Reviewer Report 1

I appreciate the authors' hard work of addressing all comments from the reviewer. The revised manuscript has greatly improved its readability and has also addressed all my concerns. Therefore, I recommend this manuscript for publication.

We appreciate the valuable comments from the reviewer.
Our responses are in blue below each comment from the reviewer.

Minor comments:

(1) Line 664: it may not be suitable for...

Modified as suggested.

(2) Line 930: I wonder if this is the correct format for citing ATBDs, (the format is also inconsistent with the other ATBD you cited on Line 1005). Please check other's manuscripts for reference.

The Algorithm Theoretical Basis Document (ATBD) for Optimal Cloud Analysis Product is an online product guidance document from the Europe's Meteorological Satellite Agency (EUMETSAT). Therefore, we used this format in the reference.

(3) Also general for the reference section, please double-check that the format is consistent across all references, and make sure you have listed all references in the revised manuscript.

We double-checked the reference section, and all references were included.

Reviewer Report 2

The authors have addressed most of my concerns. Here are my remaining comments:

We appreciate the valuable comments from the reviewer.
Our responses are in blue below each comment from the reviewer.

(1) The T-ER figures show nominal ER values below (at larger T) the aircraft measured cloud base. These values are not physical and must combine radiance from the cloud and the surface. Please add a discussion that highlights this problem and the way it may affect the inference of the seedability. For example, it erroneously increases the indicated depth of the diffusional growth zone. There is such an example in Figure 9e.

We agree with the reviewer that we should be careful about the satellite data at a high temperature, which might be below the cloud base. For the case in Figure 9, the cloud base captured by the aircraft was about 9.1°C (Figure 6a). Meanwhile, according to the Skew-T chart (see figure below) from the observed sounding in Abu Dhabi at 00 UTC on the same day of this cloud case (closest sounding observation), the lifted condensation level (LCL, approximating the cloud base) was 15°C. That is warmer than the cloud base temperature captured by aircraft (~9.1°C), possibly due to the differences in time and locations between the sounding and aircraft observations. If the cloud base temperature from a sounding observation at the same time and location as the cloud case is available, it can be used to accurately exclude the satellite data below the cloud base and inhibit the corresponding uncertainties in the depth of the diffusional growth zone (Zone 1) if it is identified.

We replotted Figure 9 to exclude the satellite data below the cloud base (15°C) and clarified that in the caption. Meanwhile, we added the discussion above in the manuscript after the description of Figure 9.

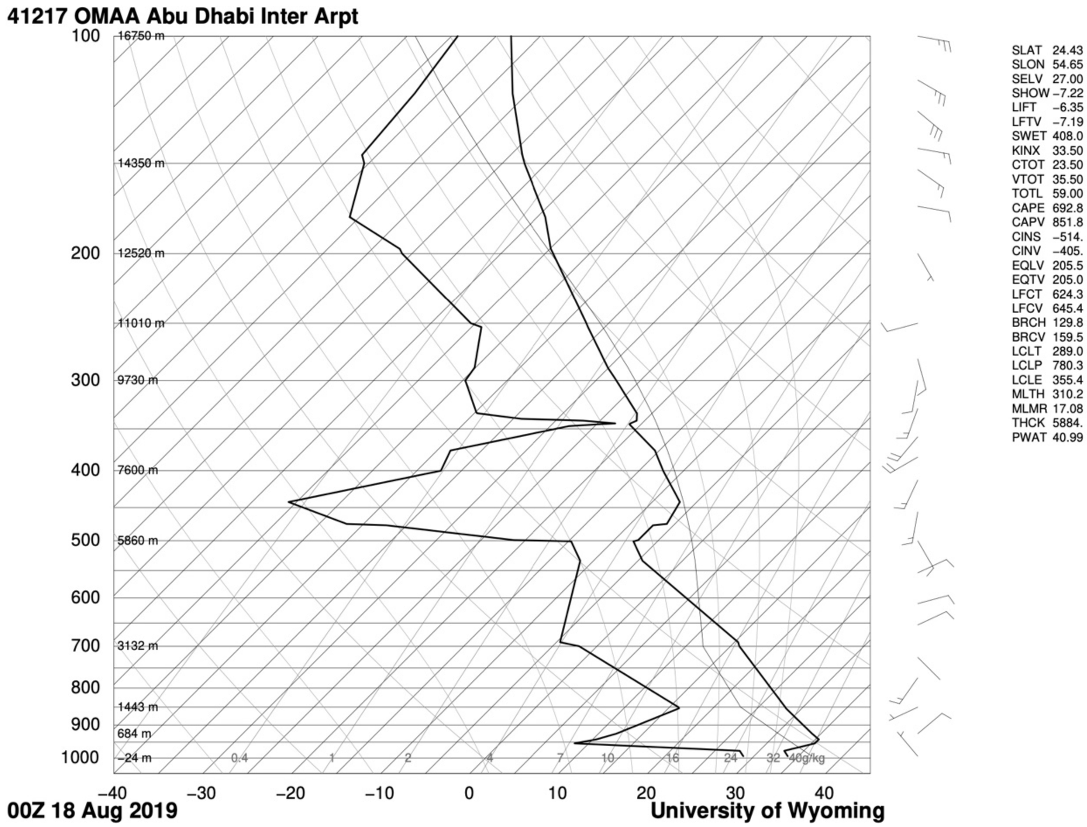

Figure: Skew-T chart from the sounding observation in Abu Dhabi at 00 UTC on August 18, 2019. (Credit: University of Wyoming)

