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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The relative dispersion of cloud droplets: its robustness with respect to key cloud properties" *by* E. Tas et al.

Anonymous Referee #2

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ACPD REVIEW of Manuscript: acp-2014-227

Review of "The relative dispersion of cloud droplets: its robustness with respect to key cloud properties" by Tas, E., A. Teller, O. Altaratz, D. Axisa, R. Bruintjes, Z. Levin, and I. Koren. [Ref.: acp-2014-227]

This paper addresses relative dispersion and its relationship with other cloud parameters in warm cumulus clouds for 5 flights during the Cloud and Aerosol Research in Istanbul project in 2008. They use observations made with the Cloud Droplet Probe (CDP) and the Passive Cavity Aerosol Spectrometer Probe (PCASP).

While this paper addresses a scientific topic within the scope of ACP it does not present a novel concept or approach. In fact, the conclusions reached are difficult to interpret

due to a severe lack of clarity in the figures included with the manuscript. There are gaps in the description of the methods, for instance in determining cloud depth, which are critical for their presentation of the results in the discussion section. While the results may support their conclusions it is impossible to truly make this statement with the figures as currently formatted.

The title accurately describes what they attempted to do in their experiment and the abstract summaries the work, though the last sentence "a clear criterion. . ." is unsupported by the results/figures as presented. However, whether or not the figures support this is impossible to tell. They do give proper credit to previous work and use well known papers by respectable aerosol-cloud scientists. The overall presentation is not well structured or clear and there are serious language issues. The writing style, grammar, typographical errors and other wording issues make the manuscript difficult to understand and follow. There are no mathematical formulas but, they often forget to subscript or italicize certain symbols throughout the text. The supplementary material has formatting issues and could be included in the main manuscript if re-worked to do so.

This paper is not publishable in its current format. It needs significant work in the methods section, figure presentation and writing quality in order to bring it to the level expected for being published in ACP. It needs to be reworked and resubmitted as s new manuscript. Specific comments are below.

MAJOR COMMENTS: 1. It is unclear how they determine cloud height. This is an important quantity for the their discussion and it is ambiguous how it is determined. 2. They don't make a very strong case for why this new work is needed. They do not present a novel or unique way of assessing relative dispersion. 3. They tend to generalize concepts without the necessary elaboration. Such as mentioning "microphysical processes" without describing what processes are relevant to their study. 4. It is unclear why they chose pre-frontal and post-frontal clouds. They do not elaborate on their reasoning for doing this. Why not use data from many more flights to establish a

statistical grouping of clouds that can be sorted by cloud height and aerosol amount? The limited number of flights and the amount of data used is concerning. It is concerning that they only use two flights and 5 clouds since they are obviously not using high resolution data. 5. It is unclear how the flights were conducted. Aerial views of the flight paths are never shown. Based on Figure 1B it needs to be assumed that they flew back and forth in single clouds an multiple levels, but they never explicitly say this. 6. They should include average meteorological parameters for each "cloud" in their table. They should have access to these data from the aircraft. This would allow a fair comparison between theses clouds rather than just saying they are pre- or post-frontal. 7. They need to provide evidence for the "regeneration of the air pollution layer." With the current wording it is just speculation that this is the case. 8. Uncertainty, and an assessment of if their results are statistically significant in light of the few clouds/data points they have, in their measurements and results needs to be more thoroughly discussed. The lack of droplets over 20 um needs further discussion. How much will the results change if those droplets are included, the authors discussion of this is not thorough. 9. It would be helpful for them to include the number of data points in each cloud pass in Figure 1B and Figures 3-5. 10. Flight speed needs to be mentioned so we can accurately assess the that 2 sec = 140 m of cloud. 11. A discussion of entrainment and mixing at cloud top and cloud edges is necessary (see Small et al 2013, Tellus)

SPECIFIC FIGURE COMMENTS Figure 1) This figure is poorly formatted. Flight tracks should be included over the MODIS image to show where the flights took place. Highlighting locations like the Black Sea and Istanbul are useless to the study. Where were the flights made? In part B of this figure the altitude axes are too short to be able to clearly tell the differences between cloud penetrations. Making these panels larger and including grid lines will help make this figure easier to understand. In the caption it states that the measurements were carried out from June 6-8, though in the manuscript (line 12) it says June 6-7. Figure 2) The vertical axes in these panels needs to be larger. It is almost impossible to see the green line that represents the standard deviation. Figures 3-5) These figures constitute the bulk of the results section and are

incomprehensible. It is impossible to see the difference in colors of the dots (for LWC, Nc) due to the extremely short y-axes on every panel. It is also almost impossible to read the axes labels. These figures need to be completed re-done in order for them to be useful to the reader. With the figures in the current format this paper cannot be published.

