

Review of **Persistence of moist plumes from overshooting convection in the Asian monsoon anticyclone** by Sergey Khaykin et al.

The authors present a thorough and comprehensive study into moist plumes related to overshooting convection in the Asian monsoon anticyclone (AMA). The primary data source for their analysis is from the EU StratoClim flight campaign in Summer 2017, and they supplement this well with satellite observations and an ensemble trajectory analysis. The paper is well-written, informative, and enjoyable to read, and their findings regarding the persistence of moisture in the AMA are new and unique. I have some minor concerns related to the trajectory analysis utilized in this study that are addressed in the comments below, as well as some suggestions to improve readability of the paper, particularly regarding the figures.

General Comments:

1. There should be some more discussion of the limitations associated with long-term trajectory analyses, especially when using 30-day backwards trajectories. While using ERA-5 with a higher temporal resolution may improve the reliability of the trajectories compared to previous generation reanalyses, there is still a concern of large spatial errors given the length of some of the trajectory-matched convective sources presented in Figure 5c.
2. The figures presented throughout the paper are very informative but are also quite busy and hard to digest. One major improvement that I suggest would be to find a color table that is less harsh than rainbow for many of the Figures. I think rainbow is fine for designating individual flights like in Figure 5c, but when it comes to analysis in Figure 1, Figure 5a and b, etc., a less harsh color table will make the analysis feel less overwhelming on a first time read through. This will also allow layered contours of different variables to stand out against the background color.

Specific Comments:

1. Line 36 – A citation should be added for further information on stratospheric ozone chemistry, specifically Anderson et al. 2017 and similar papers discuss the potential for ozone destruction via activation of inorganic chlorine due to convective increases of H₂O in cold lower stratosphere environments
2. Line 79 – Please define FP7
3. Lines 152-155 – The horizontal resolution and some precision/accuracy information about the MLS measurement should also be provided here
4. Lines 158-163 – As above, please provide a sentence regarding horizontal resolution and precision/accuracy information

5. Lines 176-178 – This sentence should either be reworded or include an addition to provide a little more detail into the ozone-water vapor relationship and how that is a reliable method for diagnosing the transition layer
6. Line 184-185 – This sentence should include a citation
7. Lines 184-188 – Some discussion of above anvil cirrus plumes could be warranted in this paragraph, see Homeyer et al. 2017 (<https://doi.org/10.1175/JAS-D-16-0269.1>) and O’Neill et al. 2021 (<https://www.science.org/doi/10.1126/science.abh3857>)
8. Lines 190-196 – As noted in general comments, some discussion of trajectory errors and limitations is appropriate here
9. Line 211 – What is the reasoning for examining convective hits at 100 hPa only? Could this have an impact on your results where 100 hPa is farther into the stratosphere in the northern AMA (with high tropopause pressures) and closer to the tropopause in the southern part of the region?
10. Lines 213-214 – A sentence further describing this method that is shown in Bucci et al. could be helpful, especially to indicate how convective hits would not be overly dependent on parcel age at time of convection due to trajectory ensemble spread over time.
11. Lines 219-221 – This sentence is a bit wordy, I would suggest rewording and breaking into two separate sentences
12. Figure 1 – This figure has a lot of important information, but it is a bit overwhelming and hard to interpret. Following my general suggestions above, I think that reworking the color table for this figure and being sure to prominently display overlaid contours could help. Additionally, the black pixels representing likely sources of hydrated features seems important and should be emphasized; the black pixels almost make it look like a region of missing data on a first read through.
13. Figure 1c and d–The vertical dashed lines could be labeled as they are in Figure 5 for consistency throughout the figures, and it could also help to clearly indicate what they are
14. Lines 236-237 – For clarity, this should include a citation and some further explanation
15. Line 240 – I think it would be helpful here to specify the time by which CLS water vapor mostly returns to late July values
16. Line 269 – What is the bin size here?
17. Lines 290-291 – Citation needed here
18. Figure 5 – There is a lot going on in this figure as well, a couple of suggestions: (1) it would be helpful for the flight numbers to be as bold (as they are in the legend). (2) making the circles indicating the location of sampling more prominent by filling them in, making them larger, or both. (3) Increasing the density of wind vectors could help to fill in the areas of the map that are fairly empty, and also will help draw attention to them (it took me a while to notice them at first).
19. Line 310/Figure 5 – Given that C2 represents a different observation than A2 and B2 for flight F2, it may be helpful to visually indicate that, perhaps with a ‘C2*’. When first reading through, I was unsure if C2 was mislabeled until it was first mentioned on page 11.

20. Lines 347-348 – What are these measurements coming from? Flight data? MLS? And is this the mean for the entire domain? Is it the mean for the entire warm/wet period, or just a selected portion?
21. Line 372-373 – How many of the trajectories intersected the convective system vs. passing just south of it?
22. Lines 402-403 – I suggest that this statement should be a little stronger, something along the lines of “It is still possible that some of these...” rather than “this does not rule out that...”
23. Line 450 – Suggest changing ‘a lot of evidence for’ to ‘ample sampling of’
24. Line 483-485 – Suggest breaking this sentence into two separate sentences
25. Page 14 – It would be nice to include a sort of ‘looking forward’ paragraph to the conclusions, particularly with regards to the future of *in situ* observations of stratospheric H₂O. One example would be the ongoing Dynamics and Chemistry of the Summer Stratosphere (DCOTSS) field campaign, which should help to provide similar observations in the North American Monsoon Anticyclone.

Technical Corrections:

1. Line 21 – ‘the key contributor’ should be changed to ‘a key contributor’
2. Lines 120-121 – FISH instrument should be changed to “The FISH instrument” and “in flight” should be changed to “for flights”
3. Line 221 – typo: ‘sown’ instead of ‘shown’
4. Line 253 – ‘are hardly’ could be replaced by ‘cannot’
5. Figure 5 – There are two flights labeled F4, and no flight labeled F5.
6. Line 350 – ‘Fig. 6a,b’ could be replaced by ‘Figs. 6a and 6b’
7. Line 396 – One hundred? Or multiple hundreds?
8. Line 474 – ‘that the convective’ should be changed to ‘that convective’