Atmospheric
Chemistry
and Physics
Discussions

Interactive comment on "Drivers of cloud droplet number variability in the summertime Southeast United States" *by* Aikaterini Bougiatioti et al.

Anonymous Referee #1

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Title: Drivers of cloud droplet number variability in the summertime Southeast United States Author(s): Aikaterini Bougiatioti, Athanasios Nenes, Jack J. Lin, Charles A. Brock, Joost de Gouw, Jin Liao, Ann M. Middlebrook, and Andre Welti MS No.: acp-2020-225

This manuscript focuses observations of aerosol and vertical velocities over the southeast US and how it impacts predicted cloud droplet number concentration. The work uses data from the 2013 field campaign SENEX with 13 flights over the Southeast US. They find that aerosol amount and vertical velocity are responsible for up to 90% of cloud droplet number variability. They stress, early in the manuscript, that most studies do not include the impact of vertical velocity. There are some edits required, though other than that it is a fell written manuscript that will be of interest for the aerosol com-

munity.

My recommendation to accept this work with revisions and modifications to figures.

Main comments: 1) Do you have access to actual cloud data? How do the calculated Nd values compare to the calculated Nd values presented in this paper? I find it hard to believe that there were no cloud data available. Even a simple discussion about how realistic the calculated Nd values are in comparison to what was seen in in situ observations is necessary.

2) For figures 5 and 6 there could be additional discussion in the manuscript. When looking at Figure 5: the first thought I had was it would be nice to see a comparison of cases when the sw* was the same and you could ese how droplet number and Na were related. That seems more important than looking at a range of Na and simultaneously looking at a range of w*. Maybe a three panel figure with "Low w*," "medium w*" and "high w*" like mentioned in the text but then plot Nd and Na? Secondly, for Figure 6, Could the difference in Na with w* be due to the vertical transport? Since the w* values are higher more aerosol can be brought up from the surface.

Table Comments: 1) All the tables are ok, though it might be helpful to note daytime vs. nighttime in some way, either by shading or some type of annotation (sun and moon perhaps?)

2) For Table 4: Perhaps add a mean row at the bottom for the contributions for K, Nd and sigmaw? A quick average gives k = 4.2, Nd = 75.2 and sigmaw = 13. Nd + sigmaw = 88.2. Is this where the 90% comes from that is mentioned in lines 313-314?

Figure Comments: 1) Figure 1: The 3D flight paths are hard to see in such a small format. Perhaps just 2D would be better, or make each panel larger. How many flights look like (a) and how many flights look like (b)? Could you include statistics about this? Otherwise it looks like your cherry picking examples.

2) Figure 2: Make all the panels larger, the legends are hard to read. Why are the

words and numbers together in the legends (e.g. Flight15 pass2)... spread them out Flight 15 pass 2. Also, in the caption Line 523: you say "flights" did you mean passes? In panel (c) you have Flight 14 pass 6 and in (b) you also have Flight 14 put pass 1. Also, on panel c) consider different colors for the lines. If someone was colorblind they would not be able to tell the difference between the pink/red lines and the greenish ones.

3) Figure 3: Suggestion: 4) Figure 4: same comment as in Figure 3: Add annotations to the figures to label the columns "Day" and "Night" and the rows "Alabama" and "Atlanta"

5) Figure 5: In the caption (line 547) "shading" is mentioned but is not visible in the figure. Also, the yellow marker for Flight 15 (I think) is difficult to see.

6) Figure 6: In the caption (line 552) "shading" is mentioned but is not visible in the figure. What is the "constant altitude" that is referred to in this figure? Include the altitude somehow.

Line by line comments: Line 37: Try not to use symbols in the abstract, just describe in words (it's clearer).

Line 45: remove "the" before "incoming"

Line 182: Specify Figure 1b here. Figure 1a does NOT show the significant decrease in organic mass fraction.

Line 236: how do you define what an "important contributor" is? What percentage do you consider important?

Line 242: Specify that the "first pair of flights" is for the Alabama flights.

Line 244: Specify that the "second pair of flights" is for the Atlanta flights.

Lines 253-256: The sentence that starts with "Figure 3" would be better up after "(see Fig 3.)" on line 240. It doesn't make sense where it is now.

Line 264: "characteristic", should be "characteristic,"

Line 313-314: How do you get the 90% number?

Line 319: "S.Atlantic" should be "Southeast Atlantic"

Line 523: you say "flights" did you mean passes? In panel (c) you have Flight 14 pass 6 and in (b) you also have Flight 14 put pass 1.

Line 527: add "calculated" between "showing" and "cloud"