finally, in summertime, the air temperature sometimes can rise above 0◦C, and the surface snow will reach its melting point and start to melt. For the melting process, the incoming radiative energy is partly used for latent heat uptake, keeping the near-surface temperature close to the melting point.

l. 310: "Moisture uptake coming to Neumayer Station depends on different factors such as sea ice extent, the Southern Hemisphere semi-annual oscillation (SAO), and absolute temperature. As Fig. 5 shows, the sea ice prevents evaporation from the ocean. In the areas with ice coverage more than 90 %, the moisture uptake is minor. The SAO is the main phenomenon that affects surface pressure changes at the middle and high latitudes of the Southern Hemisphere (Schwerdtfeger, 1967). It means the twice-yearly contraction and compression of the pressure belt surrounding Antarctica as a result of the different heat capacities of the Antarctic continent and the ocean. The SAO leads to a clear half-yearly pressure wave in surface pressure at high latitudes and modifies the atmospheric circulation and temperature cycles (Van Den Broeke, 1998)."

Suggest to change to

"Moisture uptake and subsequent transport to Neumayer Station depend on different factors such as sea ice extent and the track of cyclones. As Fig. 5 shows, the sea ice prevents evaporation from the ocean. In the areas with ice coverage of more than 90 %, the moisture uptake is minor. The SAO is the main seasonal phenomenon that affects surface pressure changes at the middle and high latitudes of the Southern Hemisphere (Schwerdtfeger, 1967). It represents the twice-yearly contraction/expansion of the low-pressure belt surrounding Antarctica as a result of the peaking/dipping latitudinal gradient in solar radiation. This leads to a clear half-yearly cycle in meridional fetch and associated heat and moisture transport which strongly modifies the temperature cycles in coastal Antarctica (Van Den Broeke, 1998)."

Corrected as requested. Revised manuscript, Subsubsection 3.3, line 310:

Moisture uptake and subsequent transport to Neumayer Station depend on different factors such as sea ice extent and the track of cyclones. As Fig. 5 shows, the sea ice prevents evaporation from the ocean. In the areas with ice coverage of more than 90 %, the moisture uptake is minor. The SAO is the main seasonal phenomenon that affects surface pressure changes at the middle and high latitudes of the Southern Hemisphere (Schwerdtfeger, 1967). It represents the twice-yearly contraction/expansion of the low-pressure belt surrounding Antarctica as a result of the peaking/dipping latitudinal gradient in solar radiation. This leads to a clear half-yearly cycle in meridional fetch and associated heat and moisture transport which strongly modifies the temperature cycles in coastal Antarctica (Van Den Broeke, 1998).

l. 326: 5.67 -> 5.7

Corrected as requested. Revised manuscript, Subsubsection 3.4, line 324:

The origin of the air masses measured at Neumayer Station depends directly on the local wind, which is characterized by relatively high wind speeds, with an annual mean value of 8.7 m s^{-1} during the measurement period (with a standard deviation of 5.7 m s^{-1}, considering daily values of all days).

l. 355 -> 365: for the meteorological variables, use a single decimal. Do this throughout.

Corrected as requested. Revised manuscript, Subsubsection 3.5, line 355:

The average of all values of each variable for the diurnal cycle study period (December-January of 2017/18 and 2018/19) are: $\delta^{18}O$: −26.3 ‰; δD: −205.3 ‰; d: 5.5 ‰; 2-meter temperature: −4.3 °C; 10-meter temperature: −3.9 °C; specific humidity: 2.5 g kg^{-1}; relative humidity: 86.3 %; wind speed: 7.6 m s^{-1}; wind direction: 291 degree (we consider only winds with a wind speed of more than 3 m s^{-1}); shortwave downward radiation: 229.0 W m^{-2}.
Strong diurnal cycles in 2-meter temperature (Fig. 8d, red line), 10-meter temperature (Fig. 8d, green line), specific humidity (Fig. 8e), and relative humidity (Fig. 8f) are detected. For wind speed, the diurnal cycle is weak (Fig. 8g) and for wind direction no diurnal cycle is detectable (Fig. 8h). In summer, there is no strong temperature inversion close to the surface, at least not for the first 10 meters above surface. The temperature differences between 2-meter and 10-meter height reaches up to 1 °C during the coldest time of a day, while during half of the day their difference is less than 0.4 °C.

l. 367: "A very high correlation coefficient between $\delta^{18}O$ and 2-meter temperature (r = 0.98) and 10-meter temperature (r = 0.99) suggests the temperature changes as the main driver of water vapour $\delta^{18}O$ diurnal variations" The fact that both variables show a daily cycle will *result in high correlation but does not prove causation. Could be solar radiation, sublimation, boundary layer depth….this also applies to similar statements elsewhere in the paper.*

According to the ultimate goal of studying isotopes, we have changed the argument. Revised manuscript, Subsubsection 3.5, line 367:

There is a very high correlation coefficient between $\delta^{18}O$ and 2-meter temperature ($r = 0.98$) and 10-meter temperature ($r = 0.99$). These high correlations cause the temperature to be predictable based on water stable isotopes variations. *d* is rather anti-correlated with relative humidity ($r = -0.59$), while it does not show a considerable correlation with temperature and specific humidity.

l. 398: I could be wrong, but it appears that Fig. 10 is referenced before Fig. 9.

You are right; thank you for the remark. We have reordered Fig. 9 and Fig. 10.

l. 402: pattern -> patterns

Corrected as requested. Revised manuscript, Subsubsection 4.1.2, line 401:

Then we look at the residual between the predicted $\delta^{18}O$ value and the observed $\delta^{18}O$ value (Fig. 10) and analyse how this residual might be linked to different wind patterns at Neumayer Station.

We thank referee #3 for his/her detailed comments and suggestions on our manuscript. We hope that we have dealt with all comments in an adequate manner and that the revised manuscript now qualifies for publication in The Cryosphere.

References

Klöwer, M., Jung, T., König-Langlo, G., and Semmler, T.: Aspects of weather parameters at Neumayer Station, Antarctica, and their representation in reanalysis and climate model data, Meteorol. Z., 22, 699–709, https://doi.org/10.1127/0941-2948/2013/0505, 2013.

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Turner, J., Marshall, G. J., Clem, K., Colwell, S., Phillips, T., and Lu, H.: Antarctic temperature variability and change from station data, Int J Climatol, 40, 2986–3007, https://doi.org/https://doi.org/10.1002/joc.6378, 2020.

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