Comment on amt-2022-34

Anonymous Referee #1

Referee comment on "Locations for the best lidar view of mid-level and high clouds" by Matthias Tesche and Vincent Noel, Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-34-RC1, 2022

Evaluation of overall quality

This manuscript presents an investigation whereby the authors use primarily CALIPSO lidar data from six years to determine the ideal sites to observe altocumulus (Ai) and cirrus (Ci) clouds with a clear line of sight with ground-based lidar systems. However, due to its sun-synchronous orbit, CALIPSO only collects data at 0130 and 1330 local time. To determine the representativeness of Ai and Ci data collected from CALIPSO, these data were compared to International Space Station-based, CATS lidar system, which collects data throughout the diurnal cycle. Results from these analysis found that CALIPSO nighttime observations were representative for at least the first 9 hours of the day and the afternoon observation is able to capture the period with the greatest anomaly, which is much more pronounced when observing the diurnal variability of cirrus clouds. The authors demonstration that when averaged overall times the global distribution of cirrus and altocumulus clouds derived from CATS and CALIPSO qualitatively compare well, despite both CALIPSO and CATS not including the same analysis period. The resultant maps of location siting for cirrus and altostratus observations is both useful and relevant, but its utility toward shorter term field campaign studies is limited because the shown maps lack any seasonality, which would be crucial for field campaign planning. In addition, the original manuscript was riddled with grammatical errors and the overall tone was at times colloquial. However, I do feel that this manuscript does fit within the mission of AMT and I would recommend the paper for publications following major revisions.

Specific Comments/Questions

Major:

- The scientific relevance and utility of this manuscript lies in ability to show the best locations to deploy ground based instruments to monitor altocumulus and cirrus clouds with an emphasis on both field campaigns and multi-year observation sites based upon 6 years worth of CALIPSO data. However, the focus on field campaigns that may last a few weeks to a couple of months, which I strongly believe demands that the authors also address the seasonality of their results. I would expect that the best study regions will shift following the season cycle and the associated shift in storm track and seasonal weather patterns, such as the monsoon. To address this concern, I feel that the authors need to generate a version of Figure 9 for all four seasons and include these in the manuscript as additional figure.

Minor:

- Were cloud aerosol determination confidence score also applied to filter CALIPSO and CATS data for problematic data points?

Excerpt from CALIPSO User's Guide

Cloud / Aerosol

For cloud and aerosol layers, feature type QA is directly related to the cloud-aerosol discrimination (CAD) score, as follows:

high confidence = $|CAD\ score| \geq 70$

medium confidence = $50 \leq |CAD\ score| < 70$

low confidence = $20 \leq |CAD\ score| < 50$

no confidence   = |CAD score| < 20

- Were the cloud feature sub-type identifications used to denote cirrus, altostratus, and other cloud types?

I think that such details need to be clearly identified in the CALIPSO data and methodology section and doing would help clarify the authors assumptions and help establish any potential limitations to study's results. While QA filtering was applied (only values larger than 5 are included), I personally feel it might also be helpful to also filter by the CAD score too to increase cloud identification confidence, which is vital for the aims of this manuscript.

