

Review of Vallet-Coulomb et al

October 6, 2026

This article presents a unique dataset of the triple isotopic composition ($\delta^{18}O$, d-excess, ^{17}O -excess) of rain samples collected in Benin at the quasi-event time scale during 7 years at an inland station, with complementary samples at the weekly time scale during 1 year at a coastal 400km to the South. This allows to investigate the isotopic variability at the event scale, the seasonal scale, the inter-annual scale, and along a continental transect. This dataset is precious, especially given the scarce data coverage in West Africa.

The isotopic variations are interpreted using complementary meteorologic data, satellite observations and back-trajectories. They show that the so-called amount effect can only be observed at the monthly scale. Isotopic variations at other time scales reflect cloud processes or convective organization. A weak continental recycling is also observed.

I think the interpretation could be made more rigorous. In particular, the role for convective organization is asserted but never confirmed by observations (major comment 1). More generally, I think the interpretation of isotopic variations could be deeper (major comment 2).

The article is well-written. Illustrations could be improved with larger font size.

1 Major comments

1.1 Confusing use of the notion of convective organization

Convective organization, in the weather and climate community, refers to the how convection is spatially distributed in a given domain, e.g. more or less aggregated (e.g. review by [Holloway et al., 2017]). “Organized convective systems” typically refers to the organization at the mesoscale: large and persistent convective systems are often called “organized” (e.g. review by [Houze, 2004]). Many metrics to quantify convective organization have emerged in the past decade (e.g. review by [Biagioli and Tompkins, 2023]).

In this paper, “convective organization” is often discussed but never defined nor quantified. The only variable that could be a proxy for convective organization is “event duration”. However, in fig 6b, we can see no longer systems for C3 than C2. **Does this refute a role for convective organization to deplete C3 samples?**

-> To assess the impact of convective organization, I suggest to **rigorously quantify convective organization**, using for example the Lorg metric based on satellite data ([Biagioli and Tompkins, 2023]).

In absence of a more rigorous quantification of convective organization, one of the main conclusion of the paper, emphasizing the role of convective organization on the isotopic composition, is simply an hypothesis that observations do not confirm.

A few examples where the notion of convective organization is confused:

- l 206: “mean event intensity” is not a proxy for convective organization
- l 516: “higher relative humidity and lower OLR values, suggesting more extensive cloud cover and a greater degree of convective organization.” -> no, we cannot deduce convective organization based on relative humidity and OLR. Actually, observations rather show the contrary, i.e. drier troposphere and higher OLR when convection is more aggregated (e.g. [Tobin et al., 2012, Stein et al., 2017]).
- Same issue l 509: “drier and warmer atmospheric conditions and higher outgoing longwave radiation (OLR) are consistent with less extensive and less organized convective activity.”: observations rather suggest more organized convection in drier regions away from ITCZ cores (e.g. [Roca et al., 2014])
- l 556: “progressively more organized convective systems”: this was not shown. Plot the seasonal cycle of a metric of convective organization to confirm this?

- l 618: “a shift toward larger and more mature convective systems”: can you show it by quantifying convective organization?

In Fig 6b, the only significant difference that I find between C2 and C3 is the “weak rain fraction”. This could reflect the **stratiform fraction of the rain**, and thus support the hypothesis of a depleting effect of stratiform processes (e.g. [Aggarwal et al., 2016]).

Note that convective organization and stratiform fraction of the rain are not necessarily correlated, contrary to what is mentioned in l 619. For example, [Stein et al., 2017] observed weaker high-cloud cover when convection is more aggregated.

