

Comments on AMT manuscript (amt-2020-387) entitled
 “Version 4 CALIPSO IIR ice and liquid water cloud microphysical properties,
 Part I: the retrieval algorithms” by Anne Garnier, Jacques Pelon, Nicolas Pascal,
 Mark A. Vaughan, Philippe Dubuisson, Ping Yang, and David L. Mitchell.

This paper presents retrieval algorithms of cloud micro- and macro-physical properties using Version 4 CALIOP Imaging Infrared Radiometer (IIR) data. 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, lines 124-126: the authors state, “A “Was_Cleared_Flag_1km” SDS is now available in the V4 IIR product, which reports the number of CALIOP single-shot clouds in the atmospheric column seen by the 1-km IIR pixel that were cleared from the 5-km layer products.” Spell out ‘SDS’.
2. On p. 5, Fig. 1b: at $\epsilon_{\text{eff},12} < \sim 0.4$, $dT_{k,BG} = 0.1$ K (red dashed line) deviates more from 0 than $dT_{k,BG} = 1$ K (black dashed line). This is opposite to what I expect. Why?
3. On p. 6, lines 211-212: the authors state, “Underestimating T_r (and therefore TOA T_{BB}) yields under-estimates in $\epsilon_{\text{eff},12}$ and the microphysical indices.” What is difference between ‘radiative temperature T_r ’ and ‘TOA T_{BB} ’?
4. On p. 7, lines 246-247: the authors state, “In contrast, the V3 median 10-12 and 08-12 inter-channels biases were up to - 0.7 K and - 1.8 K, respectively, at $IWVP = 5 \text{ g.m}^{-2}$.” ‘ 5 g.m^{-2} ’ should be ‘ 5 g.cm^{-2} ’.
5. On p. 8, lines 270-271: the authors state, “In V4, the mean absolute inter-channel differences are smaller than 0.1 K globally.”. What is the difference between ‘mean absolute inter-channel difference’ and ‘mean absolute deviation (MAD) of the differences between observed and computed brightness temperatures’ in Table 2?
6. Fig. 3(j) and Fig. 4(a): In summer, peak of V4 daytime (red) is more deviates more from 0 than peak of V3 daytime (red). Why?
7. On p. 14, lines 379-380: the authors state, “For daytime data, both T_r and T_m are lower in the apparent cloud than at night, and even below ($T_m > T_{\text{base}}$), which is at least in part due to the smaller daytime apparent thickness.”. However, for daytime data, both T_r and T_m are higher than at night in Fig. 7(c). How do you reconcile these opposite facts?

8. On p. 16, lines 431 and 435: ' $\beta_{12/k}$ ' should be ' $\beta_{\text{eff}12/k}$ '.
9. On p. 19, lines 493-494: the authors state, "For a given D_e , $\beta_{\text{eff}12/10}$ is notably larger when $N(D)_1$ is not modified (blue and red solid lines) than when $N(D)_1$ is forced to zero (blue and red dashed lines), because the presence of small particles in the unmodified PSD increases $\beta_{\text{eff}12/10}$ faster than D_e ." 'faster' should be rephrased.
10. On p. 22, Eq. (12): Define the IIR weighting function $WF_{\text{IIR}}(z)$ used in Eq. (12).
11. On p. 25, Eq. (A4): Define $\varepsilon_{12,x}$ and $\varepsilon_{k,x}$ used in Eq. (A4).

Technical corrections

1. On p. 8, line 252: the authors state, "Over-plotted in green in the median MERRA-2 surface temperature; (b): number of IIR pixels." 'in the median' should be 'is the median'.
2. On p. 28, line 748: the authors state, "in the 10-mm window region". '10-mm' should be '10- μm '.