- Why are CALIPSO data retrieved only for years 2011, 2012, 2015, 2018, and 2019? On the surface, this selection of years comes across as somewhat arbitrary, especially given both the lack of any clear rationale provided by the authors.
- For Figure A1, I would suggest adding a panel C where the CALIPSO and CATS cloud fraction are differenced. Although these data look similar, I think it would be of interests to reader to be readily able to identify where CATS and CALIPSO cloud fractions vary and by how much.
- When comparing CATS and CALIPSO in Appendix A, the authors hypothesize that "noise induced from the decreased amount of grid boxes for deriving the values is likely to affect the comparison". While this is certainly plausible, I believe it would be insightful to at least qualitatively map out this noise in both I believe this would best be accomplished via a figure showing interquartile range as a function of latitude. If the noise is indeed a root cause, I would expect the CATS data to have a wider interquartile range.
- In Figures A2 and A4, it is clearly see that the latitudinal variability in varies little between CATS and CALIPSO. CATS however has a persistent low bias in cloud fraction near the cloud fraction maximum. Can this be explained by noise or is there something else possibly afoot. Personally, I agree with the authors assertion that CATS and CALIPSO both compare well, but I think it would be useful to include a sentence or two highlighting what might be behind these differences in cloud fraction at high altitudes for both cloud types. This suggestion is optional.
- Diurnal variability analysis in section 3.3. is slightly problematic because CALIPSO and CATS comparison is not for the same time period. Figures 1A and 4A, as described in the methodology, specify CALIPSO data was collected from the years 2011, 2012, 2015, 2018, and 2019 (Figures 1A and 4A), whereas the CATS cloud fraction plots (Figures 7A and 8A) are created using 2015-2017 data. I would suggest generating cirrus and altocumulus cloud fraction plots from CALIPSO from the same period as CATS and add these to the appendix to remove any potential interannual variability complications from the analysis.

Technical Corrections

General comments:

- I found a number of grammatical and spelling issues in the manuscript (detailed below) and request that the authors carefully check for similar error when revising the manuscript with fresh eyes.
- Common spelling error. Please check to make sure all usages of the word "focussed" are replaced with "focused".
- Common grammatical error. Often the phrase "mid-level and high cloud" is used throughout the manuscript, which lacks parallelism. I would strongly advise modifying this phrase to read "mid- and high-level cloud". Doing this change removes any potential ambiguity.
- When using sentences that point to or contain references *:i.e.", and "e.g." these phrases should be segregated within rounded paratheses and not as part of the sentence, which grammatically is incorrect.
- Make sure figure caption labeling is consistent. For Figures 1 through 6, the letter (i.e., (a), (b), etc.) comes before what is described, whereas after Figure 7, the letters come after what is described. I would advise putting the letters prior to what they describe in the caption. Regardless, please to be consistent.
- Figure colorbar labels are a bit on the small side, especially from Figure 7 and onwards. I would advise making them larger.
- Please format Table 1 in a consistent and clear way. Please revise Table 1 to have the same alignment. I would also consider increasing the font size and adding commas to the numerical values to improve the legibility and interpretation.
- Figures 7 and 8, the "local time" X-axis label in panel C should be removed.
- Line 212, misleading statement. CATS has a cloud flag (as in there is or is not a cloud), yet it lacks the cloud sub-type flag that CALIPSO has to specific transparent cirrus and other cloud types. Please correct this sentence to reflect this.

Specific comments:

- Page 1, line 3: grammar error, please add "the" before "ground"
- Page 1, line 7: typo, "focused" is misspelled
- Page 1, line 7: grammar error, please modify "mid-level or high" to "mid- or high-level" for parallelism
- Page 1, line 16: grammar error, please add "the" before "ground"
- Page 1, line 18: grammar error, please replace "–" with ",'
- Page 1, line 20: grammar error, need to either enclose references in rounded parentheses or include the phrase "including" or "such as" before "Platt".
- Page 2, line 26: grammar error, please add a hyphen between ice and nucleating
- Page 2, line 26: grammar error, please modify to read "They, therefore, mark"

