

Interactive comment on “A comprehensive in situ and remote sensing data set from the Arctic CLOUD Observations Using airborne measurements during polar Day (ACLOUD) campaign” by André Ehrlich et al.

Sebastian Schmidt (Referee)

sebastian.schmidt@lasp.colorado.edu

Received and published: 19 July 2019

This manuscript provides a comprehensive description of the ACLOUD data set, with references to DOIs and publications for individual data sets and instrumentation. Pairing the data archive itself with such a data description following the ESSD journal's philosophy is an excellent way to get the best use of the data across the user community beyond the original ACLOUD team itself. Generally, the manuscript does a good job describing the data in such a way that they can be broadly used. However, I do have a few general recommendations to improve on this aspect. I also have a few sequential

comments. I did not comment on language much. Copyediting should be done. There are a few re-occurring errors (for example, the use of a comma before "that", which is very uncommon in BE/AE; also: there should always be a comma before "which" - numerous other [minor] language issues including mismatching numerus, tense etc.). While I recommended "major revisions" above, I actually think that no major changes to the content are needed. However, I volunteer (at the discretion of the editor) to re-read the manuscript after improvements proposed below have been made.

General comments:

1) The description of the individual data sets and instruments comes across as too much of a "laundry list" where the individual pieces are treated unequally. While to some extent unavoidable in this type of paper, I recommend to go through judiciously and decide what the user really needs to know, and also to add details where necessary. Would it be possible to follow one single template for the contributing data sets? I would like to point out that for the most part this is done well; CVI hits a good balance of material where measurement principles are described with sufficient detail for the user to understand its strengths (and weaknesses, where applicable). A counterexample is the lidar; for the non-expert, it is not satisfying to be confronted with channel specifics without being told about their use. In the end, the question remains whether one actually obtains extinction profiles, and if so, at what resolution (since this is not an HSRL, it is probably just backscatter). Occasionally, details are given that are not useful for the reader - why the "five-times" threshold, for example? On the other hand, the information on p11, I30-34 are useful. I would also like to note that the collective description of some instruments is nice: It is satisfying to see that a consistent cloud droplet size distribution can be derived across multiple instruments (question though: were there any bulk probes flown like a Nevzorov? It is conspicuously absent from Table 2. Why? Seems like the 1 microphysics instrument to include in the payload.)

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2) To truly make the data set useful to the community, it would help to understand the motivation/genesis for the various different types of flights. After all, they were motivated by the science, not just be the objective to have P5/P6 collect some data together. It is understood that the science is described separately in other papers. However, this paper is incomplete without describing what the flights actually looked like, whether the flights delivered on their objectives etc. At the very least, list the various objectives, such as "above-cloud radiative effect", "surface cloud radiative effect", "surface characterization", "cloud microphysics profiling", "remote sensing validation", "air mass modification", "process-understand of xyz cloud type" [in no particular order]. This will allow the reader to understand the flown flight patterns, why individual maneuvers had the lengths they had etc... Is it possible to include meteorological context, and/or imagery? In other words, it is very desirable to have the philosophy of the campaign with sub-objectives flow down to the execution of the individual flights. This is, to some extent, more important than the description of the instrument, which can be found in other publications. That aspect is only very sparsely covered at the moment.

Sequential comments

Table 1:

- * Should come after the general strategy for ACLOUD is introduced and include objectives for modules, for example as proposed in point 2 above (e.g., "air mass modification", ...)
- * spent (caption) - replace with less colloquial term
- * A-Train = NASA A-Train
- * What are "staples"?
- * Comment above suggest that we need a nomenclature of commonly flown modules. We often find "walls", "spirals", "parking garages" in the literature. If new terms are introduced here, explain them.

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p3,l3: "comparability" - This is not the translation for "Vergleichbarkeit" if that was the intent. "Comparability" would be understood as our ability to compare the data sets, but not how they actually compare.

p4,l9: numerous -> many

p6,l15: insert "of the sensor" between "heating" and "by"

p6,l26: Insufficient description how eddy covariance method would be implemented.

p6,l32-34: Run-on sentence, re-write

p7,l11: 12-15 nm: Is this sampling or resolution? If resolution, what is the sampling?

p7,l21: remain -> maintain

p8,l10: convoluted -> should this be "convolved"?

p8,l14: have been → were (multiple occurrences throughout document)

p9,l1-2: check language (punctuation, numerus)...

p9,l2: Why is the comparison limited to pitch/roll angle $< 2^\circ$?

