

Reviewer #1 Comments

1. Eq. (11) on page 7: The cloud depth H (i.e., geometric thickness) is derived from cloud optical thickness and effective radius from the MODIS cloud product. I wonder if this formulation guarantees that the cloud bottom does not reach the ground level or does not provide such situations in practice.

In rare cases, the method for retrieving H described in the appendix results in a cloud depth that is greater than the cloud top height – that is, physically impossible. In these cases, we iteratively increase the value of the condensation rate (c) by 1% and re-compute H , repeating this process until we arrive at a value of H that is less than the cloud top height. We have added this explanation to the revised manuscript (Lines 416-418).

2. Lines 191-192 on page 8: As the MODIS product assumes the single-layer homogeneous cloud in the retrieval process, applying this assumption to vertically inhomogeneous clouds leads to a systematic bias in the retrieval products (i.e., t and re) due to vertically inhomogeneous microphysical properties (Platnick, 2000). Although these biases are small for adiabatic clouds (Saito et al., 2019), it would be good to mention this here.

This is a good point. We have mentioned this in Lines 193-196 and now cite both Platnick 2000 and Saito et al. 2019.

3. Line 239 on page 8: “estimates of estimates of” should be “estimates of.”

Fixed as suggested.

4. Line 281 on page 10: Figure 9a shows SW reflectance (true color), but the corresponding description indicates IR brightness temperature. Please clarify this.

The figure description should say true color reflectance. This has been corrected in the revised manuscript (Line 271).

5. Line 290-291 on page 10: “are some are some” should be “are some.”

Fixed as suggested.

Reviewer #2 Comments

Line 210: The SLNPW cloud fraction shown in Figure 3 represents the SLNPW cloud fraction of CloudSat pixels, not CALIOP or MODIS cloud fraction. The title of Figure 3 and the text in the manuscript could be modified to explicitly state that the cloud fractions of MODIS or CALIOP are CloudSat pixels-based cloud fractions. Additionally, including the actual MODIS and CALIOP SLNPW cloud fractions (or the total cloud fraction), would provide the reader with a comparison of MODIS and CALIOP cloud fractions to the CloudSat pixels-based cloud fraction.

This is a good clarification, and we have adjusted the text (Lines 210-211; 214-215) and the title of Figure 3 to clearly state that what is shown is the fraction of CloudSat pixels with clouds, not cloud fraction at CALIOP or MODIS resolution. Because the SLNPW classification as we have

defined it is only possible at the CloudSat pixel level, we have refrained from adding any additional plots of MODIS or CALIOP cloud fraction.

Line 258: The MODIS-based sub-adiabatic LWP estimations show a positive bias in Fig. 7 panel (d), which could be attributed to the COT biases in the MODIS observations. Perhaps the authors could elaborate on the criteria used to choose the best COT observations from MODIS (e.g., flags) and consider the solar zenith angle when choosing MODIS COT observations.

The LWP estimates (in panel b) are actually almost total unbiased with respect to the RVOD estimates. What panel (d) shows is that the MODIS-based maximum LWC (i.e., the LWC in the radar bin at or near the top of the cloud) is positively biased. This has to do with the tendency of the subadiabatic model to make clouds that are thinner (with a steeper growth rate in LWC) than those retrieved by RVOD, as discussed in Lines 259-264. Nevertheless, it is true that MODIS COT observations have been shown to be biased at high solar zenith angles. We plan to implement a correction for this (as suggested in Lebsock and Su 2014, doi: 10.1002/2014JD021568) in the next reprocessing of the algorithm. However, as the focus in this paper is on warm clouds, most of the pixels considered are at low latitudes and so any solar zenith angle effects are small.

Line 267: The title of Figure 8 panel (a) says it is MODIS True color, but the text states it is the 11um brightness temperature.

MODIS true color is correct. The figure description in the text (Line 271) has been updated.

Line 65: Is -> It

Fixed as suggested.