

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2022-674

Anonymous Referee #1

Referee comment on "Establishment of an analytical model for remote sensing of typical stratocumulus cloud profiles under various precipitation and entrainment conditions" by Huazhe Shang et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-674-RC1>, 2022

General comments:

The submitted publication addresses scientific questions inherent in cloud physics and entirely fits with the scope of the ACP journal. The title properly represents the paper's contents, and the abstract is concise and complete. I appreciated the presented approach and methodology to investigate typical cloud profiles of liquid water content (LWC) and Effective radius (ER) to exploit them for satellite remote sensing. However, the paper does not bring to any substantial conclusion, and future work is needed to complete the envisioned step forward in satellite-based retrievals of the quantities mentioned above. I found the description of the dataset and the experiment quite plain and clear, thanks to fluent and precise language, and the method is reproducible. However, I have three main remarks:

- I enjoyed reading the introduction and the multiple references presented there. However, I found that literature focusing on retrieving LWC and ER from ground-based instruments deserves a paragraph in the presented text. Besides, I also lack a more specific description of the limitations and the sources of uncertainty that affect the satellite-based estimations of LWC and ER.
- I think that, sometimes, it is not easy to follow the interpretation that should support the results, especially regarding the conclusions extracted from the analysis of Figures 6,7, and 8. I believe that re-writing this part and providing more help to the reader to follow the presented argumentation will benefit comprehension.
- I did not find any indication regarding the availability of the data and the code used to produce this work. I consider this a necessary condition for any publication to be accepted, so I strongly recommend that the authors make their code and dataset publicly available for open science and the reproducibility of results.

Please find more regarding the points above in the specific comments provided in the PDF

and in the specific comments below. (Also, technical corrections in there).

I recommend publishing the paper after the minor revisions requested to solve the remarks mentioned earlier.

Specific comments:

Line 40: This study refers to ground-based observations, while all the others in the paragraph deal with satellite observations. I would remove this study from here and devote a separate paragraph to present a summary of the research done using ground-based obs for detecting LWC and effective radius

Line 65: It might be worth also mentioning some studies investigating LWC and effective radius profiles using ground-based observations. (for example

Roebeling, R. A., Placidi, S., Donovan, D. P., Russchenberg, H. W. J., and Feijt, A. J. (2008), Validation of liquid cloud property retrievals from SEVIRI using ground-based observations, *Geophys. Res. Lett.*, 35, L05814, doi:10.1029/2007GL032115.

Rémillard, J., Kollias, P., and Szyrmer, W.: Radar-radiometer retrievals of cloud number concentration and dispersion parameter in nondrizzling marine stratocumulus, *Atmos. Meas. Tech.*, 6, 1817–1828, <https://doi.org/10.5194/amt-6-1817-2013>, 2013.

Wu, P., Dong, X., Xi, B., Tian, J., & Ward, D. M. (2020). Profiles of MBL cloud and drizzle microphysical properties retrieved from ground-based observations and validated by aircraft in situ measurements over the Azores. *Journal of Geophysical Research: Atmospheres*, 125, e2019JD032205. <https://doi.org/10.1029/2019JD032205>)

Line 78: I would recommend repeating the acronym explanation since it is given in the abstract, and a reader interested in the paper might go straight to the text.

Line 100: Please specify where these profiles were taken and if the conclusions can be considered general.

Line 105: There's a whole literature on retrieval of cloud and drizzle profiles from ground-based, some works are also mentioned in my previous comments. I think it might deserve a dedicated paragraph, as stated in the general comment and above.

Line 106-108: I think this proposition is quite strong. Validation with other observing platforms is crucial. I am missing a discussion on the limitation of airborne sensors in retrieving quantities like LWP, or LWC for example. What are the possible sources of uncertainty that can affect the retrieval? Also, in Grosvenor there is some discussion on that

Line 115: Replace in order to with simply To

Line 129: Taking...by an LES: Maybe add a reference that supports this statement.

Line 190: Capital letter for we

Line 190-191: by just summing rainwater content prescribed by the LES output over the cloud profile? maybe just complete the sentence with this information for clarity to nonexperts.

Line 249-255: where can I learn how the SP, WP, SE, WE, and ALL subsets are characterized in terms of entrainment and precipitation? sorry if I missed this aspect. Figure 3 shows the distributions but only for all... how is the distribution for the specific subsets? In general, I have some difficulties here in following the discussion because I don't know how to locate in figure 6a/b) the various subsets. For example, in line 252: "among WP profiles, stronger cloud top entrainments correlate to smaller weighting factors for EOF2". How can I see this?

Line 265-266: I find it really hard to follow and understand what you are referring to when you say center bottom boxes and leftmost column. Please try to clarify the description and identify clearly to which boxes you are referring for WE and SE.

Line 270-271: same as before.

Line 274-275: Which boxes, again? not clear what are the 16 boxes in the subplots of figure 6. Do you mean the grid 4x4 if visible in each subplot of figure 6B? please, clarify this better, it is very hard to follow.

Line 275: I would say: "the most populated region of weighting factors for EO1/EO2 in figure 8 a and b are the left bottom corners"

Line 276: there's also a 6.83 in the second column at the top that is relevant, in my view. I would re-scale the color bar to make the occurrences more visible. The light blue is too light. Also, the color bar and the numbers are the boxes, aren't they doubling the information?

Line 280-282: It is not clear. I would suggest adding a figure where you support the considerations with some graphical representation highlighting what you are summing up.

Line 350: How do these profiles compare with in situ and ground-based observations? at least a qualitative comment can be interesting

Please also note the supplement to this comment:

<https://acp.copernicus.org/preprints/acp-2022-674/acp-2022-674-RC1-supplement.pdf>