1.2 Deepen the interpretation, especially regarding C3 samples

- l 147-148: to what extent is the event-based vs weekly sampling responsible for some of the differences between the 2 stations? If the analysis was repeated using weekly averages at the inland site, how different would the results be? For example, I expect it would smooth the extreme values: does it contribute to the lower frequency of C3 samples at the coastal site?
- Fig 7 shows that C3 samples are mainly found between 15 Aug and 15 Oct. During this period, most samples are C3 samples. Could it be an intra-seasonal-scale signal rather than a effect of convective organization? Fig 3a suggests a smooth intra-seasonal signal in $\delta^{18}O$. Fig 1b shows that Aug 15 corresponds to the Northernmost position of the ITCZ, with maximum precipitation at the inland site. After this date, the ITCZ retreats and most of the precipitation is found upstream trajectories to the inland site. Therefore, could larger **upstream precipitation** after Aug 15 be responsible for the depletion after this date? To check this:
 - plot precipitation maps separately for July-Aug 15 and Aug 15-september, i.e. 3 maps in Fig 1a: is it larger after August 15?
 - Fig 1a: change the color scale to better see the precipitation in Benin: e.g. from 0 to 15 mm/d. Currently, it's all white, no seasonal variation can be seen.
 - Fig 1b: apparently this mainly reflects precipitation near 10W and 10E, which is relatively far from Benin. Fig 2 suggest trajectories don't go through these regions -> try plotting an average between 0-5E or between 5W-10E?
 - Quantify upstream precipitation, for example by averaging precipitation over a $5 \times 5^\circ$ or $10 \times 10^\circ$ box upstream the inland site? Try to plot it as a function of time e.g. as in Fig 4d or as box plots as in Fig 6?
 - As a complement to precipitation, OLR, a proxy for convection intensity and depth, could be analyzed as well.
- l 593: Could the absence of C3 in the coastal station actually reflect the reduced convection along trajectories? Over the ocean, some balance is expected between the depletion by convection along trajectories and the recycling b ocean surface evaporation. Over land, recycling is partial, so depletion by convection along trajectories is expected to be more efficient. I suspect that the role of upstream convection has been overlooked in this article, consistent with my previous point.
- Fig 10 is interesting and left me with several questions:
 - is $\delta^{18}O_{core}$ related to the % of C3 events? Is it related to the length of the monsoon retreat phase, i.e. from the maximum extent of the ITCZ to the monsoon end date? The anti-correlation with the monsoon end date suggests tat this could be the case.
 - is $\delta^{18}O_{ann}$ related to the % of the rain that falls during the core season? Is this the reason for the anti-correlation with $precip_{core}$?
 - why not looking at similar relationships for d-excess and ^{17}O -excess as well?
- l 538-553: Contribution of upper tropospheric processes: I don't think this part is convincing. Kinetic effects during ice deposition in convective updrafts have been explored for example by [Bolot et al., 2013]: they are restricted to the upper troposphere. We would expect the isotopic signature of these processes

to get erased by rain-vapor exchanges as the rain falls (e.g. [Risi et al., 2021]). Isotopic processes in the upper troposphere of the West African region have been explored by [de Vries et al., 2022], and they explain isotopic variations mainly by cloud dynamics and microphysics, without invoking kinetic effects. There are other processes that could contribute to a decrease of ^{17}O -excess as $\delta^{18}\text{O}$ decrease. For example, continental recycling is known to increase both $\delta^{18}\text{O}$ and d-excess ([Salati et al., 1979, Gat and Matsui, 1991]), so a decreased contribution of continental could decrease both $\delta^{18}\text{O}$ and excesses.

2 Detailed comments

- It’s strange to add plenty of additional figures in Appendix. Move them to a kind of Supplementary information maybe?
- l 22-25: “more organized convective systems” is used both for C2 and C3. Clarify with respect to what.
- Fig 1: number each sub-figure: 1a, b, c... rather than just a for several maps. Same for other figures.
- Fig 1a: add grid or ticks to better see where the latitudes and longitudes are on the map.
- Fig 2: in caption: recall which months?
- Fig 3: labels and numbers are too small to be comfortably read. Same for figs 6, 7, 9, 10
- l 340: “and” missing after “Nalohou”
- Fig 6: too small to read. Cut into several figures? + label a,b,c... each sub-figure.
- l 430: “observed the” -> “the observed”
- Fig 7: what about on the coastal site? what replaces the C3 events after Aug 15?
- l 557: “with an increasing contribution from precipitation associated with large-scale monsoon circulation”: this is not obvious from fig A2. It looks like all months show that most trajectories are associated with the monsoon flow?
- If you end with too many figures, Fig 8 is not absolutely necessary. It could go as SI.
- l 473-477: refer to fig 7?
- l 615: “when ... the monsoon system becomes fully established”: actually, C3 becomes dominant **after** the Northernmost extent of the ITCZ, when the ITCZ is retreating. See my major comment 2.
- l 640: add a few references to support these possible changes? e.g. [Bickle et al., 2021, Roca et al., 2024]
- l 655: remove “increasing”.
- l 675: “stratiform downdraft” -> “mesoscale downdraft” (e.g. [Houze, 1989])
- l 675: no sure why supersaturation effects should be larger in the stratiform region?
- figs A1, A2: indicate which months are shown.

References

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