

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2021-200

Anonymous Referee #3

Referee comment on "Analysis of aerosol–cloud interactions and their implications for precipitation formation using aircraft observations over the United Arab Emirates" by Youssef Wehbe et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-200-RC2>, 2021

General comments

This manuscript presents a study of aerosol (especially giant particles such as mineral dust) & cloud interactions over UAE regions by using aircraft measurements. Comparative analysis from penetrated sampling by two research flights gives important information on cloud microphysical characterizes and precipitation formation mechanisms over this region. Among many recent studies on aerosol-cloud interaction, this research provides a new insight into understanding the influence of aerosols on cloud and precipitation processes, as well as its application for hygroscopic cloud seeding. This paper is overall well-written, but some scientific discussions tend to draw conclusions quickly without a strong statement, especially the linkage between aerosol properties and cloud microphysical process in section 5. In general, minor revisions are needed before the acceptance of this manuscript. Below listed are the comments and suggestions.

Specific comments

- In section 1: This part is a review of the roles that aerosols play in the cloud microphysical process. However, it lacks some important introductions such as the aerosol effect on precipitation or its application on hygroscopic seeding, as the title includes "... aerosol-cloud interactions ... precipitation formation ...". Please give a literature review about research that has been conducted in association with aerosols (especially giant CCN) as an agent of cloud seeding (you can put this part in this section or section 5.3):

Jung, E., Albrecht, B. A., Jonsson, H. H., Chen, Y.-C., Seinfeld, J. H., Sorooshian, A., Metcalf, A. R., Song, S., Fang, M., and Russell, L. M.: Precipitation effects of giant cloud condensation nuclei artificially introduced into stratocumulus clouds, *Atmospheric Chemistry and Physics*, 15, 5645-5658, 2015.

Rosenfeld, D., Axisa, D., Woodley, W. L., and Lahav, R.: A quest for effective hygroscopic cloud seeding, *Journal of Applied Meteorology and Climatology*, 49, 1548-1562, 2010.

Ghate, V. P., Albrecht, B. A., Kollias, P., Jonsson, H. H., and Breed, D. W.: Cloud seeding as a technique for studying aerosol-cloud interactions in marine stratocumulus, *Geophysical Research Letters*, 34, 2007.

Wang, F., Li, Z., Jiang, Q., Wang, G., Jia, S., Duan, J., and Zhou, Y.: Evaluation of hygroscopic cloud seeding in liquid-water clouds: a feasibility study, *Atmospheric Chemistry and Physics*, 19, 14967-14977, 2019.

- In section 5: It looks interesting that almost all the droplets in the negative temperature zone are supercooled water. According to glaciogenic seeding theory, does it mean the rich potential of cloud seeding in the UAE region?
- Line 255-258: Please show the relationship between vertical velocity and spatial position (or time series) during cloud penetration with a diagram to illustrate the huge difference of updraft (17.8 m s^{-1}) and downdraft (-12.4 m s^{-1}) measured in the upper portion of SF1.
- Line 266-267: Why does drop size in the lower portion of SF1 seem smaller than that of SF4 from CIP image? As the fallout of ice irregulars or graupel are observed in both cloud penetrations.
- Line 274-276: In contrast to $8.3 \mu\text{m}$ and $-0.3 \mu\text{m}$, $6 \mu\text{m}$ and $8.3 \mu\text{m}$ are almost at the same height during SF4 cloud penetration, please explain why spectrum broadening is obviously observed.
- Figure 9 and 10: How to determine the red oval in camera photo corresponds to the measurement by 2ds and cpi? Please add descriptions.

Technical corrections

- Line 93: "in favour of" -> "in favor of".
- Line 161: "compliment" -> "complement".
- Line 205-206: "...with high concentrations of around 1000 cm^{-3} ..." -> "...with high concentrations of aerosols (around 1000 cm^{-3})...".
- Line 254: " -12 C " -> " $-12 \mu\text{m}$ ".
- Line 287: What is "PSD" short for? Please give the full name of the acronym when it first appears.
- Figure 1: Please mark the location of the airport.

- Figure 2 and 3: Please improve the graph resolution.
- Table1: The second annotation was not marked on the table.
- Table 2: Please add standard deviation of the data.
- Reference: Please unify the format of journal titles, such as "Atmospheric Chemistry & Physics" and "Atmospheric Chemistry and Physics, "Atmospheric environment" and "Atmospheric Environment" ...