

Atmos. Chem. Phys. Discuss., referee comment RC3
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Comment on acp-2021-653

Anonymous Referee #3

Referee comment on "Persistence of moist plumes from overshooting convection in the Asian monsoon anticyclone" by Sergey M. Khaykin et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-653-RC3>, 2021

General comments:

This is a very good paper that should be published.

The authors present the results of StratoClim 2017 flight campaigns over South Asia, satellite dataset analysis, and Lagrangian calculations to investigate the processes by which convection affects water vapour concentrations in the upper levels of the Asian Monsoon anticyclone.

The paper first identifies that the flights took place in two regimes consistent with earlier publications, which differ by the thermodynamic role of convection on local temperatures and hence water vapour concentrations.

The paper then studies the history of anomalously wet air parcels that were observed above the cold-point tropopause, which are shown to have originated from convective injection.

The results provide two contrasting examples of in situ cloud processes on convectively injected water vapour.

I have enjoyed reading this paper, I am very impressed with the narrative that navigates a number of complicated processes with very concise figures.

In my opinion some aspects could be clarified, detailed in specific comments below.

There are also some technical corrections below which are mainly typos/clarifications.

Specific comments:

L291 Please provide a reference in support of this statement.

L303 What number of convective clouds are identified in each case? It is too hard for the reader to integrate by eye the proportion of convective hits over the wet parcels for each flight. e.g. From Fig S3, F1, F5 and F6 appear to have very few wet parcels exceeding 1 standard deviation. I am surprised they appear to have identified as many convective

cloud intercepts as other flights. Also, I presume F8 isn't shown in Fig 5 for this reason (no wet parcels along the flight track) but it should be explained somewhere.

L310 and L317 Reading is made harder by occasional forward references in the early results sections, particularly L310 and L317. Please reconsider the use of forward references. I would suggest mentioning the convention of labelling hydration events when you point to Supplementary Fig. S4 near L306, rather than referencing forward, since that is where the reader is currently expected to look if they want to see individual moist features.

L330 This sentence is hard to follow. Can the text please specify the flight paths being referred to? Does it mean the paths taken by F1-F7? Or is it referring to F1, F2, and F4 being over Nepal? Perhaps I misunderstand, but F3 seems an obvious exception to the flights F1-4 during the warm/wet period. I am not sure that the argument about intercepts in space can be separated from the impact of time differences.

L343 I found the shift of terminology from 'period' to 'regime' unclear. This is first use of the word regime even though it refers back to section 3 where 'period' is used (and section 3 heading uses 'mode'). Suggest rephrase introduction of the word regime here, or a more consistent terminology introduced in Section 3.

L364 A2 must also be displaced horizontally, which is not shown in Fig 6. How extensive is that? Is it conceivable that such a body of air remained intact after 5 days? You could test this by calculating a series of back trajectories released from vertical and horizontal positions between A2 and B2. Or perhaps more precisely, forward trajectories, allowing for ice settling, from the suspected original convective event for B2. This is a point of interest, I do not expect any revision for this.

L467 It would be of general help to the reader to provide the summary with more backward references to specific results. In particular at L467, a reference to the analysis supporting this conclusion of a drastic drop of water vapour. It might be interpreted that all of Section 1 is relevant, but Fig 1 seems to be the key result for this sentence. It's also important so that a reader does not mix up this convectively-modulated temperature effect from convective lofting processes.

Technical corrections:

L221 typo 'shown'

L335 'at' seems unnecessary. Remove?

L367 The bibliography is missing Kim and Alexander 2015. A quick glance finds Muller and Peter 1992 also missing. Please double-check your bibliography is complete.

Fig1 Figs 1c and 1d are in the reverse order compared to the text in the caption and main body. Correct the text or the figure order.

Fig5 F5 appears to be incorrectly labelled as F4. Please correct.

Fig5 Refers to a hydrated feature C2 but is not mentioned. Please clarify. Is this associated with the ice cloud identified in Fig 6? Or is it meant to be hydrated feature A3 (as the colouring suggests)?

FigS4 The hydrated feature for flight 5 is marked A7. I think it is meant to be A5?