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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The diurnal cycle of cloud profiles over land and ocean between 51 S and 51 N, seen by the CATS spaceborne lidar from the International Space Station" *by* Vincent Noel et al.

Anonymous Referee #2

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Review "The diurnal cycle of cloud profiles over land and ocean between 51°S and 51°N, seen by the CATS spaceborne lidar from the International Space Station" by Noel et al.

By using CATS measurement, the paper presents a first land-ocean contrast of cloud diurnal cycle. Results are very useful. However, there are many uncertainties associated with CATS data for diurnal cloud studies, which need to be clearly discussed. I suggest the paper for publication after the following comments are properly addressed.

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Discussion paper

Major issues:

1. There are many challenges in using CATS data to study diurnal cloud cycle. First, it is linked with space lidar observations itself. Although several points (day-night solar background difference, attenuation of lidar signal by upper and middle clouds) are touched in the paper, they are needed to be clearly presented and quantified. Results discussions need to consider these uncertainties.

2. It needs to be very clear that CATS from ISS don't provide exact diurnal cycle cloud observations as ground-based observations. Due to the nature of ISS orbit characters, you need to combine over a month-long measurements together to cover the diurnal cycle. So, composed the diurnal cycle include seasonal cloud variations. Although it is fine to perform the seasonal study as discussed in the paper, it is important to make readers aware of the nature of CATS diurnal cloud properties. Thus, related information needs to be added in the introduction or the method section.

3. One way to make these limitations well understood is by using ground-based observations to validate CATS results. Although there is one figure for this purpose, it is not enough. Tropical observations and over oceans are needed. ARM observations are available for the validations.

Minor issues

1. L23-24: change "high clouds maximum" to "high cloud thickness maximum." The interpretation of cloud thickness detected by a lidar has to consider cloud optical thickness.

2. Line 88-101: Some references are needed her to support the discussion. For example, the Fig. 9 of Wang and Sassen 2001, will support your middle latitude discussion.

Wang, Z., and K. Sassen, 2001: Cloud type and macrophysical property retrieval using multiple remote sensors. J. Appl. Meteor., 40, 1665-1682.

3. Line 106-107: There are many more important related papers should be cited than

your paper.

4. L165: "measured every 350m" not accurate. It is a 350 m average profile.

5. L 171: What is "L2O"?

6. L201-202: So you shouldn't use this site considering it data collection biases.

7. L273-274, "low clouds have their base below 4km ASL": Do you sure that you mean cloud base height here. If so, it does not make sense. First, it is almost impossible for you to detect the base of optically thick clouds. Assuming that you can detect, we refer clouds with the base higher than 2 km as middle-level clouds. Using top height will make more sense.

8. L308-308: Not necessarily true. How often do you detect low clouds below high clouds? Even if high cloud occurrences are high, they are not 100

9. L315-316: Solar-background variations need to be better quantified.

10. L336-346: To what extent, these variations are due to the lower daytime detection sensitivity, especially considering the contrast between N 30-50 with S30-50?

11. L368-374: The high occurrence of middle-level clouds are well documented by may early studies (Zhang et al. 2010; Sassen and Wang 2012, and other), which should be properly referenced.

Zhang, D., Z. Wang, and D. Liu (2010), A global view of midlevel liquid-layer topped stratiform cloud distribution and phase partition from CALIPSO and CloudSat measurements, J. Geophys. Res., 115, D00H13, doi:10.1029/2009JD012143.

Sassen, K. and Z. Wang, 2012: The Clouds of the Middle Troposphere: Composition, Radiative Impact, and Global Distribution, Surv Geophys (2012) 33:677-691,DOI 10.1007/s10712-011-9163-x

12. L411-473: This part of the discussion should occur early in the paper as validation

efforts.

13. L421-422: Considering the night time sampling biases, I don't think that you can trust this result.

14. L449-452: It will good to include a panel for SGP ground-based observation results here.

15. L484-487: In Fig. 5, why cloud top in Europe JJA is significantly lower than the other regions?

16. L522: Where is ISCCP data? Is there any reason not to plot it?

17. L539-541: This could also due to the different day-night cloud detection sensitivities between lidar and ISCCP passive measurements.

18. L574-579: You could try to use CALIOP 1064 only measurements to run the same detection to minimize the difference.

19. L585 "Cloud Fraction": either use CF or "cloud fraction".

20. Section 5: It will good to have some discussion on the potential limitations here.

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