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Abrupt excursion in water vapor isotopic variability during cold fronts at the Pointe Benedicte observatory in Amsterdam Island

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Thank you for the detailed replies. Many of my concerns have been addressed and I think that this manuscript fits to ACP, especially when highlighting that the combination with mercury measurements allows for new conclusions regarding vertical air movements. I think that in the new manuscript, this message is improved. But mercury is only marginally mentioned in the introduction. There are many explanations in the data section which might better motivate the study if included in the introduction.

I still have some concerns regarding the interpretation of the cold front dynamics and the figures highlighting these dynamics. Even though the term “cold front” is less dominant throughout the manuscript, the cold front dynamics are still prominent in the conclusion and synthesis figure. This makes sense as most of the d18O excursions are related to the passage of a cold front. But Figures 8, 9, S2 and S3 show a very wide longitudinal range that does not allow to see features along the cold fronts. Some detailed comments on this issue in the following:

- why is is LMDZiso-VLR only reproducing d18O excursion on 3 Jan, what is special about this event?
- Figure R6: Thanks for this analysis! *In front of* and *during event* seem to be in a very similar dynamic environment (ascent; both during precipitation?) and show a similar evolution in Fig R6a. While *after event* shows a very different evolution. So, could this mean that *during event* is an enhanced signal of the *before event* at the rear of the precipitation event?
- The locations where you chose before, during and after event in Fig. R6 are within 10° around AMS. Why do you show a 50° (or 60°) window for Fig. 8, 9, S2 and S3 if the relevant processes occur within these 10°? This aspect is mentioned again for several of the following points.
- Lines 573-575: “*However, we note that when negative d18Ov excursions are not concomitant with subsidence, they occur right after an ascending movement and are generally followed by subsidence (Figures A1 and A2).*”
  What does “after” and “generally followed” mean? It seems that this is no longer referring to the trajectory calculations. Does this mean that large-scale subsidence (as represented by the trajectories) is not important?
- Lines 601-604: “*While the LMDZ-iso modelled vertical velocity displays a rather strong homogeneity on the vertical axis, ECHAM6-wiso modelled vertical velocity highlights subsidence of air below the ascending column at the exact location of the negative d18Ov anomaly (Figure 8c).”*
  Which subsidence below the ascending colum do you mean? Do you mean the strong subsidence behind the cold front between 65-75°E? This does not correspond with a d18Ov excursion at the surface. The x-axis scale makes it difficult to see these small feature at the AMS location.
- Lines 605-609: “*The fact that subsidence of air occurs just below uplifted air, at the limit between ascendance and subsidence (Figure 8j and Supplementary Material Figure S4),*

permits to reconcile the GEM data suggesting subsidence and the sign of the vertical velocity of the ERA5 reanalyses at Amsterdam Island."
I don't understand this sentence. What do you mean with "permits to reconcile"?

- Lines 621-623: *"This ascending column is coupled to the subsidence of d18Ov depleted air at the rear of the event, which is pushed toward Amsterdam Island through a south west advection of cold air."*
  What do mean with "coupled"? I don't understand what you mean with subsidence and south west advection. Do you refer to large-scale advection within the cold sector? Is the horizontal advection an important process for the d18Ov excursions? This has not been mentioned so far. Also, the trajectory analysis did not show any important signals from large-scale advection for the selected events.
- Fig. 8
  - The cold front appears as a vertical line due to the large longitudinal window. Therefore, no typical features along the cold front can be seen.
  - Isentropes in Fig.8 could help to see the cold front in vertical profiles
  - Why is subsidence > 10° away from the front important for the isotopic signature during front passage? The surface isotopic composition between 60 and 75° in Fig. 8 b,e,h shows a distinctly higher signal than the water vapour above ~2km and at the AMS position. Is it important to show this to understand the processes leading to the d18Ov excursions? I recommend to choose a smaller window around the cold front for Fig.8.
- Fig.9 does not help to understand the described processes leading to the d18Ov excursion. New phrases are mentioned (e.g moist and dry subsidence, marine boundary layer) but they were not introduced in the manuscript in the context of the d18Ov excursions. It is not evident from the manuscript why processes more than 10° away from the front are important for d18Ov excursion.

Minor comments:

- Lines 597/598 state *"For the other events, neither LMDZ-iso nor ECHAM6-wiso show a clear signal of subsidence neither at 500 nor at 850 hPa (Figures 4 and A1)."*
  Neither captions of Fig 4 nor A1 state at which level the vertical velocity is shown.
- 582-586: "*Still, the fact that at least ECHAM6-wiso is able to reproduce every negative d18Ov excursion (whether they are associated or not with subsidence or rain- water vapor reequilibration) shows that not only the patterns of atmospheric water cycle are correctly reproduced (a validation which can also be performed using humidity and precipitation data) but also that the isotopic processes are correctly implemented in this model."*
  Not all aspect of the atmospheric water cycle can be assessed with humidity and precipitation data only, e.g. the residence time of water in the atmosphere cannot be seen with a precipitation field, but can be traced with isotopes. This is one of the strength of an isotope measurements and isotope-enabled models.
- Lines 659-660: *"They are most of the time characterized by a decrease in water vapor mixing ratio. "*
  There is an increase in qv during the d18Ov excursions in Fig.4.
- Lines 673-674: "*This study highlights the added value of combining different data from an atmospheric observatory to understand the dynamics of the atmospheric circulation."*
  This is a very broad statement? Can you be more specific what you highlight about "the dynamics of the atmospheric circulation"?

- Lines 675-677: “*We have especially shown that the isotopic composition of water vapor measured at the surface is a powerful tool to identify aspects to be improved in the atmospheric component of the Earth system models.* “
  Which aspect of the atmospheric component of Earth System models should be improved according to this study? I would say that different model setups have been used but the atmospheric component of the models stayed the same.
- Please, check again the chronological order of the references in the text.
- Fig. S4: check caption.