Review of the Paper "A 10–year climatology of globally distributed ice cloud properties inferred from the CALIPSO observations" by H. Pan et al.

General comments

This paper analyzes a 10 year climatology of the spatial and temporal distributions of ice cloud fraction, ice water content, and ice cloud optical depth for sub-visual, thin, and opaque clouds, based upon the newly released CALIPSO level 3 data files.

Due to the concerns expressed in the Specific comments section of this review, the paper falls in the "Good" category. Revision is necessary prior to publication.

Specific comments

Though the calculations are useful, I do not know

a) How the calculations compare to previous published calculations, and
b) What is "new and innovative" in the results presented in the paper.

For these two reasons, the paper is problematic. The authors need to address these issues prior to acceptance of the paper.

In the Introduction (line 92, page 4) the authors state that previous studies (6 studies, see lines 89-90) "are not sufficient". Why are those papers "not sufficient"? What does the current paper achieve that was not achieved by previous papers? Please answer these questions without stating an unsubstantiated negative value judgement.

In the Summary and Conclusions section, there are no references to the previous literature. What are the commonalities (and differences) between the current calculations and the previous literature? Add a paragraph or two, with references, to address this concern in the Summary and Conclusions section.

Technical comments

Abstract, line 42: Change to "The latitude-and-altitude mean distributions of ICF and IWC were found to be unimodal in all seasons". I am not sure what unimodal refers to, either on line 42 or later in the text at lines 206 and 242. Please clarify. See comments below on lines 206-209.

The use of the phrase "On the other hand" is confusing, since it is commonly used to make a contrast, and the sentence if it is used in (line 42) does not make a contrast to the previous sentence.

Though the English in the text is generally good, there are several lines in the text which should be revised:

Line 47, page 2: change "strong convective activities" to "strong convective activity" This comment also applies to lines 192 and 213.

Line 111, page 5: change to the "A-train" constellation of satellites

Line 131-136, page 6: change to The Level 1 CALIOP data file contains 532 nm parallel-polarized and 532 nm perpendicular-polarized attenuated backscatter coefficients. The attenuated

backscatter coefficient at 1064 nm is also used to produce the level 2 data file products, given the CALIOP measurements and several algorithms.

In equation 2, line 165, on page 8: Why is the summation from 43 to 19 (with 43 below the $\sum$ symbol, instead of 19 to 43 with the 19 under the $\sum$ symbol?)

Line 167, page 8: What are the numerical ranges of IWCBB and IWCH?

Line 189, page 9: change to storm activity

Lines 206-209, page 10: change to coverage of ICF generally exhibited a vertical profile with a single peak, with the peak under the latitude-independent tropical tropopause altitude, followed by a peak decreasing in altitude steadily towards both the SH and NH polar regions.

When I first looked at Fig. 3, I asked myself the question: "Why are the nighttime ICF larger than the daytime values?" Though there is discussion later in the text (lines 248 and 373), it would be good to tell the reader that a discussion of this matter is discussed later in the text. Is the nighttime and daytime differences a measurement artifact or a cloud microphysics issue? Are nighttime temperatures less than daytime temperatures? Some reference to the previous literature would be helpful.

Line 228, Page 11: change to asymmetrical distributions.

For Figure 1, page 31, the color scale goes up to 0.5, while the data is mainly from 0 to 0.3. The authors should consider redoing the graph with a color scale from 0 to 0.3

For Figure 2, page 31, the color scale goes up to 0.01, while the data is mainly from 0 to 0005. The authors should consider redoing the graph with a color scale from 0 to 0.005

Line 232, page 11: Use the same g/m^3 units in the text as in Figure 5.

Line 235, page 11: I did not understand what the "spike-shaped structure" refers to. From previous CALIPSO papers, this structure is likely identified with a physical feature. Refer to the literature to make the structure less mysterious. (Is it related to the melting-band lidar backscatter feature, or something else?)

Line 238-240, page 11: The sentence is not clear. Please revise. The term "we excluded the maximum" is not clear.

Line 328, page 15: change to during night compared to day.

In Figure 8 (page 37), it may be better to graph

100 (# night observations – # day observations) / # night observations

instead of # night observations - # day observations.

Line 387, page 18: The phrase "the values of these parameters were obtained from the CALIPSO platform" implies that the RH and temperature profiles are measured by the CALIPSO experiment. It would be better to state that auxiliary files specify these profiles. Please specify the origin of the auxiliary files.

Line 388-389, page 18: change to Fig. 9 shows the 10-year global contour density plots of nighttime and daytime IWC, RH, and TE.

Line 443-446, page 20: Rephrase. See comment on lines 206-209.

Table 3. The numbers are too small. Expand the table into two parts to increase the font size.

1. Does the paper address relevant scientific questions within the scope of ACP? yes
2. Does the paper present novel concepts, ideas, tools, or data? No (the calculations are similar to those in many previous studies)
3. Are substantial conclusions reached? No
4. Are the scientific methods and assumptions valid and clearly outlined? Yes
5. Are the results sufficient to support the interpretations and conclusions? There are few interpretations and few conclusions that are new.
6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? Yes
7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? No (this is a major concern)
8. Does the title clearly reflect the contents of the paper? Yes
9. Does the abstract provide a concise and complete summary? Yes
10. Is the overall presentation well structured and clear? Yes
11. Is the language fluent and precise? There are several places in the text where the English could be improved.
12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? Mostly yes (the bounds of the sigma summation are odd)
13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? There are several places where clarifications are needed, and the fonts of Table 3 are too small.
14. Are the number and quality of references appropriate? Suggested additional paragraphs will introduce more references.
15. Is the amount and quality of supplementary material appropriate? Not relevant here.