

The manuscript submitted by Twohy et al. presents measurements of fluorescent aerosol and ice nucleating particles (INPs) collected from the Gulfstream-V aircraft as well as modeled interpretations of these data. The investigation of biological particles at altitudes relevant for mixed phase clouds has been performed only a few times, but this is the first manuscript to describe the application of real-time fluorescence-based detection (i.e. WIBS here) along with analysis of INPs from an aircraft and showing vertical distributions. Overall, the manuscript is an excellent contribution to the literature and is very well written. The manuscript fits well in ACP, and I anticipate that it will be well received and well cited. I have some minor points that I think may help clarify certain aspects of the text, but otherwise I recommend the manuscript be published without major alteration.

Review by J. Alex Huffman

Minor Comments:

- 1) The presentation of the sites of observation and the timeline of comparison with previous studies is a bit confusing at times.
 - a. L82 states that Figure 1 was taken from the Southern Great Plains ARM site. I would suggest putting a mark on the map in Figure 2 to highlight this.
 - b. L97 discusses data “taken near Boulder, CO”. Does this refer to flight data, or ground-based measurements from the BEACHON study? If referring to the aircraft data, it is confusing, because the flight tracks extend well beyond Colorado. However, if referring to the BEACHON study, I would be much more specific.
 - c. L139 mentioned the “BEACHON” study (in quotes), but does not list the full name. For this journal I would suggest listing the specific name as BEACHON-RoMBAS and spelling out the acronym, per convention. The first time it is mentioned, which I believe is at this point, I would also suggest referring to the site itself, which is called the Manitou Experimental Forest Observatory (MEFO), rather than the “BEACHON project site.” This may help clarify for community members familiar with the site, but not with this specific BEACHON study. An overview of the site is presented by Ortega et al., 2014.
 - d. I would also suggest pointing out that the BEACHON-RoMBAS study was in July-August 2011, whereas these flights were performed in October 2013. Because the years are sometimes not reported later, it may confuse some readers who are not already familiar with these studies.
 - e. L241: Here is an example where I would add the year (2011) and consider changing to MEFO or adding that information here.
 - f. L304: MEFO (or the site where BEACHON-RoMBAS was performed) is near Woodland Park, CO, but not very close to Manitou Springs, CO.
- 2) The discussion of WIBS data is treated relatively carefully, but I would suggest changing the wording in a few places to make the statements somewhat more conservative. For example:
 - a. L162 states that “most biological particles contain amino acids and other compounds that fluoresce ...”. True, but I would either give more detail (as in L185), or remove ‘amino acids and other’ from the sentence. As written it seems half-way between a specific statement and a vague one.
 - b. L164, L313, L396, L423: Each of these lines give some statement implying that biological and non-biological particles can be differentiated by the WIBS. This is a nuanced discussion, as the authors mention. However, I would suggest scaling back the wording for these sections a bit to involve the word fluorescent, or some other terminology that does not inadvertently imply more knowledge than can be defended. Even though the authors do bring this up, I think it would be best to utilize terminology along the way that will help in case a reader doesn’t look carefully at the sections with these important caveats.

- 3) Sizing
 - a. The manuscript discusses “large particles” several times, but I’m not sure they are ever rigorously defined. I think the authors use 0.8 um as the lower cut for “large” because of the WIBS. Please add this unambiguously when the term “large particles” is used first. I would also add an upper size range for this, since the WIBS, and probably the inlet, do a poor job of collecting very large particles.
 - b. See L395, but many other locations as well.
 - c. L423
- 4) End of page 5 discusses how the WIBS background signal was calculated. Was the “forced trigger” calculated as one average per flight, one average for all flights, a running average within a flight? Please clarify.
- 5) I would suggest adding Huffman et al. (2013) to L305 and including that droplet freezing apparatus measurements were also performed alongside CFDC measurements.
- 6) Figure 3: Legend is a bit confusing. The caption implies that there is a difference between large and small data points, in terms of whether they passes statistical significance tests. The sizing difference is subtle, however, and I would suggest making this easier to determine from the (i.e. shaded or not ...). Also, the legend repeats information (e.g. 6B upper bnd, 6B lower bnd), but I’m not sure if this is intentional or necessary.
- 7) Figure 7: I would suggest making one legend and putting in a location of a sixth panel. This would reduce legend redundancy and would remove the current issue that the legends cover parts of the graph and axes labels.

Specific and technical comments or corrections:

- 1) L 76: Comma after “Thus”
- 2) L110: Does the sentence need to be parenthetical?
- 3) L183: Add closing parentheses.
- 4) L204: “calibration was verified” seems a bit strong for a 1-point measurement. Maybe “check” is a better word?
- 5) L278: Add space between “10hPa”
- 6) L288: Add space between “4um”
- 7) L308: Add comma after “First”

References:

Ortega et al., ACP, 14, 6345-6367, doi:10.5194/acp-14-6345-2014, 2014.