

Comments on “Optimal estimation of cloud properties from thermal infrared observations with a combination of deep learning and radiative transfer simulation” by Huang et al. (AMT-2024-87) This manuscript introduces a cloud property retrieval method “OE-CNN-IR” by integrating the optimal estimation and machine-learning methods to effectively derive the COT, CER and CTH from passive satellite imagery. The method is suitable for both daytime and nighttime conditions. Validation results reveal that the OE-CNN-IR method outperforms stand-alone OE-IR method, especially for optically thick ice clouds. The topic is within the scope of Atmospheric Measurement Techniques. However, the results and discussions in the manuscript lacks rigor, especially for the evaluation and clarification on OE-CNN-IR and TIR-CNN. Specific comments are as follow.

Line 110: “one representative day each month” what I am concerned is that how the authors choose the representative day? And all the statistical evaluation in the manuscript was based on the 12-days data? That maybe not enough and unrepresentative.

Figure 4: from this figure, the author claimed that the performance of OE-CNN-IR is better than OE-IR, but at the same time, the difference is relatively small for most results with iterations of 0 (i.e., the priori from TIR-CNN) and iterations of 100 or more (i.e., the optimal estimation from OE-CNN-IR). So how to access the optimization or necessity of the new OE-CNN-IR algorithm, or whether the alone TIR-CNN algorithm is considered to be sufficient? Since figure 6 also reveals that the COT\CER\CTH derived form TIR-CNN appear to be closer to MODIS products.

Figure 5: the author’s illustration and results reflected from this figure are confusing. They claimed that the retrievals of OE-CNN-IR method align more closely with observations than TIR-CNN, which can be attributed to the OE iterations. However, the performance of OE-IR method is better than that of OE-CNN-IR method both in terms of RMSE and correlation coefficient. From my opinion, the comprehensive discussion combining radiation consistency with optical property evaluation (Figure 6) is more suitable.

Line 308-309: the performance of CER retrievals using the OE-IR method maybe not comparable to that of the OE-CNN-IR method. Please check.

Line 317: “using CNN-IR, OE-CNN-IR and OE-IR” change to “using TIR-CNN, OE-CNN-IR and OE-IR”.

For the retrieval method, it is unclear that the authors used all the nine IR bands (band 27 - 36) for cloud retrieval or only the three IR bands (band 29,31,32) discussed in section 3?

Figures 8/9: Compared to the difference between OE-CNN-IR and OE-IR, what I am interested in is the difference between TIR-CNN and OE-CNN-IR, as TIR-CNN retrievals seem to be closer to MYD06 from Figures 6 and 7.

There is no discussion of the cost function throughout the manuscript, whether all inversion can achieve successful convergence?