(2) Line 618-619: The text reads: “This is to identify the best targets for cloud seeding using hygroscopic particles, which is most effective in cases when coalescence is not active.” But there are different kinds of hygroscopic seeding – small particles to suppress coalescence and invigorate the clouds or large particles to accelerate coalescence and make the cloud rain faster. You have to specify that the hygroscopic seeding that might work there is one that is aimed at enhancing drop coalescence and accelerating warm rain processes.

We have added two sentences for clarification (copied below) after the original sentence.

“When we reference hygroscopic seeding, we assume that the objective is to enhance precipitation. In this case, the hygroscopic particles are ultra giant cloud condensation nuclei (UGCCN), which when introduced at the cloud base and in the updraft region enhance the coalescence of warm-based clouds, accelerating the warm rain process (Rosenfeld et al., 2010).”

Rosenfield, D., Axisa, D., Woodley, W. L., and Lahav, R.: A quest for effective hygroscopic cloud seeding, J. Appl. Meteorol. Climatol., 49, 1548-1562. doi:10.1175/2010JAMC2307.1, https://doi.org/10.1175/2010JAMC2307.1, 2010.

(3) Line 630: Again, which kind of hygroscopic seeding do you refer to here?

The hygroscopic seeding here is similar to the hygroscopic seeding we mentioned in our response to the last comment. We modified the sentence in the manuscript to clarify that.

(4) Line 631: Zone 3 is defined here as the diffusional growth of supercooled cloud droplets. Supercooled clouds with drop coalescence are common but excluded from any zone's conditions. This gap has to be filled.

We agree with the reviewer that drop coalescence can occur in supercooled clouds, where collisions between supercooled droplets lead to the formation of larger, more massive droplets. A few studies reported observations of supercooled drizzle drops formed via coalescence processes when there were sufficient large droplets (Cober et al., 1996; Kajikawa et al., 2000). However, coalescence mainly applies to warm clouds where water droplets of many different sizes are swept upwards at different velocities so that they collide and combine with other droplets. The coalescence in supercooled clouds is typically rare and less efficient than in a warm cloud. That is because the precipitation-forming process in supercooled clouds is often dominated by the Bergeron-Findeisen process, when ice crystals form and rapidly grow by capturing supercooled water droplets.

In this study, the "supercooled water zone" (Zone 3) is defined as the zone of small, supercooled droplets with a slow droplet growth rate as shown in Figure 8. As we mentioned in the description of Zone 3 in Section 3.4, it is designed by the requirements of the cloud seeding operator to conduct hygroscopic and glaciogenic seeding. When Zone 3 exists and is sufficiently deep, the precipitation-forming processes are usually suppressed, indicating potential for rainfall enhancement by hygroscopic and/or glaciogenic seeding. The supercooled water droplets with coalescence may be partially covered by Zone 2 (droplet coalescence growth zone), in which the lower temperature threshold is -10°C and the droplet growth is quick. However, given the limited aircraft observation (so lack of validation), we are not confident to technically parameterize the occurrence of supercooled clouds with coalescence.

Because of the reasons discussed above and the goal of this study (categorizing microphysical zones to identify cloud seeding targets), the supercooled water with coalescence is not defined as a separate zone in this study.

Cober, S. G., Strapp, J. W., & Isaac, G. A. (1996). An example of supercooled drizzle drops formed through a collision-coalescence process. Journal of Applied Meteorology, 35(12), 2250-2260. https://doi.org/10.1175/1520-0450(1996)035<2250:AEOSDD>2.0.CO;2

Kajikawa, M., Kikuchi, K., Asuma, Y., Inoue, Y., & Sato, N. (2000). Supercooled drizzle formed by condensation–coalescence in the mid-winter season of the Canadian Arctic. Atmospheric research, 52(4), 293-301. https://doi.org/10.1016/S0169-8095(99)00035-6

(5) Line 649 and many other places: What are "suppressed microphysical processes"? I guess that you mean "suppressed precipitation-forming processes". Please replace all such occurrences with what is meant by this expression.

We agree with the reviewer that the term "precipitation-forming processes" is more accurate. We have changed suppressed/active "microphysical processes" to suppressed/active "precipitation-forming processes" throughout the manuscript, including the names in Figure 8 and Figure 14.