The Cryosphere Discuss.,
https://doi.org/10.5194/tc-2020-302-RC2, 2020

The Cryosphere Discussions
Open Access
EGU

Interactive comment on "Continuous monitoring of surface water vapour isotopic compositions at Neumayer Station III, East Antarctica" *by* Saeid Bagheri Dastgerdi et al.

Anonymous Referee #2

Received and published: 21 December 2020

Review of Saeid Bagheri Dastgerdi et al.: Continuous monitoring of surface water vapour isotopic compositions at Neumayer Station III, East Antarctica

Bagheri Dastgerdi and co-authors present a new dataset of vapor isotopic composition, sampled continuously at Neumayer Station, Antarctia over two years. The authors analyze the dataset using meteorological observations and back-trajectory modeling. The dataset appears to be of high quality, and sheds light on isotopic processes in the continent important for the interpretation of ice cores. Unfortunately the analysis is somewhat limited. For example, the authors only perform back-trajectory modeling for less than half their dataset, which limits their ability to interpret the data. Some

of the more interesting features – such as a secular trend in the d-excess data – are not addressed. The reader is left with very little new insight in what type of dynamical processes may be driving the isotopic trends.

I am not a meteorologist, but it appears there are some shortcomings in the interpretation of the various weather data (as noted in the detailed comments below). The paper would benefit from being read/reviewed by an expert on Antarctic meteorology. Very few, if any, papers on this topic are cited. Various meteorological observations must be placed in a broader context of such observations, and the correct interpretations must be given.

While somewhat unsatisfying, I believe the paper deserves to be published based on the quality of the unique new observations.

Comments:

The back-trajectory provides the most meaningful and relevant data analysis tool in the paper, but it is only used vey summarily. First, I would encourage the authors to run the backtrajectory on the full data period. Second, I would encourage the authors to provide more in-depth analysis of what the back-trajectories mean.

For example, they show in Fig. 12 that there is a difference in vapor origin between low-d and high-d events. However, the authors do not provide us any insight into WHY these patterns may lead to the observed d values.

For the d-excess, it would be very valuable to understand the long term trend. Is it related to changes in the vapor origins? And can these long-term changes be understood in terms of the large-scale atmospheric circulation, for example through changes in southern annular mode? Or perhaps it is linked to local effects such as the sea ice extent in the Atlantic sector of the Southern Ocean? These types of analysis would provide some valuable insights into the dynamics, which are currently lacking.

Detailed comments:

Line 7: d-excess; more commonly just d (lower case italicized).

Line 23: Buizert et al. (2015) should be WAIS Divide Project Members (2015)

Line 32: “clouds”: much of the precip in central Antarctica is clear-sky precip (diamond dust).

Line 35: temporal relationship *may* differ from spatial relationship.

Line 37: Better citation for inversion strength is (Van Lipzig et al., 2002)

Line 39: Another key control is sea ice (Noone & Simmonds, 2004)

Line 72: “sections” instead of “chapters”

Line 92: from the east?

Line 107: Perhaps define this as the climatology

Line 109: above (below) the climatology

Line 113: “merged to”? What about “reported as”

Line 145: what is the philosophy behind the 25h? Is the idea that taking a fixed time of day could introduce biases?

Line 150: Are the tanks measured at the very end of the campaign against independent standards to ensure there was no drift?

Line 162: Why 2017 only? If you had let your code run during the period of the review process, you would probably have these already. Having the full 2017-2019 period would allow you to analyze the d-excess trend. I would strongly encourage you to run these also. It should be little work, given that the code is working.

Line 170: can you add the climatology for comparison (T and q)? Section 2: did the setup require a human operator at all times, or was it fully automated (e.g. to do the calibrations)?

Line 183: Can you also say something about the relative (rather than absolute) humidity? That is a much more intuitive parameter. Perhaps add it to the figure?

Line 192: But the long-term d-excess trend is robust, correct?

Line 196: Not fully reliable given the large difference in slope of 1.5. Is this a calibration issue? Can you elaborate a little – it seems this does not impact your isotope data, but it would be nice to know where this difference in slope originates.

Line 208: Given the strong Antarctic temperature inversion in winter, this 22 m difference may actually matter a lot for temperature and therefore humidity - in the interior of Antarctica, the difference could be up to 10K (Hudson & Brandt, 2005), but the inversion is probably less strong near the coast.

Line 220: How are the seasons defined? Do you use DJF, MAM, JJA, SON?

Line 223: Enhanced temp variability in winter is seen all over Antarctica (e.g. at South Pole), and has been explained elsewhere via the stability of the inversion (Hudson & Brandt, 2005). Please refer to some other papers on the meteorology of Antarctica, I think this is more fundamental and not specific to Neumeyer. I don’t think the reason you state is the correct one necessarily. Please clarify and provide relevant citations.

Section 3.2.2.: I think you need to give us the relative humidity plots to evaluate ho meaningful this correlation is. Since q and T are strongly correlated, these observations are unsurprising.

Section 3.2.3.: is there a diurnal cycle in isotopes?

Line 263: Is that really the reason? The cyclonic storm tracks are moving from west to east, so opposite to what you state. I am no meteorologist, but I always thought the near-coastal easterlies were driven by Coriolis deflection of the katabatic winds off the continent. Please clarify and provide relevant citations.

Figure 8: what years of the reanalysis are used?

Figure 8: what is the purpose of this figure? I don't see how it contributes to the paper or the narrative.

Line 283: "the main air path is a cyclonic circulation" What does this mean?

Figure 9: The vapor pressure over ice via the Clausius Clapeyron has an Arrhenius type relationship, with vapor pressure scaling as exp(-H/RT). So not quite the relationship that you show. Can you plot correctly vs. 1/T (with T in Kelvin), and estimate the Enthalpy H?

Line 288: What form of the CC equation do you use? Please give the equation.

L300-302: I don't understand this point. Can we see this in the data?

L305-320: It is not clear what the analysis of the relationship between wind direction and pressure anomaly is based on. Reanalysis data? Case studies? No citations are provided.

L330: Again, this is unfortunate. How long does it take to run the code? Surely not more than a few days?

L345: This is an valuable observation. Does it make sense that water vapor originating close to the continent has higher d-excess? Please elaborate

L352: Is Neumeyer data assimilated in ERA-interim?

L370: So does Neumeyer have greater relative humidity then?

Section 4.5: The agreement in slope between d18O-T from vapor and precip is remarkable. Do you think this relationship is valid only because you are so close to the coast/vapor source?

References:

Hudson, S. R., & Brandt, R. E. (2005). A Look at the Surface-Based Temperature Inversion on the Antarctic Plateau. Journal of Climate, 18(11), 1673-1696.

https://journals.ametsoc.org/view/journals/clim/18/11/jcli3360.1.xml

Noone, D., & Simmonds, I. (2004). Sea ice control of water isotope transport to Antarctica and implications for ice core interpretation. Journal of Geophysical Research: Atmospheres (1984–2012), 109(D7).

Van Lipzig, N. P., Van Meijgaard, E., & Oerlemans, J. (2002). The effect of temporal variations in the surface mass balance and temperature-inversion strength on the interpretation of ice-core signals. Journal of Glaciology, 48(163), 611-621.

Interactive comment on The Cryosphere Discuss., https://doi.org/10.5194/tc-2020-302, 2020.