Thanks so much for the valuable comments. The responses are in situ.

The paper presents a novel method for aerosol optical depth retrieval from observations performed by the sensor Meteosat Second Generation – Spinning Enhanced Visible and Infrared Images (MSG/SEVIRI). Meteosat Second Generation – Spinning Enhanced Visible and Infrared Images (MSG/SEVIRI) provides high-temporary with multi-spectral dataset, however, there are not many Aerosol Optical Depth (AOD) retrieval method for such a good dataset, especially for 15 minutes AOD product. In the proposed method authors predefine six aerosol types (including both spherical and non-spherical types), solving a set of differential equations in the application to short wave radiation transfer reaching finally to a relationship between the ground surface reflectance and apparent reflectance.

Although the plane parallel radiative transfer employed restricts the solar zenith angle range and the predefined aerosol types do not cover all the natural and anthropogenic sources (e.g. biomass burning) the results obtained for the aerosol optical depth retrieval and analysis show promising. I recommend acceptance after the suggested revision.

Specific comments
(1) Sensitivity study is needed for the analytical solution;
Reply: Generally speaking, TOA reflectance increase with the aerosol load over a dark surface while over a bright surface increasing aerosol load would cause darkening of the scene at visible band. There is a critical reflectance divide the positive effect and negative effect of aerosol and during a certain range of this critical reflectance, the algorithm is insensitive to AOD. In Fig. 1, TOA takes values of 0.0 to 1.0. SZA takes two different values of 30° and 65°. From Fig.1, we can see that the