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Comment on acp-2022-12

Anonymous Referee #1

Referee comment on "Disentangling the impact of air–sea interaction and boundary layer cloud formation on stable water isotope signals in the warm sector of a Southern Ocean cyclone" by Iris Thurnherr and Franziska Aemisegger, Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-12-RC1, 2022

This is a well-written and comprehensive article that help understanding processes leading to negative water vapor d-excess observed in surface air during the ACE campaign, within the warm sector of an extra-tropical cyclone, south of South Africa.
The authors combine regional atmospheric modelling with water isotopes (COSMOiso simulation) together with 3 single-process air parcel models to understand the drivers of observed changes in water vapor isotopic composition.
They show that regions of low d-excess in surface water vapor are created by decreasing ocean evaporation and dew deposition at the ocean surface. Low water vapor d-excess close to the ocean surface is assessed to result from local air-sea interactions and to overwrite the advected d-excess signal.
I think this article allows better quantification and understanding of processes driving d-excess signal in near-surface ocean water vapor. In addition, the article structure guides the reader toward a good understanding of the authors' conclusions. I found this article very pleasant to read, with adapted figures. Consequently, I recommend this article to be published with minors revisions detailed bellow.

Minor comments

L37 : 2RVSMOW2.2 : typo? is the final **.2** right?

L169 : « αe » is not described in the text (even if I agree it's a standard notation)

L177 : « supplement Fig.S3 » cited first, why not S1 ?
Re-number all supplement figures.

L177-178 : « The simulation is initialized with qa,0=5 g kg−1 (and, thus, hs=0.5 because qs=10.0 g kg−1 at 14°C), â□□q=10−3·(qs − qa), δ2Ha,0=−137 ‰ and δ18Oa,0=−19.5 ‰ »
Why this choice ?
How is chosen the â□□q factor 10−3? Does it have an influence on the results ?

APMdew
L235-236 : « The simulation is initialised with hs=1.1, which means that qa,0=6.8 g kg−1, â□□q=8·10−4·(qs −qa), δ2Ha,0=−98 ‰, and δ18Oa,0=−13 ‰ »
Again, why this choice? End of APMevap ? (seems yes from Figure 4, but with different hs)
Why â□□q=8·10−4·(qs −qa) ?

Figure 3.h : I was confused at the begining between (h) above the purple line and hs in gray, maybe it's just me, it's clear for me now.

APMray
L269-270 : « Ta,0=8°C (which gives qa,0=6.7gkg−1), â□□SST=1°C, δ18Oa,0 = −15.0‰ δ2Ha,0 = −98‰ »
Again, can you briefly explain why you choose these values ? (I can guess end of APMevap from Fig. 4)

Figure 4 : This scheme highlights very well what you do in Section 3. Maybe you could move it at the beginning of Section 3 together with a small introduction of the APM and 3 example simulations presented after. It would help the reader to better understand the link between the 3 APMs, and also between the 3 examples (e.g. choice of start values in the examples).

Figure 5 : Use a continuous colormap for potential temperature, unless you can justify the threshold at 294 K to separate warm and cold sectors?
Is **Θe** the same as **θe** in the text ?
« The white contours show that warm temperature advection mask. » Add information of the definition of this mask, or refer to the text.

L304 : « sharp gradients in THE » What is THE? TPE = **θe** ? or not?

L305 : Define **θe** in the text

Figure S1 / Figure S2 / hs in Figure S4: Rainbow-like colormaps are to be proscribed for continuous variables, use a continuous colormap instead.

https://www.climate-lab-book.ac.uk/2014/end-of-the-rainbow/
https://mycarta.wordpress.com/2012/10/14/the-rainbow-is-deadlong-live-the-rainbow-part-4-cie-lab-heated-body/

L317 : « A good agreement of measured and simulated hs and qa can be seen (Fig. 6). » I cannot see qa in Fig. 6. Can you add air temperature in Fig. 6 too ?

L318-320 « The simulated precipitation compares well with the measurements except for the few hours around 00 UTC on 26 December 2016, during which enhanced precipitation is simulated, while no precipitation has been measured. »
Why focus on the 26 December 2016 00 UTC when model-observation differences are way larger from 26/12 12h ?
Model mostly underestimate precipitation, I don't understand the focus on the very show period when it is the opposite?
I would say that the first peak is well represented but the second peak is off (lower precipitation, and too late ?)

L340 Is **Θe** the same as above, i.e. **θe,** i.e. equivalent potential temperature at 900 hPa ?

L354-356 « Furthermore, the back-trajectories arriving in region CF, were located in region WF 48 h before arrival also coming from a region of high d with values above 20 ‰ (Fig.7a and supplement Fig. S4). »
For CF, Fig. 7a shows low d 48h before as in Fig.S4. In Fig. S4, high d for CF is around 72h before?