Review of Egusphere-2025-2390 Revision
"Assessing raindrop evolution over northern Western Ghat from stable isotope signature of rain and vapour"

Thank you to the authors for your revised submission. The revised study is overall much improved. I commend the authors for the additional steps they have taken to strengthen their analysis. The authors have now provided complete context and information about their methods to allow the reader to assess the results. Overall I feel the study is scientifically acceptable, with the exception of a few statements/conclusions that are made without sufficient support.

I caution the authors against making strong scientific claims that do not come with sufficient evidence. Or, to do so with the disclaimer that it is a hypothesis/speculative. Some of these cases are mentioned below.

From an organization and writing quality standpoint, there is still much revision required to meet the journal standards.

Scientific Merit

- Ln 485-486: I think you need to explain and justify the 6 data points that are discarded.

- Ln 512 - 518: I recommend removing this paragraph. I'm not following this line of logic. You're saying that Run-3 agreed well with observations, so this implies the microphysics in the BCIM model must be valid? Specifically, you claim that the good agreement means that all of your BCIM inputs were valid, and that your estimate of raindrop evaporation is therefore accurate? You seem to be reaching for a claim that has insufficient support. You do not need to assert that your results are 100% irrefutable: You have provided your methods to the reader, and they can discern for themselves how convincing they find your results. What matters is that you are transparent with the reader on what you have done to obtain your results.

- With the range of evaporation fractions being so large from day-to-day, the authors could consider reporting the range in their abstract and conclusions, in addition to the mean value. This may be more informative to the reader as they can get a sense for the variability throughout the ISM.
    - On this topic: Your abstract says 23%, then the final paragraph changes to ~25%. It is recommended to remain consistent in how you report the results.

- Your radiosonde RH and T uncertainties are not quite correct: You've used uncertainties for a single sonde measurement, but because you have averaged two radiosonde measurements, this introduces a larger uncertainty that needs to be accounted for. As a rough estimate, your supplementary materials indicate that the uncertainty on a daily RH value is +/- 10% and the uncertainty on temperature is ~2°C. But if you wanted to be

more precise, you could take the uncertainty of the mean (the standard deviation of the two data points divided by the square root of the number of samples, in this case two).

- 777-779: *"The intense convective events, indicated by these anomalies, lift the air parcels to higher altitudes where the ambient vapour isotope ratios are highly depleted. Droplets formed from these vapours are correspondingly depleted"* - I'm not sure that this is conceptually accurate: Is the isotopic depletion from intense convection due to the air being lofted up to higher altitudes, or is it because of rayleigh distillation associated with condensation and precipitation? I think it is the latter, because convection, by definition, brings moisture up from the surface, and droplets form within parcels of rising air. Cloud droplets do not grow from the pre-existing ambient vapor at altitude, they grow from the moisture that was brought up from the cloud base. If I am wrong here, then please provide references to justify your claim.

- 782-783 and 785-787: You cannot draw this conclusion, because the higher CLWC peak could be a decoupled cloud layer, or even cirrus. Intense convection can create conditions for higher-level cloud formation (through anvils and detrainment of moisture into the upper atmosphere). I think it's an interesting observation that the higher CLWC is present during these cases, but it is mere speculation to say that the convective column extended all the way up to 5.5km, unless you can provide additional evidence.

- 901: This is too strong of a conclusion to make without evidence. You have already shown that drop size is a dominant factor in the isotopic exchange, so why would the impact be small? You could instead explain that since the BCIM follows a single droplet there is no opportunity for collision coalescence, therefore you have to rely on your input droplet diameter being representative of droplet sizes that would occur through collision-coalescence processes. In theory this is all built into the M-P relationship.

631-632: What do you mean when saying they "are not independent"?
632-636: What is this section getting at? Are you saying that higher precip rates are associated with higher droplet diameters in your data, and this is a result of collision-coalescence?

- This was a bit confusing, but if I understand correctly, I think all of this (631-636) can come together more concisely, for example: "We note that rainrate and droplet diameter are directly related through the M-P relationship we have used, so larger rate rates will always translate to larger droplet size. This physical relationship is thought to be a result of increased collision-coalescence during higher rainfall intensity (Law et al., 2021)."

Ln 641, 646: Did you mean upper left quadrant?

- It's confusing that the figure does not have quadrants, yet you refer to the lower left quadrant. I now understand what is happening, but for me, it took me a while to catch on because my first instinct was to divide the figure visually into quadrants, and it would look like your data points lie in the upper right quadrant. Hence my confusion about the "lower left quadrant". This can either be made much clearer in the text, or you can show all four quadrants in your figure.

Organization

Organization and readability of the beginning of the manuscript is much improved. However, the writing and organization steadily declines after around section 2.4.3. It is clear that much technical editing is still needed.

Here I offer some points of feedback on organization. The manuscript is quite long with a lot of redundant information, so I've also suggested areas where the manuscript can be shortened.

- Abstract: "3rd and 4th quadrants" has no context for the reader, so I would avoid using it in your abstract. Suggest something like the following: "Using the $\Delta\delta$-Δd diagram method of assessing sub-cloud rain and vapor exchange, our data suggest an equal share of equilibrium exchange and drop evaporation."

- Section 2.4.2 Isotopic composition of the ambient vapour and hydrometeor
    - Here is where I would have logically expected to see your methods for obtaining the isotopic vapor profiles from LMDZ.

- The "Key Findings" section seems to just be an abbreviated repeat of the results and methods section. There is quite a lot of redundancy with the previous discussion, as well as some new concepts that appear for the first time. I would suggest removing this section and incorporating anything that is not redundant into the results/discussion.
    - 813-821: You do not need to repeat this discussion, you already did this.
    - 822-831: Shouldn't this be with the discussion of the $\Delta\delta$-Δd plot, instead of being introduced for the first time?

- There is no clear and concise "Conclusions" section. A conclusion section should be added, and it should be more or less equivalent to your Abstract, but with a little bit more detail, now that the reader has complete context. For example, you could mention quadrants in your conclusion, since the reader now has that context.

- Reorganization within the results section: I find that there are too many nested subsections, and I would offer the following changes:
    - 3.2 "results of BCIM simulations"
        - The table should be moved up into this general area (not in section 3.2.1).
    - 3.2.1 and 3.2.1.1 can be combined into one subsection under "3.2.1 Run-1 Results"
    - 3.2.2.1 RF and T from Radiosonde - This information may fit better under the methods section.
    - 3.2.2.2, Vertical profiles of vapour isotopes - I feel this belongs in the vapor isotope methods.
    - 3.2.2.3 and 3.2.2.4 can be combined into one section under "3.2.2 Run-2 Results"

- Change 3.2.3.1 to “3.2.3 Possible sources of discrepancy between Run-1 and Run-2”
- 3.2.3.2 becomes “3.2.4 Run-3 results”
- Remove section 3.2.3.3:

If it’s in the supplementary, then it does not also need to be included in the main manuscript. The manuscript should be self-contained, not having in-depth discussion of figures that are in supplementary information. For example, this section can be condensed to a few sentences:

> “We find that the vapor isotope value is the most important factor controlling rain isotope ratios in the BCIM. The uncertainty of the model predicted δD and d-excess are 3.5% and 2% respectively. BCIM sensitivity analysis and uncertainty calculation are available in SI-13,14.”

- Lines 854-860: Once again, if it’s in the supplementary materials it means you do not need to discuss it at length in the main text. Condense this to one sentence and refer the reader to supplement for details. For example:

  > “sondes are launched at 00 and 12Z and are generally not carried out when there is rain. We determined that two soundings taken on the same day are similar to within 10% RH and 2C on most days. Analysis of sonde daily variability can be found in supplementary information”.

- Section 5.2 is a good addition and much appreciated, but it should probably go ahead of your key findings. Perhaps at the end of the results section.

- 378 - 382: This can be condensed to just one sentence.

- 537 - 540: Do not describe the supplementary material. Just state for example:

  > “In our data, the vapor d-excess is not significantly correlated with temperature or relative humidity (Details are provided in S10-1).”

Typing Errors

The manuscript contains typing errors throughout that need to be given attention. I have listed some below, but it is not comprehensive:

Notation and subscripting is inconsistent throughout the manuscript: vapor subscript is sometimes “v”, sometimes “vap”. Vapor d-excess is sometimes “dv”, sometimes “dex”, sometimes d-excess$_{vap}$, and sometimes d-exc$_{vap}$

Ln 97: “a mountain” or “the mountains”. Mountain should not be capitalized.
Figure 1: (1901-2017) in ln 111, but (1901-2020) in ln 112 - Why?
Figure 1: Label for the rainfall contours is needed.
Ln 158: Graf reference has no year.
Ln 167: suggest “(3) tracking the microphysical evolution of a falling hydrometeor”

Ln 168: define (T) here, as it is used later in Ln 172.
Ln174: needs paragraph indent
Ln 177: **Δ** symbol is missing
Ln 177: reference Graf for this concept.
207: “consider the cloud base height *to be* the Lifting Condensation Level”
217: remove “subsequently, these drops grow of diminish as they fall” (unnecessary sentence)
222: “using equations governing the microphysics..”
226: “Therefore, the BCIM inputs are taken accordingly in the present study” - Odd sentence. Maybe say “therefore we have not included them in our BCIM inputs”

Figure 2 caption: Ln 251 - put the (a) before d18O, and move (b) before d-excess.
254: “The label, A, indicates…”
256: remove hyphen from southwest.
Figure 3 caption: mention that the data source is from ERA.
270: “fall below the overall mean (μ) minus half the standard deviation (σ)”
284: need space after “Fig.”
291: delD “v” needs to be subscripted
294: “rain” instead of “rains”
318, 319: your subscripts are not subscripted.
319,321,322: I’m confused by these (δv,0), (dv,0) notations… where are they used?

Could remove 326-328, it is not needed.

398: needs period after profile, before “Our”.
400: “The only justification” should be changed to something like “To achieve closer representation of our sampling location, we use a boundary constraint…”

406: “possibly added by” → “with potential additions from evaporation components…”
407: areal → spatial
413: minimum, mean, maximum do not need to be capitalized.
412, 417: The use of “digital values” is a bit odd… perhaps the authors mean to say “discrete values”.
425-426: grammar and notation issues.
428: “for the three runs: Run-1, Run-2 …”
432: It’s not clear what the authors mean by “adopted”?
435: “strictly correct, but it…”
435: “yields”
454: Remove “based on previous discussions”.
466: “size” -> “droplet size”
542: “drop in evaporation” → “evaporating droplet”? Or did they mean “decrease in evaporation”?
565: What is “mean~2%”?
574: Rain and Vapor do not need capitalization.

Figure 6 caption: subscripts.
624,626: Cant start sentence with a number. Spell out “fifteen”, “fourteen” or revise sentence.

Equation 2: What is the (norm) in parentheses mean?

684: There is an incomplete sentence lingering.
806: Can remove the phrase in parentheses: you already explained this in methods, so don't need to repeat it here.
828: uncompleted parenthesis.