

The authors developed an operational algorithm to retrieve the aerosol effective height (AEH) using the slant column density of the oxygen dimer (O₂-O₂) at 477 nm from the Geostationary Environment Monitoring Spectrometer (GEMS). This algorithm was applied in GEMS observation domain from January to June 2021 and provided important aerosol vertical height information for severe dust plumes over East Asia and anthropogenic aerosol pollutants over India. GEMS AEH product was also compared with CALIOP and TROPOMI aerosol layer height in this study. Although this product provides important data source for diurnal variation of aerosol vertical distribution information and deserves to be published, there are many unclear descriptions in the manuscript and the presentation quality, especially the English writing style needs to be improved. The detailed comments are as follows:

1. Line 72: "Because cloud optical properties are relatively simple" is mentioned here. I don't think "simple" is an accurate description. The cloud optical properties also depend on droplet size, cloud phase, etc. This sentence needs to be re-worded to better describe the distinctions between cloud and aerosol optical properties.
2. Line 81-90: The objective of this paragraph is not clear. The aerosols vertical distribution retrievals from multiple sensors have been introduced in last paragraph. Then, at the beginning of this paragraph, the satellite retrieval of aerosols properties were introduced. Later on, TROPOMI aerosol layer height retrieval was mentioned again. I think it's better to move this introduction to the above paragraph and the connection between these paragraphs needs to be improved. It is not smooth for the readers.
3. Introduction: I suggest to add some introduction about the AEH or ALH, since that is the single parameter to describe the aerosol vertical profiles, differing from measurements of lidar.
4. Line 122-123: The definition of AEH described here is hard to understand. Think about rewording this sentence.
5. Line 128-130: I think a figure showing the different values of AEH, peak height and top height for the same GDF aerosol profile will help demonstrate the conclusion here.
6. Figure 1: There is a repeated box for "simulated radiance" in the flowchart.
7. Section 2: I think some descriptions about DOAS fitting are needed here. Although it may have been introduced in the previous paper (Park et al., 2016), it becomes hard for the readers to follow the details related to DOAS fitting, such as Table 1. I don't understand what the fitting parameters mean and which parameters represent setting information, similar as the information about polynomial orders and offset in Table 2.
8. Line 203-204: I don't think the "optical reflection" is a professional description here and I don't understand why it is large for absorbing aerosols.

9. Table 3: The AOD and imaginary refractive index are both at 440 nm in this table, but the retrieval band used is 477 nm. Is the wavelength dependence considered when creating the look-up-table? If so, how to convert from 440 nm to 477 nm? If not, this needs to be emphasized in the manuscript.
10. Line 256-257: The "insignificant diurnal variation" is mentioned here. I don't know how many kilometers the diurnal variation is and why it is not significant.
11. Figure 2: Add the CALIOP tracks used in later analysis in the map here, and also in Figure 5.
12. Line 280-282: How is the "0.5 km" overestimation in an ideal case concluded?
13. Figure 4: When comparing GEMS AEH with CALIOP, I notice that for the same CALIOP AEH, the GEMS AEH shows large variation. For example, for those pixels with 2 km AEH from CALIOP, the GEMS AEH changes from 0.2 km to 5 km. What is the reason for this phenomenon? Maybe adding figures showing CALIOP aerosol extinction profiles helps. How is the correlation between CALIOP and GEMS AEH? What do the black dots and error bars in panel (b) represent?