

Comments on AMT manuscript (amt-2020-388) entitled
 “Version 4 CALIPSO IIR ice and liquid water cloud microphysical properties,
 Part II: results over oceans” by Anne Garnier, Jacques Pelon, Nicolas Pascal, Mark
 A. Vaughan, Philippe Dubuisson, Ping Yang, and David L. Mitchell.

This paper presents retrieval of cloud micro- and macro-physical properties over ocean using CALIOP Imaging Infrared Radiometer (IIR) Version 4 algorithm developed in Part I. It also shows the improvements over Version 3. However, there are several points to improve in the manuscript. The authors must revise their manuscript addressing my following specific comments.

Specific comments

1. On p. 4, Fig. 1: ‘Latitude (°C)’ should be ‘Latitude (°)’.
2. On p. 5, lines 141-143: the authors state, “South of - 36.7° and down to - 37.2°, the portion of this cloud which is used as an opaque reference between - 36.45° and - 36.7° is included in a single opaque cloud of top altitude equal to 11.5 km, which extends down to the southernmost latitudes.”. However, it seems to me that there is two-layer cloud between -36.7° and -37.2° in Fig. 1a. Why do the authors regard it as ‘a single opaque cloud’?
3. On p. 5, lines 155-157: the authors state, “In Fig. 1 we find cloud systems composed of ROI only (flag = 1), liquid water (WAT) only (flag = 2), ice and WAT (flag = 4), and some systems that include at least one layer of unknown phase (flag = 9).” ‘flag=4’ should be ‘flag=6’.
4. On p. 5, line 161: the authors state, “Effective emissivities in ST clouds vary between 0 and 0.9.”. However, there are negative emissivities around -36.5° in Fig. 1f.
5. On p. 6, lines 188-190: the authors state, “Scenes with only ST layers are spread into three main categories: only one layer, two vertically overlapping layers, and multi-layer configurations with two non-overlapping layers or more than two layers.”. What do you mean by ‘two non-overlapping layers’? Explain it briefly.
6. On p. 8, lines 238-240: the authors state, “Overcorrections combined with uncertainties cause an increase of the fraction samples with $\epsilon_{\text{eff},12} > 1$, from 3 % in V3 to 12 % in V4 at night, and from 1.2 to 3.3 % for daytime data.”. Does this sentence mean that V4 is worse than V3 in terms of overestimation of $\epsilon_{\text{eff},12}$?
7. On p. 9, lines 265-267: the authors state, “This indicates residual inter-channel biases smaller than 0.1 K in V4 according to the simulations shown in Fig. 1c of Part I, which is consistent with the residual inter-channel differences seen in clear sky conditions (Part I).” ‘Fig. 1c’ should be ‘Fig. 1b’.

8. On p. 10, Fig. 4(a) and 4(b): ‘color’ is red (~ 4) at $V3 \tau_{vis} = V4 \tau_{vis} = 1$ in the whole plots, whereas ‘color’ is green (~ 2) at $V3 \tau_{vis} = V4 \tau_{vis} = 1$ in the embedded small plots. Why are these colors different at the same point? This comment is also applied to around $V3 \tau_{vis} = V4 \tau_{vis} = 0$.
9. On p. 15, line 424: the authors state, “In this example, mean D_e increases from 17 μm at 185 K to 53 μm at 245 K.”. In comparison to Fig. 15 of Heymsfield and Iaquinta (2000), $D_e = 53 \mu\text{m}$ at 245 K is smaller than their observed ice crystal size around -35°C . How do the authors reconcile this difference?
10. On p. 18, Fig. 11(c) and 11(e): the same comment as the item #9 is applied to D_e around $T_r = 245 \text{ K}$. The authors’ retrieved D_e ’s are smaller than MODIS 2.1 D_e . Does this mean that the authors’ D_e ’s are underestimated at higher temperatures?
11. On p. 21, lines 574-576: the authors state, “Mean IIR D_e (Fig. 15b, red) increases steadily from 11 μm at 242 K to 18 μm at 270 K, while mean CALIOP particulate depolarization ratio (Fig. 15c) is constant and around 0.1.”. However, Many researchers (e.g., Curry 1986, Garrett and Hobbs 1995, Nicholls and Leighton 1986, Noonkester 1984, Slingo et al. 1982, Stephens and Platt 1987) reported that cloud droplet effective radius increases from cloud base to cloud top. How the authors reconcile Fig. 15b with the opposite observations.
12. On p. 23, Fig. 16: The same comment as the item #11 is applied to Fig. 16(c). In other words, dependence of D_e on temperature in Fig. 16(c) is opposite to the observed ones.

Technical corrections

1. On p. 8, lines 235-236: the authors state, “these corrections have no to little impact for ST clouds”. This sentence should be corrected.
2. On p. 17, lines 484-485: the authors state, “This could explain than IIR D_e is found...”. ‘than’ should be ‘that’ in this sentence.
3. On p. 27, line 759: the authors state, “in the 10-mm window region”. ‘10-mm’ should ‘10- μm ’ in this sentence.
4. On p. 28, line 778: ‘microphysics’ should be ‘Microphysics’.
5. On p. 29, line 852: ‘Minimis’ should be ‘Minnis’.

References

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