SPECIFIC TABLE COMMENT Table 1) Include key meteorological parameters from the atmosphere around each cloud. For example, the range of temperature from cloud base to top, the range of humidity etc.

MINOR COMMENTS: ABSTRACT Line 12: Clarify the "clear criterion" and what you are referring to when you state "statistical moments' calculations.

1. INTRODUCTION (page 11154) Line 16: "droplets" should be "droplet" Line 19: "drops" should be drop Line 21: Are you talking about cloud dynamics or atmospheric dynamics, be clear. Line 22: List or describe what "different microphysical processes" you are talking about Line 22: Are you talking about the terminal velocities of the rain drops or the cloud drops? Line 18-24: The wording/English writing in this section needs to be revised and improved.

1. INTRODUCTION (page 11155) Line 1-25: The wording/English writing in this entire section needs to be revised and improved. Specific comments below. Line 2: "like for" is awkward, change this. Line 5: "It is done in" is awkward, change this. Line 16: "strartiform" should be "stratiform" Line 20: What type of aerosol loading was the Lu et al and Berg et al papers made under? Line 23: It is random to mention that the Nc was higher than 50 cm-3, why do you include this? Line 24: You state "similar results were reported" which previous paper that you mentioned are you referring to?

1. INTRODUCTION (page 11156) Line 13: "more" should be removed Line 13: "due to that" is awkward, change this.

1. INTRODUCTION (page 11157) Line 1-2: "relationship of the droplet concentration"

should be “relationship between Nc” Line 4: “Nc” should be “Nc” in italics and with a subscript "c" Line 6: “affect” should be “affects” Line 7: “for positive Nc-“ should be “for a positive Nc-“ with Nc in italics and with a subscript "c" Line 9: “. . . and the surface precipitation” should be “. . .the surface precipitation” Line 13: You did not previously introduce the abbreviation for cumulus (Cu). You need to do that first. Line 16: “a most” should be “the most” Line 27: “. . .and the relation between” should be “. . . and the relationship between”

2. MEASUREMENTS AND INSTRUMENTATION (page 11158) Line 4: “(CARI) was” should be “(CARI) project was” Line 4-5: Avoid using the same work twice: “aimed at studying” and “as a feasibility study” Line 13: Why did you choose the pre- and post-“frontal-passage” data. You need to justify this choice to frame your study and why it is different and contributes to the body of work relating to relative dispersion. Line 15: “The upper panel of Fig. 1” should simply be “Figure 1a” Line 20: Table1 needs to be expanded to include more information Line 26: Was there no instrumentation on board to determine if there were ice crystals? A CIP perhaps?

3. RESULTS (page 11160) Line 3-4: you are speculating about the regeneration of the air pollution layer. You need to show evidence that this is the case Line 28-29: English wording needs to be improved. This sentence is difficult to follow.

3. RESULTS (page 11161) Line 2: What do you mean by “are constrained within the cloud” Line 3: “relation” should be relationship” Line 15: “boundaries” could be replaced by “edges” Line 10-17: English wording needs to be improved. This section is difficult to follow. Line 18: You mention the “total number of data points” but these values can’t be seen in any figure, table or in the text. Include them in Table 1 or on the figures. Line 24: “likely an artifact” – what do you mean by artifact, describe what you are referencing.

4. DISCUSSION and SUMMARY (page 11162) Line 25: You mention that the variance decreases significantly. What statistical test did you conduct to determine this?

4. DISCUSSION and SUMMARY (page 11163) Line 1-5: English wording needs to be improved. This section is difficult to follow. Line 10: “NC” should be “Nc” in italics and with a subscript "c" L:ine 18-20: Why do you bring up the second indirect effect here? You don’t really discuss it anywhere else. It seems out of place and like you’re trying to fill up space. Line 22: “values right” should be “values correctly” Line 10-25: English wording needs to be improved. This section is difficult to follow.

4. DISCUSSION and SUMMARY (page 11165) Line 1: “analyze airplane” is awkward. Reword this sentence.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 11153, 2014.