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p9,l7: "less than 1%" This is a bit unclear. The deviation of SMART from Eagle is 0.02 at about 0.2 in radiance units (Fig 1e). Isn't that 10%?

p9, l33: The KT-19 is not a broadband radiometer - quite the opposite. Why is it in this section?

p10,l10: off nadir (along track backwards) is a bit contradictory. Is it along track or off-nadir? If off-nadir, why was it mounted in this way (25 deg off)?

p11,l8: "which successively stem from..." This is unclear. How is the frequency related to the "center of the emission line" and (supposedly) sensed atmospheric level. Isn't this rather a matter of atmospheric opacity (regardless of where the emission line center is located), which translates to the location of the weighting function maximum (in remote sensing terms)? I am probably getting this completely wrong based on the text provided.

p12,section 2.6: should be completely re-written, too many things are unclear. A sunspot is used for measuring solar radiation and solar irradiance? First off, what is the difference - does this refer to sky radiance vs. direct-beam radiance? The use of "solar" for a wavelength range (if that is the intent) is especially confusing here. How about shortwave, visible or near-infrared? Second, why do sunspots (as in the "sunspot cycle" matter here? Or is it literally a "spot of sunlight"? If so, please don't use that term, which is historically reserved for something else. Third, how can a diaphragm do the "focusing"? If anything, it will diffuse radiation, quite the opposite of focusing.

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p13,l19: Please describe the "Monte Carlo method" or cite paper.

p15,l9/10: Give some quantitative specifics on which parameters are provided for "sphericity", "shape" and "mesoscopic crystal complexity". Are all of these numbers? How can they be interpreted by the user? For example, does "shape" provide different information compared to "complexity"?

p15,section 3.1.4: What is the size range?

p16,figure 3: Does the MC correction just do the Mie correction as described, or does it also entail other standard correction as developed over the decades for single-droplet counters/sizers?

p17,l14 vs. l16: Throughout the manuscript, different values are stated for the upper size limit of the isokinetic inlet and the instruments behind it. While not contradictory, I recommend going through the paper again to make sure there's consistency.

p17: Why was no nephelometer flown? Seems standard equipment.

p17: Are all the aerosol size distributions "dry" or measured at ambient humidity (unlikely). Was $f(RH)$ measured (unlikely if no nephelometer was flown). Why is aerosol humidification considered irrelevant for this particular campaign?

p18: How do the rBC measurements by the SP-2 fit in with the rest of the aerosol measurements?

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p19,Table 3: Listing species is helpful, but doesn't per se allow attribution of aerosol type/source. How can the information from the different sensors (PSAP, neph if applicable, SP-2, mass spectrometer) be combined to retrieve broader aerosol typing? In isolation, the information provided here may not be helpful to the data user.

p19,l17: "Therefore" does not mean "Dafuer" Use "to that end" or "to achieve that" or "to do that"

p21,l16: "not detectable by the CVI" As written, this sentence suggests that under different circumstances (higher ice crystal concentrations), the CVI would be able to distinguish between crystals and droplets. But is that true?

p21,l26: "with respect to" -> "relative to"?

p21,l31: This begs the question what the detection limit of the instruments behind the counterflow impactor (or regular inlet) are...

p22,l1: "extend" -> "extent"

p22,l26: How does the transmission (=sampling efficiency?) fall off after 1 micron?

p24,l7: "loosing data" -> "losing data"

p24,l1: "aims to characterize" -> "aims at..."

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p24,l9: "exemplary" does not mean "beispielsweise" - it means "outstandingly good" (or sometimes "serving as a deterrent/bad example") - please revise unless you mean one of the two.

p24,l25: "rather" -> "more or less" ?

p25,l2: "out-side" -> "outside"

p25, section 4: This would be the opportunity to give some examples how the P5/P6 together achieve the general goals of the campaign, but this is only done in terms of instrument synergies, and not in terms of the fulfillment of mission requirements/goals. Of course, that would only be possible if those were stated at the beginning. I strongly recommend that the authors consider adding such a description as proposed in the general comments. The manuscript would benefit tremendously from that addition (IMO).

p27,Figure 8: There are not enough details provided. How about adding imagery for context, and a cross section of one of the short "fishbone" segments to allow the reader to see the vertical structure? How does the length of the short/long legs optimize the sampling / how does it fulfill mission requirements? This is very useful information for the reader.

Interactive comment on Earth Syst. Sci. Data Discuss., <https://doi.org/10.5194/essd-2019-96>, 2019.

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