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Atmospheric Measurement Techniques Discussions

Interactive comment on "Version 4 CALIPSO IIR ice and liquid water cloud microphysical properties, Part II: results over oceans" *by* Anne Garnier et al.

Anonymous Referee #4

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This is a review of the manuscript titled "Version 4 CALIPSO IIR ice and liquid water cloud microphysical properties, Part II: results over oceans" submitted to AMT by Garnier et al.

The manuscript is describes the updated version of the cloud retrieval products derived from the IIR instrument on CALIPSO. The manuscript is written well and contains some interesting results. However, as the paper aims to demonstrate the improved accuracy, some more comparisons with previously published results and some more discussion on the results is needed.

Some specific papers I suggest to reference are Kahn et al. (2018), King et al. (2013),

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Platnick et al. (2017) and Van Diedenhoven et al. (2020). Detailed references are below. Further specific comments are below.

Section 2: Please add a legend at panels c and d of Figure 1.

Section 3. Could you remind the reader what the ice model used for V3 was and also that change caused by the ice model are discussed in part I?

Section 3.4.1: Kahn et al. (2018) also found a similar difference in effective radius of semi-transparant and opaque clouds with similar, but slightly larger, sizes. For opaque cloud tops, the global statistics of Van Diedenhoven et al. (2020) show similar, but somewhat larger, mean effective sizes over ocean. Furthermore, King et al. 2013 and Platnick et al. (2017) show similar histograms with seemingly comparable results.

Section 3.4.2: I find Figure 9 interesting and strongly suggest to also include a similar figure with the opaque cloud results in the paper.

Kahn et al. (2018) find similar variations of effective radius with cloud temperature for transparent clouds.

For thick clouds, Van Diedenhoven et al. (2020) also show similar variations of effective radius with cloud temperature and find evidence that these size variations are related to variations in crystal growth rates. They also show a vertical variation of crystal shape, which may be consistent with the SCO fraction shown in the manuscript. Please show the statistics also for thick clouds and discuss how it compares to Kahn et al. (2018) and Van Diedenhoven et al. (2020).

Since both habit and size vary with temperature, it may be interesting to investigate how habit varies with size. Again, such results can be compared to Van Diedenhoven et al. (2020) for thick clouds. Note that this is just a suggestion.

Section 3.5: Van Diedenhoven et al. (2020) found a vertical variation in ice asymmetry parameter that leads to a high bias in MODIS collection 6 ice effective radius for warm clouds. This may partly explain the larger differences between MODIS and IIR for the

warmest ice cloud tops.

Section 4.3.1: King et al. (2013) and Platnick et al. (2017) show similar histograms for liquid cloud tops. Please discuss the comparison.

Section 4.3.2: Although I'm not aware of any other published statistics of liquid drop effective radius as a function of cloud top height for (near-) global clouds, I find the decrease of effective radius with decreasing cloud top temperature a bit surprising. I would expect an increase of effective radius as, under an adiabatic assumption, drops grow as the clouds deepen. I do notice that MODIS results in Fig. 16 show the same variation. Please add some discussion about this in the text. Some more discussion on how these results relate to other results would be good.

References:

Kahn, B. H., Takahashi, H., Stephens, G. L., Yue, Q., Delanoë, J., Manipon, G., et al. (2018). Ice cloud microphysical trends observed by the atmospheric infrared sounder. Atmospheric Chemistry and Physics, 18(14), 10,715–10,739. https://doi.org/10.5194/acpâĂŘ18âĂŘ10715âĂŘ2018

Platnick, S., Meyer, K. G., King, M. D., Wind, G., Amarasinghe, N., Marchant, B., et al. (2017). The MODIS cloud optical and microphysical products: Collection 6 updates and examples from Terra and Aqua. IEEE Transactions on Geoscience and Remote Sensing, 55(1), 502–525. https://doi.org/10.1109/TGRS.2016.2610522

King, M.d., S. Platnick, W. P. Menzel, S. A. Ackerman, and P. A. Hubanks, "Spatial and temporal distribution of clouds observed by MODIS onboard the terra and aqua satellites," IEEE Trans. Geosci. Remote Sens., vol. 51, no. 7, pp. 3826–3852, 2013.

Van Diedenhoven, B., A.S. Ackerman, A.M. Fridlind, B. Cairns, and J. Riedi, 2020: Global statistics of cloud top ice microphysical and optical properties. J. Geophys. Res. Atmos., 125, no. 6, e2019JD031811, doi:10.1029/2019JD031811.

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