Reviewer's comments on "A global survey of cloud overlap based on CALIPSO and CloudSat measurements" by Li et al., submitted to ACP:

General Comments

This paper mainly investigates the co-occurrence frequencies of different cloud types and their zonal and global distributions, analyzes their along-track horizontal scales and radiative effects, and evaluates the cloud overlap assumptions by using 4-year CloudSat 2B-CLDCLASS-Lidar and 2B-FLXHR-LIDAR data. The authors performed a thorough and detailed analysis, and some results may be useful for future model evaluation study and help to improve cloud parameterizations in current GCMs. However, there are too many descriptive statements of the figures without sufficient scientific discussions about the causal relationships, which largely weakened the scientific merits of the results. Besides, the wording and writing need substantial improvement. Currently it is very difficult to read through the paper because of grammar errors, typos, and many poorly structured sentences (see below for examples). Besides, some sentences are just simply repeated in the Conclusion section. I suggest the paper be carefully edited by the authors (or a professional English editor) before the final publication in ACP.

The specific comments are as follows:

Specific Comments

(1) The authors mentioned that the CloudSat and CALIPSO satellites provide 3-D structures of clouds on a global scale with high vertical resolution, but the analyses of geographical distributions were performed on 2-D maps, thus the useful vertical information is actually lost. It may be more interesting and useful to include the vertical distributions, which are the most significant advantages of these satellites compared to previous observations and studies. The authors did not explicitly explain how they calculated the global distribution maps, is it just for one layer or column integrated?

(2) Although the authors mentioned that the diurnal variations of cloud properties are referred as the differences between the two overpass times of CloudSat/CALIPSO, it is still not appropriate to use these data for the diurnal study due to the narrow swath and low signal-to-noise ratio during daytime. Moreover, deep convection and precipitation events occur most frequently in the late afternoon or early evening over land and could not be detected by

CloudSat, which may introduce bias to the statistics of some cloud types (e.g., deep convective cloud).

(3) In Table 5, the authors compared their results with previous results from other 3 datasets and claimed "reasonable agreement with at least one of the other datasets". However, the authors did not provide any quantitative comparison (e.g., percentage difference) or any statistical test, thus it is not quite convincing to the readers. I suggest remove this table and corresponding discussions.

(4) When considering cloud-overlap, the authors only discussed the overlap of 2 cloud types, what about 3 or more types overlap? In Fig.2, the authors divide the overlap into two groups, is there any reason for this?

(5) Section 4 is the most interesting and useful part of this study, but there are too many tedious statements and descriptions which blur the most important points. I suggest the authors add more discussion on how the evaluation of overlap assumptions could help improve future cloud parameterizations in GCMs and reduce the model uncertainties. One question is that GCMs do not provide so many different cloud types as ISCCP/CloudSat does, they generally divide clouds into stratiform and convective types, so how will your cloud overlap study benefit the cloud modeling community?

Technical corrections (far from exhaustive):

(1)   L29: evaluates

(2)   L32: preliminarily

(3)   L41: "contribution: 40%" refers to what?

(4)   L41: Spell out the acronym when it first appears in the context (e.g., TOA, CERES, etc).

(5)   L49: incorporating

(6)   L50: will possibly be able to

(7)   L51: a better prediction

(8)   L63: which is one of

(9)   L109: provides

(10)   L110: studying of

(11)   L111: delete "becoming available in"

(12)   L130: evaluation of

(13)   L139: add a comma after "cumulus"

(14)   L171: Following

(15)   L172: delete "level"

(16)   L193: delete "thus"

(17)   L208: when you calculate cloud fraction average, did you include clear-sky? It should be the total sample profiles.

(18)   L225: how did you calculate cloud fraction for multilayered clouds?

(19)   L328: Generally speaking

(20)   L357: I did not see STD in Fig. 4c-4d.

(21)   L370–372: "Although….However…", need to rewrite this sentence.

(22)   L379: contribute to

(23)   L449: differences

(24)   L470: "due to" change to "since"

(25)   L506–511: this sentence is too long, need to reconstruct.

(26)   L515: at all latitudes

(27)   L518: can work well

(28)   L552: mainly

(29)   L558: delete "or"

(30)   L574–575: this is a repeat of Line 106.

(31)   L581: "four different datasets"? Which four?