- Page 2, line 30: typo, "focused" is misspelled
- Page 2, line 33: grammar error, please remove comma after "ground"
- Page 2, line 59: typo, should read as "Level two CATS-ISS…."
- Page 3, line 62: grammar error, please remove comma after "cloud),"
- Page 3, line 77: spelling and grammar errors, please modify "The thus simplifies data set" to "This simplified dataset
- Page 3, line 81: grammar error, please add "the" between "without" and "interference"
- Page 4, lines 96-97: spelling error, please replace "Over water" with "Overwater"
- Page 4, line 97: spelling error, "Ocean" in Indian Ocean should be capitalized
- Page 4, line 98: spelling error, please replace "considerable" with "considerably"
- Page 4, line 101: grammar error, please remove "a" before "high"
- Page 3, line 103: grammar error, please add "the" before "ground"
- Page 3, line 105: grammar error, please replace "day and night" with "daytime and nighttime"
- Page 3, line 107: grammar error, please add "the" before "night"
- Page 3, line 109, grammar error, please add comma before "while"
- Page 3, line 111-112: grammar suggestion, I would suggest removing the phrase "by far". It reads as a little too informal as is and the data shown in Figure 3 show your observation quite clearly.
- Page 5, line 130: grammar error, please add "the" before "night"
- Page 5, line 136: spelling error, "Africa" is misspelled.
- Page 5, line 148: suggested correction, change "It is therefore" to "Therefore it is"
- Page 5, line 152: grammar error, please add a comma after "observations"
- Page 5, line 152: grammar error, please add an "A" before "much"
- Page 6, line 155: grammar error, please add a hyphen after "lower"
- Page 6, line 157: grammar error, please remove "–", and replace with a comma
- Page 6, line 167: grammar error, please change "lead" to "leads"
- Page 6, line 175: grammar error, please change, "is" to "are"
- Page 6, line 179: grammar error, please change, "this regions" to "these regions"
- Page 6, line 179: grammar error, please add commas before and after "for instance"
- Page 6, line 181: grammar error, please add a comma before the phrase "and the Caribbean"
- Page 6, line 188: grammar error, please add parenthesis around the references, (e.g., …. (2010). Phases containing "i.e" and "e.g" should be contained within rounded paratheses and not directly as part of the sentence.
- Page 7, line 199: typo, "statistical" is misspelled.
- Page 7, line 202: grammar error, please add a hyphen between "polar" and "orbiting"
- Page 7, line 204: grammar error, grammar error, please modify "mid-level or high" to "mid- or high-level" for parallelism
- Page 7, line 218: grammar error, please add a comment after "day"
- Page 7, line 219: typo, "overland" is one word, not two, please correct
- Page 8, line 224: same issue as in specific comment 33, please revise
- Page 8, line 226: grammar error, please add a comma before "and"
- Page 8, line 233: grammar error, please add a comma after "site"
- Page 8, line 235: grammar error, please add parenthesis around the references, (e.g., …. (2010). Phases containing "i.e" and "e.g" should be contained within rounded paratheses and not directly as part of the sentence.
- Page 8, line 247: please remove comma and extra space after "and"
- Page 8, line 250: grammar error, please add parenthesis around the references, (e.g., …. (2010). Phases containing "i.e" and "e.g" should be contained within rounded paratheses and not directly as part of the sentence.
- Page 9, line 251: unclear antecedent, it is not clear as to what "This" refers to.
- Page 9, line 254: grammar error, please remove "–", and replace with a semi colon
- Page 9, line 256: typo, please add a hypen between "noise" and "induced"
- Page 9, line 257: typo, should be "an almost" rather than "in almost". Please revise
- Page 9, line 260: grammar error, please add parenthesis around the references, (e.g.,

…. (2010). Phases containing "i.e" and "e.g" should be contained within rounded paratheses and not directly as part of the sentence.

- Page 9, line 266: typo, should read as "Figure A2", please revise
- Page 9, line 266: suggested revision, I think the sentence reads more cleanly if the phase "as well as the zonal average of the fraction of isolated ice clouds as seen by CATS" has commas before and after
- Page 9, line 274: grammar error, please remove comma after "opaque"
- Page 9, line 281: typo, two periods after "CALIPSO"
- Page 9, line 282: typo, should read as "Figure A3", please revise
- Page 10, line 288: grammar error, please remove comma after "study"
- Page 10, line 291: typo, "Acknowledgments" is misspelled, please revise
- Page 16, Table 1: grammar error, please add "the" before "ground"
- Page 22, Figure 9: grammar error, please add parenthesis around the references, (e.g., …. (2010). Phases containing "i.e" and "e.g" should be contained within rounded paratheses and not directly as part of the sentence.