

Interactive comment on “Comparison of MODIS and VIIRS cloud properties with ARM ground-based observations over Finland” by Moa K. Sporre et al.

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This rather straightforward analysis compares CTH and LWP from satellite retrievals to similar quantities determined from radar and microwave radiometer (MWR) from the ARM AMF package in Finland. The nice part of this study is its straightforward approach that just reports the numbers. However, it makes a few errors in interpretation and should provide a more in-depth analysis of the results. Some general and specific recommendations/comments are given below. They should be addressed before publication.

1. There is no discussion of the uncertainties or biases in the surface data set. Because the surface data set the standards, we need to know how good they are.

C1

a. radar estimates of cloud top height might be pretty good for low water clouds, but how about cirrus or thick ice clouds with small crystals at cloud top. For thin cirrus, this could be answered if the surface lidar data are used to estimate cloud top. For thicker ice clouds, previous comparisons would be informative.

b. are there limitations to MWR retrievals such as effects of precipitation or thick clouds? any differences for supercooled clouds?

2. What is actually retrieved by the satellite? cloud top height or cloud radiating height? Might this influence the relationship between the radar and satellite data? Example reference: (Minnis et al. GRL, 2008)

3. A 2000-m bias might be a big deal for a low cloud at 1500 m, and not such a big deal for a cloud at 10 km. The heights should be analyzed separately for water and ice clouds.

4. The retrievals are highly sensitive to semi transparency of the clouds, especially cirrus. The results should be separated for optically thick and thin clouds ($COD < 3$) to provide more insight into the analysis.

Specific comments

pg. 3, line 19: "data is" should be "data are"

pg. 4, line 29: "monthly averaged lapse rates" should be "zonal monthly mean lapse rates over ocean"

pg. 6, line 4: "less" should be "fewer"

pg. 6, line 17: "is" should be "are"

pg. 6, line 27: "become" should be "becomes"

pg. 8, line 8: The VIIRS data still have some large underestimates. Need some qualification of what is meant.

C2

pg. 8, line 17: First clause of the sentence is awkward, please rewrite

pg. 9, line 17: C6 accounted for the degradation of the Terra calibration, but not the Aqua degradation that occurred after 2008 (Doelling et al. IEEE TGRS 2015). The C6 calibrations did not account for a fundamental difference of $\sim 1\%$ between Aqua and Terra that was present in C5 (Minnis et al. JAOT 2008; Dong et al. 2008). That difference will cause difference in optical depth between Terra and Aqua.

pg. 9, lines 19-20: The increase in maximum tau is unlikely to be an explanation for the difference. The maximum C6 LWP is 450 gm⁻². Assuming a relatively small Re of 10 μm would correspond to COD = 67.5. Perhaps, there are larger uncertainties in the MWR data or something else going on.

pg. 10, lines 1-3: The sentence suggests that the MODIS retrievals used by CERES are the same as those used in the present comparison. They are not. The CERES MODIS retrievals were done with different algorithms, those described in the reference, Minnis et al. (2011). Please clarify.

pg. 10, lines 6-7: First, the comparisons were performed over the Azores, not the Canaries. Second, the LWP difference is 13.5 gm⁻² if the larger satellite area is used, but the difference is -3.3 gm⁻² if only pixels over the site are used due to island effects, which make the large area averages unrepresentative of site. Are there any systematic spatial variations over the Finland site (on coast, on a hill, etc.)?

Last paragraph, section 4: It appears that for the present LWP comparisons, the C6 results are not any better than C5, maybe even slightly worse. But they are better over this site compared to other sites. Why? Any thoughts on that?

Tables: Why are median height differences used instead of mean heights? What are the means? If you report medians, then means should also be included.

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