First and foremost, we would like to express our sincere gratitude to Luca Lelli, the anonymous reviewers, the editor, and the editorial support team for taking the time to review our manuscript and provide valuable feedback. The comments we received were extremely helpful in improving our manuscript, and we are very grateful for them. As outlined below, we have revised the manuscript based on the feedback. The reviewers' comments are copied below and shown in *italics*, while our responses and the corresponding text in the manuscript are shown in red and orange, respectively.

Response to the editorial support team

Regarding figures 3, 7: please ensure that the colour schemes used in your maps and charts allow readers with colour vision deficiencies to correctly interpret your findings. Please check your figures using the Coblis – Color Blindness Simulator (https://www.color-blindness.com/coblis-color-blindness-simulator/) and revise the colour schemes accordingly with the next file upload request.

Answer: In response to the comment, we updated the color scheme for Figures 3 and 4 (excluding Figure 3a) to the 'Scientific Color Maps' recommended on the AMT submission page (https://www.atmospheric-measurement-techniques.net/submission.html).We recognize that adjusting the color scheme of the RGB images in Figures 3a and 7 as well would also be preferable. However, since the values of the three channels are directly assigned to R, G, and B, we are unsure how to modify them to make them colorblind-friendly. Instead, we utilized the 'Coblis – Color Blindness Simulator' to confirm that the RGB images in Figures 3 and 7 can be correctly interpreted by readers with anomalous trichromacy.

Response to Anonymous Referee #5

This is a well-written comprehensive paper, presenting the use of O2-A band information for CBH/CGT and multiple cloud retrievals, which would be applicable to a few upcoming sensors. Below are just minor corrections and additions for clarification which would help improve the manuscript.

We would like to thank you very much for carefully reading our manuscript and providing us with valuable comments. We have revised our manuscript, by taking full account of the referee's suggestions. The original comments are copied below and shown in *italics*, while our responses and the corresponding text in the manuscript are shown in red and orange, respectively.

***Suggestions/comments**:*

Evaluations using ground, ship, and space-based observations are very impressive. Just for more completeness of the paper, especially for the regional or global analysis cases, intercomparisons with other satellite sensor cloud data like MODIS or Himawari (even a visual inspection on the general patterns) would be wonderful here, rather than just addressing the consistency or well-known cloud regimes with the sole SGLI products.

Section 5.2: I thank the authors for including this section which contains many answers about my questions and thoughts already. Looking forward to seeing your next research outcomes based on these perspectives.

Answer: As detailed in Section 2.1, the retrieval algorithm developed in this study is a coupling of two algorithms: (i) the four-channel algorithm (Kuji and Nakajima, 2001) using the VNIR, SWIR, TIR, and oxygen A-band channels, and (ii) a cloud phase retrieval algorithm using multiple SWIR channels (Nagao and Suzuki, 2021). As demonstrated in Nagao and Suzuki (2021), the algorithm of (ii) has already been evaluated through comparisons with MODIS and CALIOP. Therefore, this study focuses on the validation of CTH and CBH retrieved using the technique in (i) and compared these with measurements from ground-based and ship-borne ceilometers, as well as space-borne instruments, namely CALIOP and CloudSat/CPR, which are capable of measuring these cloud geometrical parameters. However, we agree that it is important to compare the cloud properties retrieved by our algorithm with the widely used products from MODIS and Himawari/AHI to enhance the reliability of our algorithm and to cross validate the cloud geometrical parameters inferred from multiple satellite measurements with passive

sensors. We will address this in future work.

Minor comments:

Line 50: It would be good to add "narrow" before nadir

Answer: We have added "narrow" and revised the sentence as follows:

[Section 1; Lines 49 - 50]

"Another limitation of these active sensors is that their measurements are constrained to narrow nadir views along the satellite's orbit."

Line 77-78: Remove CBH and CGT here from other fundamental properties

Answer: We have removed "CBH" and "CGT" and revised the sentence as follows:

[Section 1; Lines 85 - 87]

"Additionally, passive instruments designed for cloud remote sensing typically have multi-wavelength channels, allowing for the retrieval of other fundamental cloud properties, such as COT and CER"

Line 125: It is not very clear. Please rework on this sentence.

Answer: To clarify, we have revised the paragraph containing the sentence you mentioned as follows:

[Section 2.2.1; Lines 133 - 140]

"In the oxygen absorption channel, sunlight is significantly absorbed by the oxygen above the clouds before and after being reflected by the clouds on its path to the satellite. The TOA reflectivity in the oxygen absorption channel can be expressed with two additional parameters: CTH and the amount of oxygen above CTH. Conveniently, oxygen is well-mixed in the atmosphere, and its mixing ratio can be assumed to be globally constant and known. Thus, if the CTH (or cloud top pressure, equivalently) is given, the amount of oxygen above cloud can be immediately calculated. Therefore, when CGT~0, it is sufficient for parameterizing the TOA reflectance in the oxygen absorption channel to have CTH in addition to COT, CER, and cloud thermodynamic phase."

Figure 2 caption: TH0, TH1, FAI in Fig. 2 caption have ever defined somewhere?

Answer: We have added the explanations for these notations and revised the caption of Figure 2 as follows:
[Figure 2]
"…; θ_0, solar zenith angle; θ_1, sensor zenith angle; ϕ, relative azimuth angle."

Table 1: How to come up with Table 1 values?

Answer: The values in Table 1 were provided roughly based on cloud property products from other satellite observations, without overly constraining the solution space. For the optimal estimation method to be most effective, a prior distribution close to the true value should be used. However, since this is the first application of our algorithm to SGLI, we used a normal distribution with means of typical orders of magnitude and fairly large standard deviations to avoid excessive reliance on the prior distribution. To clarify these points, the following text has been added.
[Section 2.2.1; Lines 221 - 225]
"Note that the values in Table 1 could be assigned more appropriate prior distributions (mean, standard deviation, and even covariance) by using cloud property products from other satellite observations. However, since this is the first application of our algorithm to GCOM-C/SGLI, we used a normal distribution for simplicity with means of typical orders of magnitude and fairly large standard deviations to avoid excessive reliance on the prior distribution."

Line 206-207: This sentence leads to ask why for "rather than CBH". Just a slight revision could be done for clarification.

Answer: We revised the sentence as follows:
[Section 2.2.2; Lines 241 - 243]
"For VN9, we introduced cloud base pressure, which is more directly related to the amount of oxygen within clouds compared to CBH, as a new variable to account for oxygen absorption within clouds."

Line 208: Does it mean that this TIR region was missing in the original RTM?

Answer: Yes, the retrieval algorithm used in this study is an updated version from the cloud phase retrieval algorithm of Nagao and Suzuki (2021), which only uses wavelengths from the visible to shortwave infrared region and thus does not handle the TIR region. To retrieve CTH using TIR channels, this study additionally implemented radiative transfer computations in the TIR region, based on techniques from previous studies (e.g., Nakajima and Nakajima, 1995; Kawamoto et al., 2001).

Line 218: "TOA radiance product" means SGLI operational L1 data? Reference or data link?

Answer: The precise answer is "No". The GCOM-C mission provides Level 1B scene radiance products, but the radiance product used in this study is the "LTOA" radiance product defined as Level 2, which provides radiance data projected onto a sinusoidal tile. The data link is described in the "*Data availability*" section as follows:
"*Data availability.* The GCOM-C/SGLI products for top-of-atmosphere radiation, cloud flags, cloud properties, and land surface reflectance, referred to as LTOA, CLFG, CLPR, and RSRF products, respectively, are available online on the Globe Portal System (G-Portal) of JAXA (https://gportal.jaxa.jp)."

Line 218: "SGLI-measured refelctances and radiances -> Information specifically for which channels will be helpful.

Answer: The SGLI LTOA radiance product naturally includes top-of-atmosphere (TOA) radiance for all the SGLI spectral channels. On the other hand, the channels used in the retrieval algorithm for this study are described in Section 2.2.1 as follows:
[Section 2.2.1]
"In the analysis in Sects 3 and 4, we employed the seven SGLI channels, VN9 (763 nm), VN11 (868 nm), SW1 (1.05 μm), SW3 (1.63 μm), SW4 (2.21 μm), TI1 (10.8 μm), and TI2 (12.0 μm), to retrieve the five cloud properties."

Line 226-227: could you add a little bit more details about how to correct it, not just

added flags.

Answer: We have rephrased it as follows:
[Section 2.3; Lines 264 - 266]
"Notably, we effectively corrected for the impact of land and sea surface reflectance on the SGLI observed radiances in the manner described above. However, our algorithm did not explicitly account for the presence of sea ice over the ocean or its high reflectance."

Line 232: Add the MERRA-2 data source here or to the data availability section at the end.

Answer: We have added the following text in the Data availability section:
[Data availability]
"The Modern-Era Retrospective Analysis for Research and Applications Version 2 (MERRA-2) product are available online through the Goddard Earth Sciences Data and Information Services Center (http://disc.sci.gsfc.nasa.gov/mdisc/)."

Figure 3: Add the time to Fig. 3 caption

Answer: We have revised the caption as follows:
[Figure 3]
"…, observed at around 01:15 UTC (around 10:30 AM local sun time) on October 1, 2021."

Line 244: add 'RGB' color composite

Answer: We have added 'RGB' as follows:
[Section 3.1; Lines 288 - 289]
"Figure 3a shows an RGB color composite image"

Line 385: I understand the difficulties to obtain matchup data, but still 30 min average seems like quite a relaxed threshold.

Answer: To investigate the point the reviewer raised, Figure S3 is newly added and included in the supplemental material. This illustrates how the bias, RMSE, and correlation between CBHs from SGLI and ceilometer depend on (Δs, Δt). This figure demonstrates that the bias and RMSE worsen when Δt is set to less than 30 minutes. Additionally, it shows that the choice of (Δs < 4 km, Δt < 30 min) is not unique to minimize the bias and error; in other words, there are other combinations of values that may yield better agreement in CBH between SGLI and ceilometer.
Therefore, the following text have been added to the main text as well:
[Section 4.2; Lines 467 - 472]
"It should be emphasized that the thresholds (Δs, Δt) can influence the results in Fig. 6, but are not critical. Figure S3 in the supplementary material illustrates the dependence of bias, RMSE, and correlation coefficient between CBHs from SGLI and ceilometers on (Δs, Δt). It demonstrates that bias and RMSE worsen when Δt is set to shorter than 30 min. Additionally, it indicates that the choice of Δs < 4 km and Δt < 30 min is not the only method to minimize bias and error. In other words, there are alternative values for (Δs, Δt) that can yield better agreement in CBH between SGLI and ceilometer.
"

Line 507: remove "," after SGLI

Answer: We have removed ",".

Line 543: Maybe "Moreover" would be better, if the authors intended to address it is good to be sensitive to other cloud properties.

Answer: In accordance with the comment, the term "However" has been replaced with "Moreover" as follows:
"[Section 5.1; Lines 619 - 621]
The 763 nm channel, located within the oxygen A-band, can provide CBH and CGT through satellite-based passive remote sensing. Moreover, the challenge in utilizing the 763 nm channel is that it is sensitive not only to CBH and CGT but also to CTH and other cloud properties."

Line 566-567: "This underestimation of the CTH also suggests a systematic underestimation of the CGT by the SGLI. " Any suggestions or further thoughts for this?

Answer: The underestimation of the SGLI CGT was primarily attributed to the underestimation of CTH retrieved, rather than to errors in CBH retrieval. Meanwhile, the SGLI CTH showed good agreement with the MOD06 CTH, which is similarly derived from TIR measurements. This result underscores that the well-known and persistent issue of TIR-derived CTHs being systematically lower than those detected by CALIOP plays a critical role in CGT estimation when combining the 763 nm and TIR channels. To provide additional context, the following text has been added at the end of the paragraph containing the sentence you mentioned:

[Section 5.1; Lines 646 - 648]

"This result highlights the well-known and persistent issue that CTHs derived from TIR are systematically lower than those detected by CALIOP, underscoring its critical impact on CGT estimation when combining the 763 nm and TIR channels."

Line 596: the "current" CTH retrieval -> just for clarification

Answer: We have added "current" as follows:

[Section 5.2; Lines 674 - 675]

", and additional TIR channels cannot be added to improve the current CTH retrieval."