

Atmos. Chem. Phys. Discuss., referee comment RC3
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Comment on acp-2021-902

Anonymous Referee #2

Referee comment on "Stable water isotope signals in tropical ice clouds in the West African monsoon simulated with a regional convection-permitting model" by Andries Jan de Vries et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-902-RC3>, 2022

Review on: "Stable water isotope signals in tropical ice clouds in the West African monsoon simulated with a regional convection-permitting model" by de Vries et al. ACP, 2022

For their paper, de Vries et al. run a regional model that is equipped with water isotopologues. The model allows them to make use of a cloud resolving setup in pretty high resolution. This simulation is used for a case study and some statistical analyses to study cloud processes during monsoon season. This is generally a good paper, it is well written and structured and the outcome of it is interesting and a step forward, it should certainly be published in ACP. However, I have a couple of annotations that should be considered beforehand and my main point probably has to be considered as "major".

▪ Main point:

Clearly, an upper troposphere (lower stratosphere) evaluation is lacking, given that the the study is focused on these altitudes and that data is available there. Satellite data products, IAGOS-CARIBIC data and/or other in situ measurements (I give some examples below) could be used for that.

In consequence of this, the paper will become even longer than it already is and my advise to act contrary to that would be to cut the paper after section 4. In my opinion, section 5 is a little half-baked and has much more potential than what is shown here, i.e. potentially in a separate paper. For example, for stratospheric water vapour budgeting, it is so important how much of the ice is sedimenting out of the UTLS again after the strong convective event and I guess this could be analysed well with this tool. Moreover, some more advanced estimation could be done on how strongly this process could affect the UTLS globally and annually (I write some more about this in the minor points). Section 4 can be shortened or partly moved to a supplement. The appendix can then also be moved to the supplement.

▪ **Minor points:**

- The manuscript is full of long halting sentences that makes reading sometimes a little cumbersome. I suggest to go through the entire paper again in order to split these long sentences.
- L9: Change 'predictions' to 'projections'
- L16-20: For the abstract it would be enough to summarise this to one more general sentence.
- Remove the last sentence of the abstract.
- L40: Solomon et al. 2010 Science (10.1126/science.1182488) should be mentioned here too.
- L175-180: What do you assume/use as delta values for the ocean surface?
- L209: What variables do you nudge? And you do that within your domain, right? Not only at the boundaries?
- L254 and everywhere throughout the paper: Remove "Interestingly"! Everything you write should be interesting of some sort, hence there is no reason whatsoever to emphasise some bits to be interesting.
- L276-284: But according to the errors in the tables, precipitation seems to be best represented in the PAR14 simulation. Can you elaborate on that?
- L303-306: Can you provide the correlation coefficient between precip and d2H for the time series and the different phases. I assume the correlation will be much greater in phase 2 than in phase 1, that would strengthen your point and make this part more quantitative.
- L384: Steinwagner et al. (2010) could be cited here again too.
- L385-395: In this context, consider also the studies by Notholt et al. (2010), Coffey et al. (2006) JGR, 111:D14313, Sayres et al. (2010) JGR, 115:D00J20 and IAGOS-CARIBIC data, but that should anyway be extended by a proper UTLS evaluation of your simulations (see main point).
- L582: Change title to "Summary and conclusions", because that is what it is.
- L619: Please state here that disequilibrium in water was already used (by Aemisegger et al (2015) and Graf et al. (2019), as you state in L320) and now the idea was transferred to ice. As it is formulated now it seems like the entire idea is new.
- L636-637: It would be great to have a some more quantitative idea of what this means globally (or for the tropics) and annually, but as I state in the main point, this could be removed completely and taken up properly in a separate paper.
- L640: As I state in the main point, this is a very important point, in particular for budgeting of stratospheric water vapour. It is a little disappointing that this is not addressed more clearly here. But the paper as it stands is already fine, and this point goes too far, hence the suggestion for a separate paper, taking up section 5 of that one.
- L642-643: That is one good way, but I think also with this model here you could already start to analyse this process to some degree. It could be done in various regions (including Asian and American monsoon), and compared to regional models that do not resolve convection and to global models (like by Eichinger et al. 2015) to evaluate the differences in various regions in ice lofting/overshooting, and the effect on stratospheric water vapour and delta values.
- L645-654: This paragraph is misplaced here. It should appear in a discussion section or along with the results.
- Fig. 2: I have not seen where you clarify these station names. If you haven't, please do so. Moreover, enlarge the axis descriptions in panels m-o
- Fig. 5c and g: Use a colour blind-friendly colour bar!
- Fig. 9d, f, Fig. 10 b, Fig. 15: Use a colour blind-friendly colour bar. No green and red!

- Fig. 12 and 13 could be combined.

▪ **Technical issues**

- L15: explores -> helps exploring
- L17: ... leading to isotopic depletion of water vapour within....
- L38: ...stratosphere. This is a topic of ...
- L39: ...water vapour ...
- L41: regions
- L182: western
- L186: vertical model levels -> model levels in the vertical (This is wrong in so many papers, but it doesn't become correct that way)
- L222: ... output to these observations...
- L223: ... simulations. The intention ...
- L224: validation -> evaluation
- L257: how -> the way
- L259: 'Relevant here is that...' please rephrase
- L261: 'Consistent with previous studies, switching off...' please rephrase
- L265: over -> at, over -> in
- L302 and in many other occasions: Remove "very"
- L295: its -> their
- L397: single -> specific
- L437-439 Remove ", which isNot surprisingly,"
- L445: corresponds
- L551: Remove: "Importantly"
- L584 and L606: It may help many readers if the meaning of the abbreviations WAM and MCS are repeated again in the conclusions section.
- L638: Remove 'By large'
- Fig. 5: Enlarge axis descriptions, panel titles and colour palettes including numbers there.
- Fig. 7c-e: Add another legend (in particular due to red dashed line).
- Fig. 11: Enlarge axis descriptions, panel titles and colour palettes including numbers there