TOA critical reflectance is around 0.5 when SZA = 30° and 0.6 while SZA = 65°. It is obvious that the AOD sensitivity (the gradient in the graph) depends strongly on surface and it decrease with increasing reflectance while the reflectance smaller than critical reflectance, it is opposite while reflectance larger than critical reflectance. Fig. 1 also shows that the analytical solution is more efficient for surface reflectance less than critical reflectance. Fig. 2 demonstrates the estimations of the analytical solution errors obtained by comparison with Second Simulation of the Satellite signal in the Solar Spectrum (6S) computations for different solar zenith angles with two different aerosol types (continental and neutral). Here the reflectance equal to 0.3 (very bright surface). From the data, it follows that the errors of the analytical solution may overestimate for continental type and underestimate for neutral type. We can find that the absolute error do not exceed 15% compared with 6S (except for neutral type with large AOD). For the continental type, we can also find that the errors do not exceed 10% with view zenith angle range from 20° to 50°, which is the most probable case in the study case in the paper.
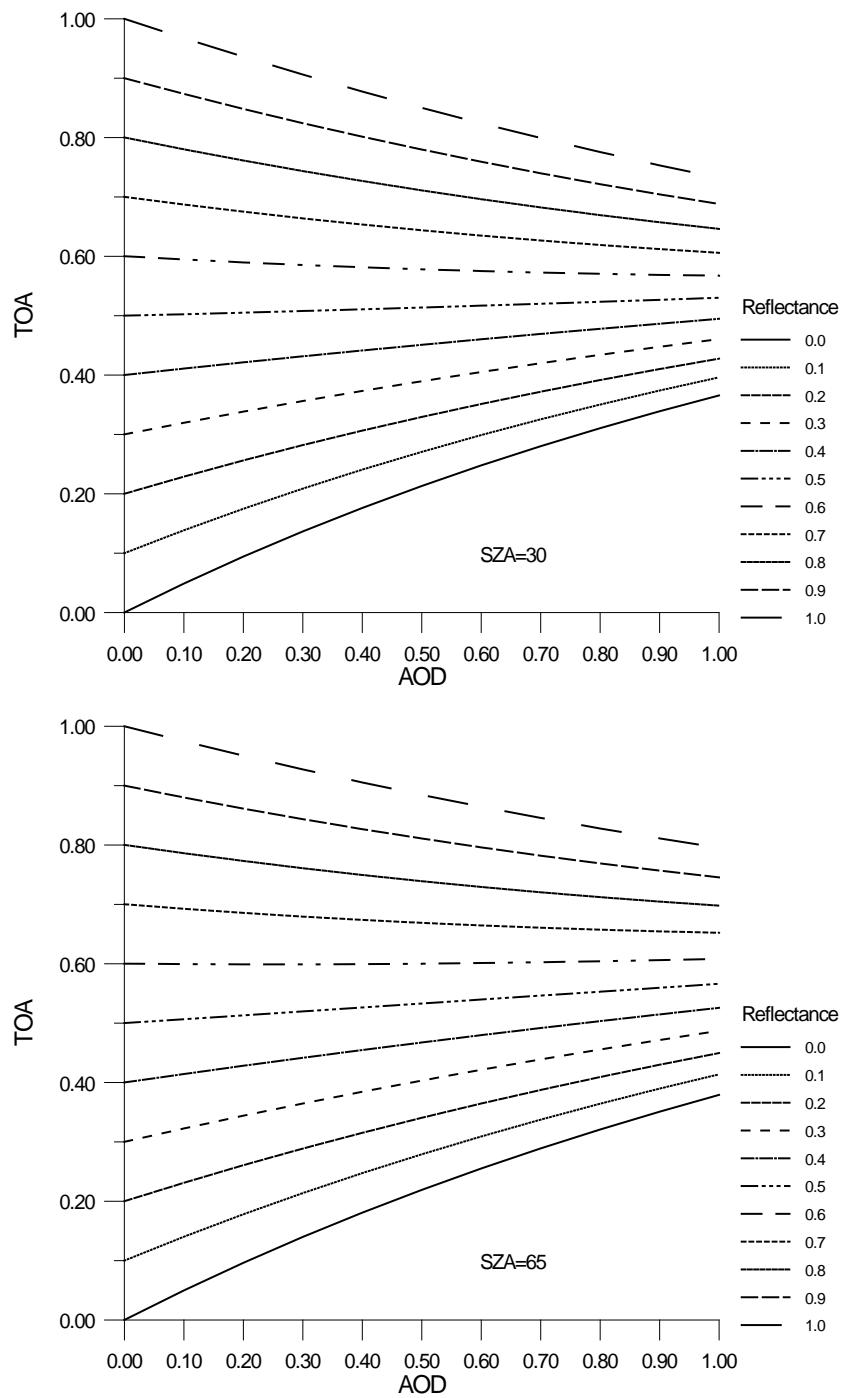
Fig. 1. Sensitivity analysis for analytical solution with two Solar Zenith Angle (SZA) of different surface reflectance.
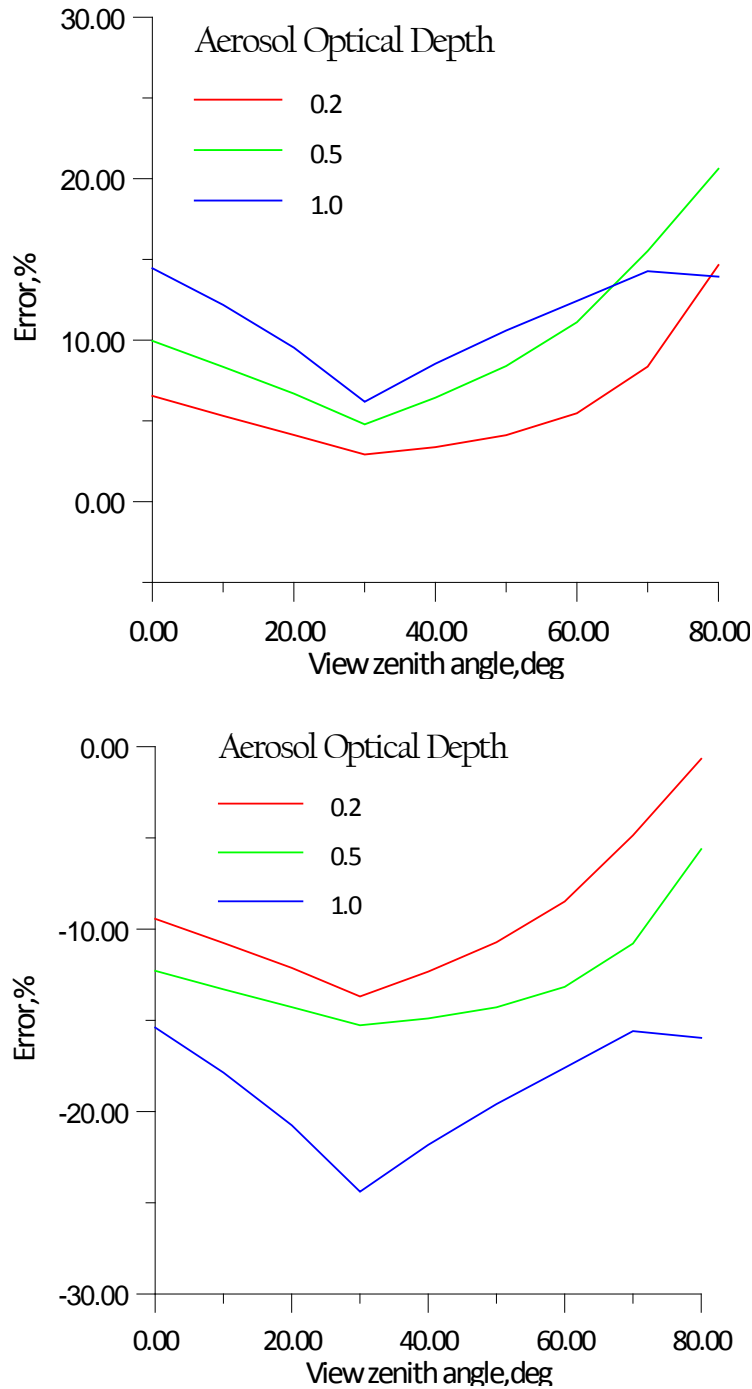
Fig. 2.Error of analytical solution computations of the TOA with continental (up) and neutral(bottom) aerosol at different solar zenith angle dependent on the view zenith angle with AOD equal to 0.2 (red), 0.5 (green) and 1.0 (blue). We can see that the analytical solution overestimate for continental type and underestimate for neutral type.

(2) Equation (22) looks reasonable to decide the true aerosol type, however, are there any other constraints for obtaining the result?

Reply: There is also another rule for determining the best aerosol type that is using NDVI value. In our paper, the reflectance of 0.6μm and 0.8μm were also obtained, we can calculate the NDVI value and choose the one with smallest various. However, over a very bright

surface such as desert, the NDVI is very low (almost always 0), so the efficient of using NDVI is related to the surface. It is more accuracy to use NDVI for a relative dark surface while using reflectance for all kind of surface.

(3) Six predefined aerosol type were tested in the paper, some more explanations were needed in the Chapter 4.3, that is how much uncertainty caused by using wrong aerosol type?

R: Aerosol type selection is one of the most important factors during retrieval. Kokhanovsky (2010) have already given an inter-comparison for major satellite aerosol retrieval algorithms and found that the error caused by wrong selected aerosol type can be larger than 100% (see Fig.3). In our paper, aerosol type, especially for absorption or non-absorption type selection will greatly affected the retrieval result. Fig. 4 showed the relative difference for different aerosol type, for most area, the relative difference is around or even large than 100%. For the red part, the best-fit aerosol type is absorption type.
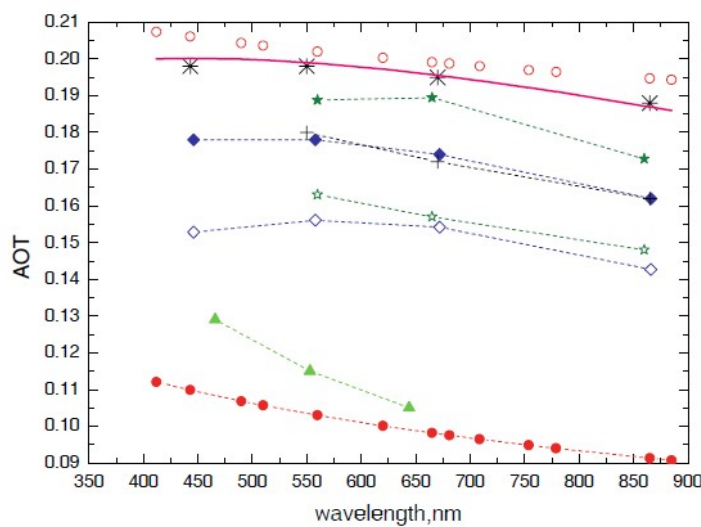

Fig.3. The spectral AOT (aerosol optical thickness = AOD) according to different retrievals. The red hollow points stand for the oceanic aerosol and red solid points for water soluble aerosol with the same retrieval algorithm (Kokhanovsky et al., 2010).
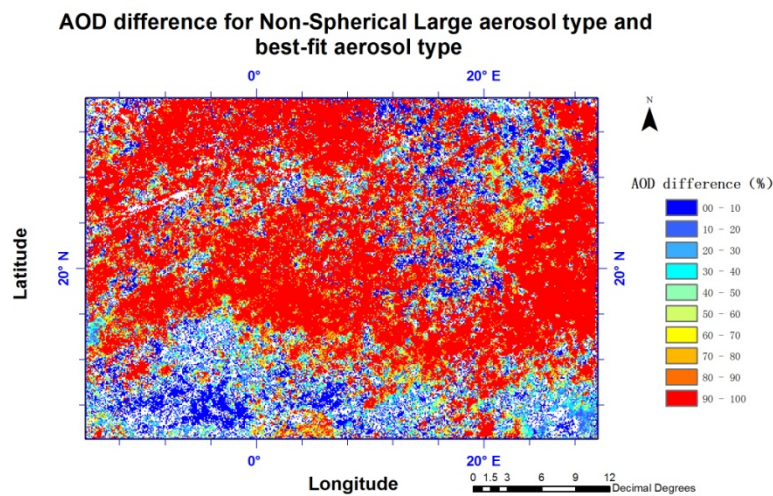

Fig.4. The difference for non-spherical large aerosol type and best-fit aerosol type. It is

obvious that the difference is around, even larger than 100% for most retrieval area.

(4) Page 15 Line 19, how you can decide the biomass burning affected the retrieval result using FMF factor? Is there any more information to support this conclusion?

R: As we mentioned in the paper, the fine mode fraction (FMF) demonstrate the fraction of fine particle to the total particle. The change of FMF factor during different time shows that whether more "small particle" insert into atmosphere. The Angstrom coefficient is also an indicator of the atmospheric aerosol type. It is really a good choice to analyze the aerosol type's various using as many aerosol parameters as we can in the certain time, however, in this paper, the FMF is enough for a primary determination of aerosol type change because in the study region, the aerosol type is greatly affected by biomass burning, which produced fine particle and it can be easily "observed" by FMF.

(5) The quality of Fig. 1 and Fig. 3 should be improved.

R: We have improved the quality of these figures.

(6) Add a few citations from experimental campaigns and others depicting long-range correlations in the aerosol content.

R: We have already added more citations such as Varotsos (2005) for the experimental campaigns.

Technical corrections

Page4031, Spelling mistake for the title, "MSG/SERIVI" should be "MSG/SEVIRI".

Page4034 Line4, dark dense vegetation should be "Dark Dense Vegetation"

Page 4035 Line9, deep blue should be "Deep Blue"

Page 4035 Line14, is (BRDF) should be (BRDF) is

Page4035 Line21, confused "ATSR data and the MISR algorithm", may be the author want to express "ATSR and MISR data"

Page4306 Line3-4, rewrite the sentence to make it more clear

Page4036 Line8, delete "Aerosol Robotic Network"

Page4306 Line10, change "depend" to "depends"

Page4036 Line21, change "a " to "the"

Page4306Line25, change "mid-infrared" to "mid-InfRared"

Page4307 Line1, change "to the wide HRV band" to "to a wide HRV band"

Page4307 Line3, delete "Some papers tried to retrieve AOD"

Page4037 Line 19, add "section 3"

Page4037 Line26-27, delete or rewrite the sentence, not clear

Page4040 Line 20-21, add (BRF) behind "bidirectional reflectance factor".

Page4056 Table1, Govaerts et al., 2011 should be Govaerts et al., 2010

R: All technical corrections have been revised.