Review of Diekmann et al

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This article documents variations in the tropospheric water vapor isotopic composition over West Africa at the convective, seasonal and inter-annual scales, using 3 products of satellite observations: IASI, AIRS and TROPOMI. Processes responsible for the isotopic variations are analyzed. This paper is consistent with many previous papers showing the impact of convective processes and air mass mixing on the isotopic composition of water vapor. The article is not exceptionally novel, but contributes to a more confident understanding of processes controlling the isotopic compositon of water vapor.

The article is well written and well illustrated. My comments are minor.

1 General comment

What is the added value of $\{H_2O, \delta D\}$ pairs? Can they teach us anything new? The paper explains well how $\{H_2O, \delta D\}$ are consistent with processes that we already know. But it doesn't show how they could improve the konwledge. It's fine, maybe they just cannot improve the knowledge. But then maybe some sentences would need to be toned down. e.g. l 3: " "quantify the atmospheric branches""; l 20: "underlines the overall value..."; l 471-473: "underlines the strong potential".

2 Detailed comments

- l 3: "quantify the atmospheric branches": unclear. We can quantify some fluxes or reservoirs, or the contribution of some processes, but not clear what it means to quantify a branch.
- l 8-9: "from a convective as well as seasonal perspective and with respect to"-> "at the convective and seasonal scales and"
- l 12: "δD depletion" -> "δD depletion in the vapor"
- l 13: remove ""without showing significant δD depletion": obvious after "enriched signals"
- l 15: "anti-correlation": at what time scale? How different is (3) different from (1)?
- l 30: what does "degree of dessication" means? Could this be clarified for people from the isotopic community who don't know about it?
- l 39 and around: is convection really the main source of uncertainty in climate projections over the Sahel? Recent studies suggest a key role of Atlantic SSTs as well, e.g. [Monerie et al., 2023]
- l 63: "in both liquid hydrometeors and ambiant vapor" -> "in ambiant vapor". Evaporation rather enriches the droplets.
- l 87: "interannual seasonal -> "interanual".
- l 182: clarify the average: average over the previous day? l 184: why do we need half-hourly IMERG observations rather than just daily? Are air masses followed along back-trajectories to calculate average rainfall? Or is the rainfall local?
- Fig 2: give some more context for these lines, e.g. in the caption. What difference between the 2 mixing lines? How are initial conditions and end members chosen?
- l 252: you may cite [Risi et al., 2021] to support the impact of snow melt on the water vapor composition.

- l 273-376: If I understand well, you interpret the absence of isotopic difference between non-rain and post-rain events by the compensation at lowest levels of the enrichment by surface evaporation and depletion by convection? If the case, how can you explain the depletion of the vapor observed after rain events in surface observations [Tremoy et al., 2012, Tremoy et al., 2014]?
  Actually, fig 6 shows that the humidity is not even larger for post-rain events. This questions whether the clustering methods applied to TROPOMI observation is really comparing non-rain and post-rain events. Is it possible that near the surface, the water vapor recovers more quickly after the event due to surface evaporation, and so the clustering methods based on average rain over the previous days might not properly capture post-rain vapor?

- l 278 and around: I'm not sure about this rationale. The depleting effect actually accumulates along the descent in unsaturated and mesoscale downdrafts of convective systems, as shown by cloud-resolving simulation [Torri, 2022, Risi et al., 2023]. So we do expect, and generally observe, depletion near the surface after convective systems in the Sahel.

- Fig 6: this compares non-rain and post-rain events. It would have been interesting to document the impact of the intensity of rain events, e.g. through the rainfall rate. If this is too much work for this article, this could be mentionned as a perspective.

- l 286 and next lines: "types of convection": the impact of convection type was not addressed in this study. Only non-rain and post-rain conditions are compared. To analyze the role of convection type, a more sophisticated clustering method would be useful, e.g. squall line vs isolated systems. This paragraph up to l 296 needs to be completely revised.
  It would have been interesting to link the δD to convection type. If this is too much work for this article, this could be mentionned as a perspective.

- l 295: "unaggregated convection (as is the case in Sahelian squall lines)": this is the contrary! Squall lines are highly aggregated convective systems e.g. [Abramian et al., 2022]. Aggregated means that convection is gathered into one big system, whereas unaggregated means that convection is scattered into several isolated systems, e.g. [Bretherton et al., 2005, Tobin et al., 2012]

- l 311: I can see only a few ‰ drop in fig 7.

- Fig 7: clarify in the caption what the error bars mean. Is it the standard deviation of all instantaneous values?

- Interpretation of fig 7:

  - To better see the link between rainfall and δD, could a scatter plot of δD vs rainfall anomalies be added?

  - Why are more rainy years more depleted? Is it because there are more rainy events, which are more depleted (fig 6)? Or is it because non rainy events are more depleted? Or because rainy events are more depleted, e.g. because they are more intense? To answer this question, it could be easy to link Fig 7 to fig 6 with a decomposition method: $\Delta\delta D = \Delta r \cdot (\delta D_{rain} - \delta D_{norain}) + r \cdot \Delta\delta D_{rain} + (1 - r) \cdot \Delta\delta D_{norain}$, where $\Delta\delta D$ is the anomaly between high and low rainfall years and r is the fraction of rain samples in the yearly average.

- Around l 365: is it possible that the smaller sensitivity of AIRS could be due to the larger impact of the a-priori profile on AIRS than on IASI, i.e. smaller sensitivity?

- l 384: "As result" -> "As a result"

- Somewhere: the recent study by [Dahinden et al., 2023] would deserve to be cited.

References

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