

# ***Interactive comment on* “Evaluation of the operational Aerosol Layer Height retrieval algorithm for Sentinel-5 Precursor: application to O<sub>2</sub> A band observations from GOME-2A” by A. F. J. Sanders**

## **Anonymous Referee #1**

Received and published: 4 August 2015

The proposed manuscript presents sensitivity study of aerosol height retrieval as changing aerosol and surface optical properties from radiative transfer model simulation and optimal fitting method. In addition, the model results adopts to the GOME-2A sensors with comparison case study by using ground-based lidar and CALIOP. The text is well written except some paragraphs. However, it needs more explanation for the sensitivity test results.

This study considered the surface and aerosol properties by adopting the parame-

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ters for fitting. As the theoretical background of possibility for the aerosol layer height retrieval, this manuscript shows spectral feature difference between finite differences of aerosol and surface optical properties and those of aerosol layer height. However, some contradictions are found during explanation of fitting method. In detail, the manuscript in Section 2 described that surface albedo, aerosol optical depth (AOD) and aerosol model (i.e. aerosol size parameter and single scattering albedo) did not use precise and accurate models, which means these parameter roughly assumed. Otherwise, the article in Section 5.2 explained that individual a-priori information for aerosol properties are necessary for the inversion process.

In addition, the feature of spectral sensitivity difference is one of theoretical basis of this study, and front of this manuscript showed that the sensitivity tests of spectral feature is necessary. But this manuscript did not include sufficient sensitivity test of various spectral feature of aerosol parameters: i.e. this manuscript will complement theoretical tests as changing spectral feature change in O2-A band as a function of other aerosol optical properties.

Finally, the aerosol layer mid pressures have realistic values when not fitting the surface albedo than fitting surface albedo on the case study as showing in Section 6's conclusion. However, this Section also showed that successfully estimated pixel number is larger when fitting surface albedo than when no-fitting. This is also need to explain the detailed reason.

In summary, this paper additionally includes in the revisions as below :

- Additional sensitivity test as changing aerosol optical and physical properties including spectral feature studies (make some figures as similar to Fig.1)
- Supplement the explanation of discrepancy between conclusions about sensitivity tests and results of case studies.
- Supplement the explanation of case study analysis

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Some detailed comments are listed below, and I suggest that the answer of suggestions would follow after revision.

#### General Comments:

Section 2: For the fitting procedure, the surface albedo consideration will improve and be stabilize the aerosol layer height retrieval. Does this improvement only correspond in aerosol height retrieval? Does the fitting method in this paper not able to estimate accurate AOD and surface albedo value simultaneously? As see in Fig. 7, AOD value is drastically chaged by adopting fitting method.

Section 4: For cloud masking method, this paper used AVHRR data and estimate geological cloud fraction by '(number of AVHRR-cloud pixel)/ (number of total AVHRR pixel)' in GOME-2A GSD pixel. However, overpass time difference between GOME-2A and AVHRR makes error of cloud fraction determination. (I think that the cloud fraction error will significantly negligible if overpass time difference has less than 30 minutes.) If overpass time difference time is large, I suggest that the domain of AVHRR pixel will be widen, or the supplements of pixel selection will be added in the manuscript if you have an idea.

Table 5 : What is exact meaning of 'varying' in the a-priori value of aerosol parameters? Please specify the 'varying' parameter. (e.g., Aerosol layer mid pressure uses 'specific' vertical distribution data from 'specific platform'...)

P6067, L18-19: Please add the explanation why the estimation error in case study is larger than expected error from simulation.

P6067, L20-24: The result is not consist. Focusing on the aerosol layer mid pressure value, the method without surface albedo fitting is realistic. Otherwise the number of successly estimated pixel is relatively small as compared to fitting with surface albedo.

P6067, L26-27: This sentense also concluded that the phase function of aerosol affects aerosol layer mid pressure retrieval. In other words, accurate aerosol optical and

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physical property model is important factor for aerosol height retrieval. This is inconsistent with the assumption of theoretical sensitivity analysis in Section 2. If aerosol property significantly affects aerosol height retrieval from observation, the sensitivity test for aerosol height retrieval additionally executed as changing other aerosol parameters, such as aerosol single scattering albedo, or types etc.

P6068, L14: How much different of overpass time between Metop-A and Terra? Is overpass time difference sensitive for aerosol comparison? Please add some references related to this issue.

- For the sensitivity test, this paper described the effect of surface, aerosol properties, background information (i.e. temperature profiles and gas cross sections) and sensor characteristics, such as stray light. However, hyperspectral sensor also sensitive to the spectral calibration condition. If possible, please add the sensitivity of spectral calibration error.

Other comments: Section 1: To add the aerosol height study, please add the reference about guideline for aerosol height accuracy, such as Fishman et al. (2012).

Fishman, J., et al. "The United States' next generation of atmospheric composition and coastal ecosystem measurements: NASA's Geostationary Coastal and Air Pollution Events (GEO-CAPE) mission." *Bulletin of the American Meteorological Society* 93.10 (2012): 1547-1566.

P6048, L12 : Please express the example of 'asymptotic solutions'.

P6048, L27 : Move to the full-name of 'GOME' to L16 in 'GOME-2A'.

P6048, L9-13 : To clarify the meaning, please rewrite the sentence of 'Because of the latter~cannot be used in case of aerosol retrieval'.

P6051, L12 : Please explain the meaning of 'fixed pressure thickness'

Fig. 7: For the consistency of figure format, please re-draw these two figures in Fig. 7.

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Please includes the result of  $r$ ,  $p$ , number of data in revised two figures.

- Please use abbreviation of 'aerosol optical thickness' and ' aerosol layer mid pressure' in the manuscript.

- Please add the reason why use the Henyey-Greenstein phase function for aerosol size parameter.

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Interactive comment on Atmos. Meas. Tech. Discuss., 8, 6045, 2015.

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