
Response to Anonymous referee #1

Comment:

Suggestions for revision or reasons for rejection
(visible to the public if the article is accepted and published)

The authors have made very careful and thoughtful revisions in response to the reviewers' comments and suggestions. I am largely satisfied with most of the modifications. My only remaining concern pertains to the issue of "Physical interpretability."

As noted in my first round of comments, neither the ~ 11 μm infrared window band nor the numerical ERA-5 temperature-humidity profiles provide direct information about cloud-top phase, particle size, or cloud optical thickness—they primarily constrain cloud-top height. While incorporating the ~ 6.7 μm infrared water vapor band may marginally improve cirrus cloud-top height retrieval, these parameters inherently lack sensitivity to cloud phase and microphysics.

In the revised manuscript, the authors configured three distinct input sets: (1) data including both 11 μm and 6.7 μm brightness temperatures together with the full ERA5 meteorological dataset; (2) data consisting solely of 11 μm and 6.7 μm brightness temperatures; and (3) data consisting solely of ERA5 meteorological fields. The experimental results merely demonstrate that using satellite infrared observations or ERA5 data alone yields inferior performance compared to combining both. However, this does not directly address the concern I raised.

After reading the revised version, I remain convinced that the proposed empirical relationships, trained on large datasets, constitute merely statistical correlations with tenuous physical connections. Nevertheless, recognizing that this is a common challenge inherent to AI-based algorithms, I do not believe it is reasonable to require an additional round of revision or to expect the authors to resolve a question that the broader research community may also struggle to answer conclusively.

In summary, I recommend that this manuscript be accepted for publication.

Response:

We sincerely appreciate the reviewer's patient and meticulous review. All the suggestions you have provided have significantly contributed to enhancing the quality of this manuscript. We concur with your aforementioned perspectives and anticipate that, with the ongoing advancement of deep learning interpretability, we will continue to develop more scientific and direct physical explanations for models.

Finally, we extend our heartfelt gratitude once again to the editor and reviewers for their valuable feedback and assistance.

Response to Anonymous referee #2

Comment:

I appreciate the authors' tremendous efforts in addressing the reviewers' questions and clarifying the context with additional analyses and reorganizations, particularly for more physical explanations in detail and global comparisons with the other datasets such as ISCCP and CLARA. I believe the manuscript has been significantly improved. Please find a few minor comments and suggestions below, which I hope will be helpful for further refinement.

Response:

We are deeply grateful to the editors and reviewers for their patient and meticulous review of our manuscript. We appreciate the reviewers' affirmation and encouragement of our work, and we will maintain a rigorous approach to address the remaining issues in the manuscript.

In our response, the reviewers' questions appear in black typeface, while our answers are uniformly presented in blue typeface. To facilitate comprehension, content quoted from the main text of the paper is rendered in blue italics. Finally, following each quotation, the relevant chapter and paragraph numbers are indicated in red typeface.

Comment 1:

Minor comments/suggestions:

Regarding Response 1: For more clarification, it should be clearly stated that the evaluation using MODIS and CALIPSO in this study has been done for optically thin clouds. Please add this to Abstract (lines 24-30) and Conclusion, as well as Response Figure 4 caption (e.g., ... CALIPSO/CALIOP "for optically thin clouds"). It should also be addressed as "optically" thin to distinguish from geometrically thin clouds. It will be good for other researchers to indicate/include potential plans regarding the overall limitations as already discussed in your response into Conclusion, including the possible improvements of the current evaluation and nighttime limitations.

Response 1:

We appreciate the reviewer's comments and agree that the modification regarding optically thin clouds is entirely reasonable. The term "optically thin cloud" provides a precise description that distinguishes it from geometrically thin clouds. Accordingly, we have revised the abstract, main text, figure captions, and conclusions to reflect this distinction. Additionally, the limitations of CALIOP's penetration capability—which currently enables evaluation only of optically thin clouds COT—and the absence of CER observations by CALIOP, as you noted, have been addressed in the future outlook section at the conclusion.

First is the abstract section:

"In addition, evaluation based on observations from the Cloud Profiling Radar and the Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) indicates that the DaYu-GCP products show reasonable day–night consistency for optically thin cloud." **(In section Abstract. line 30)**

The term "optically" has been annotated in the main text. The revised content is as follows:

"For the evaluation of COT, given that CALIOP cannot penetrate thick cloud layers, this assessment considered only optically thin cloud layers labeled as transparent in the CALIOP data

as ground-truth references. Correspondingly, within DaYu-GCP, only optically thin cloud regions with a thickness less than 5 were compared against CALIOP measurements.” (In section 3.4. Evaluation of DaYu-GCP with CALIOP official products line 332-334)

Regarding the modifications to the figure captions, additional revisions and clarifications have been made to Fig. 8 and Fig. 9. The following paragraph is the caption for Fig. 8:

“The accuracy of the DaYu-GCP (daytime and nighttime) was evaluated using data from the active sensors CALIPSO/CALIOP. (a) CLP accuracy. (b) The RMSE of CTH. (c) The RMSE of COT. The COT evaluation employs optically thin clouds labeled as “transparent” in CALIOP. The blue bar chart shows the model's daytime accuracy, and the yellow bar chart shows the model's nighttime accuracy.” (In Figure 8 line 340)

The following is the caption for Fig. 9:

“Annual evaluation results for MODIS and DaYu-GCP based on CALIOP standards. (a) Comparison of CLP accuracy. (b) Comparison of CTH RMSE. (c) Comparison of COT RMSE. The COT evaluation is restricted to optically thin clouds, defined as CALIOP “transparent” layers and MODIS clouds with COT < 5.” (In Figure 9 line 355)

As well as modifications to the conclusion:

“Compared with the CALIOP official products, the day–night Accuracy of CLP are 0.787 and 0.775, respectively; the day–night RMSE of CTH are 3.384 km and 3.568 km, and the day–night RMSE of COT are 2.836 and 3.002 for optically thin cloud. These results demonstrate reasonable day–night consistency of the product.” (In section Conclusion line 425)

The final conclusion section clearly outlines the current limitations:

“Furthermore, additional research is required in the future to explore how to enhance the data for cloud physical property products in the polar regions and continuously improve observational capabilities to obtain more reliable COT and CER products.” (In section Conclusion line 437)

Comment 2:

Abstract line 16-17: Clean up the repeated “therefore”, and please read the three sentences in lines 16-21 and rewrite them for clarification.

Response 2:

We appreciate the reviewers' careful reading and suggestions. We have also re-examined the relevant text and identified the issues. First, there are redundant conjunctions, and second, the descriptions contain redundant information. Our revised text is as follows:

“Clouds play a crucial role in the Earth's energy budget and the hydrological cycle. However, differences in the spatiotemporal resolution of satellite sensors and in retrieval algorithms lead to substantial heterogeneity among retrieved cloud products. This study is based on global geostationary satellite thermal infrared brightness temperature data from the Gridded Satellite (GridSat-B1) project and utilises the single-layer cloud retrieval model small attention-UNet (Cloud-SmaAtUNet) within the DaYu Cloud Analysis System (DaYu-CLAS). Using these data, we retrieved the first set of all-day Global Cloud physical properties Products (GCP), referred to as DaYu-GCP. This dataset achieves a temporal resolution of 3 h, a spatial resolution of 0.07°, and a temporal span of 23 years (2000–2022). The DaYu-GCP includes cloud phase (CLP), cloud top height (CTH), cloud optical thickness (COT), and cloud effective radius (CER), covering all regions between 70°S–70°N and 180°W–180°E.” (In section Abstract. line 15-24)

Comment 3:

In Abstract: "In addition, evaluation based on observations from the Cloud Profiling Radar and the Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) indicates that the DaYu-GCP products exhibit no significant day–night differences …" -> It might be revised slightly like "… shows reasonable day-night consistency for optically thin clouds …" if my understanding is correct here.

Response 3:

Thank you for your insightful suggestions. Your understanding is entirely correct. We have incorporated your recommendations into the manuscript, with the revised content addressed and presented in Response 1. The modified wording indeed achieves greater precision.

Comment 4:

In section 1 Introduction: "The National Oceanic and Atmospheric Administration (NOAA) Satellite CLOUD and Radiation Property retrieval System (SatCORPS)" -> It should be corrected. SatCORPS is NASA's product.

Response 4:

Thank you for your careful review. You are correct. This was a typographical error during the writing process. All other references to SatCORPS in the manuscript are accurate, such as the mention of NASA in Table 1. We have made the necessary corrections and thoroughly reviewed the remainder of the article to ensure no further errors of this sort.

Comment 5:

Line 90-94: Please include a reference for the DaYu Cloud Analysis System (publication or website link).

Response 5:

We appreciate the reviewers' comments. The publications and website link related to DaYu-CLAS have been cited in the article.

"Therefore, this study employs the single-layer cloud retrieval model—small attention-UNet (Cloud-SmaAtUNet)—within the DaYu CLOUD Analysis System (DaYu-CLAS) to develop an all-day Global Cloud physical properties Products (GCP) retrieval algorithm (DaYu-CLAS) (Zhao et al., 2023, 2024; Tong et al., 2023; J. Li et al., 2023). Further details about the DaYu-CLAS can be accessed at its project website: <https://fdu-crias.fudan.edu.cn/>." **(In section 1 Introduction. line 88-91)**

Comment 6:

New Figure 11: Remove the background colors if possible.

Response 6:

Thank you for the reviewer's suggestion. This may be a good idea, as the background color serves only to distinguish the northern and southern hemispheres and provides no additional information. Therefore, removing it will not affect readers' comprehension of the article. The revised Figure 11 is as follows:

