Referee: 2

We appreciate the Reviewer's insights and helpful comments/suggestions, which helped improve the scientific quality of our manuscript. Basically, we reflected all the comments and suggestions.

1. General comments

This paper presents an improvement of Yonsei Aerosol Retrieval (YAER) algorithm dedicated to the processing of the Geostationary Ocean Color Imager (GOCI) satellite data and its validation through the DRAGON-NE Asia campaign that took place in spring 2012. The second section of the paper is dedicated to the presentation of the GOCI YAER algorithm and its improvements. The cloud masking is performed by detecting spatial variability or high values of the reflectances. The number of remaining non-cloud pixels is used to determine the quality level of the retrievals, from 0 to 3.The turbid water areas are detected thanks to the difference of reflectivity at 660 nm. These regions are then considered as land areas in the data processing, where the minimum reflectivity technique over 30 days is used in order to retrieve the ground reflectance. LUT including 26 aerosol models are used with a radiative transfer model for the aerosols properties inversion, such as AOD, FMF, SSA, AE and the aerosol type (among six options). The third section presents briefly the results of GOCI YAER Â˘ afor two cases studies during the DRAGON-NE Asia 2012 campaign: a pollution haze and a dust case. The fourth section is about the evaluation of the GOCI YAER retrievals with AERONET measurements/inversions performed during the DRAGON-NE Asia 2012 campaign (40 Sun-photometers) and with MODIS (Dark Target over land and ocean and Deep Blue over land) in order for increasing the spatial coverage. A good agreement is found for AOD between GOCI and AERONET, especially when QA=3 flags are considered, and with MODIS for both DT and DB. The agreement is nevertheless slightly better with DB that uses also the minimum reflectance technique. GOCI is somehow limited by the absence of IR channels that does not permit an efficient clouds screening. For other retrievals, the validation with AERONET and MODIS is quite low, especially for low AOD in the case of AE, and prevents quantitative studies. The last section focuses on the error analysis of GOCI YAER AOD and reveals a bias of 0.1 for AOD<0.4 and large variability in the retrievals for AOD>0.9. Due to the minimum reflectivity technique in a 30 days window, the error in AOD is higher in areas covered by dense vegetation.

The paper presents an improvement of the data processing algorithm as well as the first GOCI retrievals since the algorithm has been previously developed with MODIS measurements. The scope, therefore innovative, is well-addressed. The paper is well written, the Figures of high quality, and the English is precise. I recommend it for publication after the authors respond to the few points listed hereafter.

2. Specific comments/questions

Following, some specific comments:

- 2.1: How the thresholds, of 0.4 for the reflectance and of 0.0025 for the variability, have been found?

Ans.) References were attached at lines 130 –lines 135 of the revised manuscript:

Cloud masking and quality assurance methods are based on the MODIS DT and DB aerosol retrieval algorithm. The 865 nm band for the test of standard deviation over land is changed to that of 550 nm according to the reference. The sentences have been revised as:

"1. ρ_{TOA}(490 nm) > 0.40 → cloud over land or ocean

2. Standard deviation of 3 × 3 pixels ρ_{TOA}(412 nm) > 0.0025 → cloud over land

Standard deviation of 3 × 3 pixels ρ_{TOA}(550 nm) > 0.0025 → cloud over ocean

3. ρ_{TOA}(412 nm) / ρ_{TOA}(660 nm) > 0.75 → Dust over ocean (not masked)

The standard deviation test over land is based on the MODIS DB algorithm (Hsu et al., 2004), and other tests are based on the MODIS DT algorithm (Remer et al., 2005)."

- 2.1, l15-17: How much residual clouds possibly remain at this step since. in Sec 2.3, the difference of reflectance at 660nm is used to detect remaining cloud-contaminated pixels?

Ans.) After the cloud masking step in 500 m × 500 m resolution, remaining pixels are combined in 6 km × 6 km resolution. The difference of reflectance at 660 nm ($\Delta\rho_{660}$) is calculated and used for turbid water detection. From the histogram analysis, pixels of $\Delta\rho_{660}$ above 0.02 corresponding to severely turbid water, and masked out as improper pixels for retrieval. In the scene analysis, however, some pixels for remaining cirrus clouds also show $\Delta\rho_{660}$ above 0.02. The average ratio of pixels of $\Delta\rho_{660}$ above 0.02 after cloud masking (presumed severe turbid water or remaining cloud) over total available ocean pixels is about 2 % during the campaign. Following sentence was inserted at lines 257 – lines 258 of the revised manuscript.

"The average ratio of pixels of $\Delta\rho_{660}$ above 0.02 after cloud masking over total available ocean pixels is about 2 % during the campaign."

- 2.2, l16- 17: Same as 2.1, how these thresholds of 1% and 3% have been calculated? (the following explanation of the 3%, l17-18, is not clear)

Ans.) Corresponding sentences at lines 167 –lines 178 of the revised manuscript were revised as below.

"According to Hsu et al. (2004), surface reflectance database can be obtained by finding the minimum value of the 412 nm RCR for a given month, which corresponds to about 3% for the window. In this process, cloud shadows which could lead to false reflectance should not be selected to evaluate surface reflectance. For example, Lee et al. (2010) selected the second minimum value, and Fukuda et al. (2013) used the modified minimum reflectance method using first and second minimum values to avoid cloud shadow effects for determining surface reflectance. In GOCI YAER algorithm, the maximum number of L1B pixel samples for one surface reflectance pixel at a given time is 144 pixels × 30 days, a total of 4,320 samples. Therefore, only first or second minimum threshold is not appropriate for GOCI YAER algorithm. Instead, darkest 0-1% pixels are assumed to be cloud shadow thus excluded, empirically. Therefore, threshold for the lower and upper bound are set as 1% and 3%, respectively."

- 2.4, l18: Why is it important to avoid the overlap between the climatology and the retrieval?

Ans.) It is not fair to use AERONET data for aerosol model construction and validation simultaneously. Global AERONET data are analyzed and used for aerosol model construction as "climatology", and DRAGON-NE Asia 2012 Campaign AERONET data are used for validation of GOCI YAER AOPs, which is referred as "retrieval" in the manuscript.

Some AERONET sites during the campaign are included in global AERONET sites, thus the period of data is separated to prevent duplicated usage of AERONET data. The phrase of "to avoid overlap between the period of climatology and retrieval" was revised as "to separate AERONET data usages for aerosol model construction and validation" at lines 271 – lines 272 of the revised manuscript for more proper explanation.

- 2.5, l12-13: At this step, is the AOD retrieved among the 9 values presented in the LUT?

Ans.) Sorry for confusing descriptions about inversion procedure. The following sentence was inserted at lines 308 – lines 312 of the revised manuscript.

"The inversion procedure to retrieve AOD is implemented using interpolation from pre-calculated TOA reflectance at LUT dimensions to observed TOA reflectance according to geometries (solar zenith angle, satellite zenith angle, and relative azimuth angle), assumed aerosol model, wavelength, surface reflectance, and terrain height."

- 4.3, from l10 p9580: does the QA of 3 have been selected for GOCI (and MODIS?) retrievals in the comparison with MODIS?

Ans.) Per your comments, we changed data of GOCI, MODIS DT, and MODIS DB with those of only QA of 3 in the revised manuscript.

- 4.3: the use of the same methodology for the surface reflectance calculation implies a better agreement in the retrievals. What about the inversion procedure? Does MODIS use similar LUT for the aerosol properties inversion?

Ans.) Following sentences were inserted at lines 464 – lines 482 of the revised manuscript.

"Although the surface reflectance calculation of GOCI YAER algorithm is not exactly the same as that of MODIS DB algorithm, the methodology of GOCI YAER algorithm is closer with MODIS DB than MODIS DT. Pre-calculated surface reflectance database is applied over Arid-/Semi-arid surfaces, which has been used in previous MODIS DB algorithm (Hsu et al., 2004, 2006) and enhanced MODIS DB algorithm (Hsu et al., 2013). However, enhanced MODIS DB algorithm used in this study for validation adopts three different methods according to land surface types. Over vegetated land surface, it takes the spectral relationship in surface reflectance between visible and longer wavelengths, which is used in the MODIS DT algorithm. Over urban /built-up and transitional regions, a hybrid approach is applied by combining the Deep Blue surface database with the angular shapes of surface BRDF. Aerosol model constructions of three algorithms are similar as the model considers fine/coarse and absorbing/non-absorbing characteristics. But the MODIS DB uses reflectance at 412 nm for retrieval, similar with GOCI, but MODIS DT does not. Inversion procedures of three algorithms are not significantly different. Both MODIS DT and DB retrieve spectral AODs (470 and 660 nm for DT; 412, 470, and 660 nm of DB) and interpolated to the AOD at 550 nm. But GOCI YAER algorithm retrieves AOD at 550 nm directly from other channels reflectance. Hence, the tendency and accuracy of retrieved AOD from GOCI are closer to MODIS DB than DT."

- 5: the growth of the vegetation seem to be a crucial point in the retrievals when using the minimum reflectivity technique. It is mentioned also that some AERONET stations are located on mountains and could lead to lower AODs when compared to the GOCI one. If I understand clearly the AOD retrieved by GOCI is above sea level, and not above ground level. In this case, these stations should be filtered from the error analysis, thanks to the altitude of the instruments, in order to isolate the vegetation effect. What would be the cost of adding the altitude of the surface in the LUT?

Ans.) Sorry for confusing descriptions about possible error at high NDVI. The altitudes of the surface in the LUT are two points at 0 and 5 km, and pressure-considered interpolation to the surface elevation of GOCI observation area is done for retrieval so that GOCI YAER algorithm retrieves AOPs above ground level, not above sea level. Following sentences were inserted at lines 624 – lines 628 of the revised manuscript.

"Because aerosol concentration decreases exponentially as altitude increases generally, any GOCI retrievals made over the hills or mountains will have lower AOD than the values located in the valley or at low altitude level area. NDVI is largest over the forested mountain slopes which extend to the upper part of the aerosol layer, therefore the GOCI retrievals are underestimated as NDVI increases.

3. Technical corrections

No major technical correction have been found: 2.4, l19-20: adding a coma could facilitate the understanding of the sentence: "10 times, giving"

Ans.) A coma was inserted as your comment at lines 273 of the revised manuscript.

References used in this response.

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Ishida, H.: New approaches to removing cloud shadows and evaluating the 380 nm surface reflectance for improved aerosol optical thickness retrievals from the GOSAT/TANSO-Cloud and Aerosol Imager, Journal of Geophysical Research: Atmospheres, 118, 13520-13531, 2013.

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