Thanks for all the helpful comments from the reviewers. We have revised our manuscript addressing each of the suggestions. Detailed responses are listed below after each comment.

This manuscript proposed a simple algorithm to retrieve the aerosol optical depth (AOD) over land for the AVHRR sensor based on the dark target approach. First, an empirical relationship between the reflectances at 2.1 microns and 3.75microns is used to connect the reflectances at 3.75 microns and 0.64 microns; next, an aerosol scattering Look-up-Table is employed to perform the AOD retrievals. Comparisons between the AOD retrievals and the limited AERONET observations show a rather good correlation over a small region (Beijing, China).The authors conclude that this method may be applied to AVHRR AOD retrievals over land surfaces.

Retrieving the AOD over land is an important issue in quantitative land remote sensing and this manuscript has provided a potentially useful empirical approach. Although I do not have major critiques of the manuscript, the presentation especially the algorithm description part should be improved to help the readers comprehend the approach. The manuscript can be published after the following corrections/clarifications.

1. page 2229, lines 20-24: I think this long sentence is ambiguous and difficult to understand. Try to split it into two or three shorter ones to be clearer.

Response: The sentence has been polished as follows:
For geostationary satellites a time series method are employed assuming that the surface reflectance can be selected for each pixel during a certain period of time (Knapp et al. 2002, 2005), which is based on the assumption that the surface reflectance is stable in a short time period (Mei et al., 2012). And in order to avoid cloud shadow, the second darkest image is preferred.

2. page 2231, paragraph 1 below Eq.(1): Shouldn't the total reflectance at TOA =R(atmosphere)+R(Earth surface)? If so, line 11 "…, R_TOA(…) is the contribution of the Earth surface to the TOA reflectance" would be incorrect; instead, R_TOA(….) should be the total reflectance which includes the contributions from the land and the atmospheres. Clarify this.

Response: $R_{TOA}(\lambda,\mu_0,\mu,\phi)$ is the total signal contributions from both surface and atmosphere, we have revised this in new version.

3. page 2231, lines 13-14: Is there any Rayleigh scattering and aerosol scattering interactions? Neglecting such a multiple scattering effect would have any effects on your AOD retrieval results?

Response: Rayleigh scattering and aerosol scattering interaction has been included in the simple Look-UP-Table in BAER algorithm. The total

atmospheric reflectance contains two linear parts, the aerosol reflectance and Rayleigh reflectance, since the Rayleigh part is determined by wavelength and the scattering angle, the aerosol reflectance starts at 0 for AOD=0 ,contains multiple scattering exchanges between aerosols and air molecules (von Hoyningen-Huene et al 2011).

von Hoyningen-Huene, W., Yoon, J., Vountas, M., Istomina, L. G., Rohen, G., Dinter, T., Kokhanovsky, A. A., and Burrows, J. P.: Retrieval of spectral aerosol optical thickness over land using ocean color sensors MERIS and SeaWiFS, Atmos. Meas. Tech., 4, 151–171, doi:10.5194/amt-4-151-2011, 2011

4. page 2231 lines 20 to page 2232 line8: To assist readers unfamiliar with this topic, more detailed equations are needed to fully describe your AOD retrieval model. Specifically. the expressions of T1(lambda, miu0), T2(lambda, miu0) and s(lambda) etc.

Response: $T_1(\lambda,\mu_0)$ is the transmission of light propagating downward, $T_2(\lambda,\mu)$ is the transmission of light propagating upward from the surface to TOA and S is the atmospheric hemispherical albedo. The definitions of these parameters are as follows and we will add one more reference to refer the definition of these parameters:

$T_1(\lambda,\mu_0)=e^{-\tau(\lambda)/\mu_0}+t_d(\mu_0)$ and $t_d(\mu_0)=\dfrac{E_{sol}^{diff}}{\mu_0 E_s}$, E_{sol}^{diff} is the downward diffuse solar irradiance and E_s is the solar flux at the TOA.

$$T_2(\lambda,\mu)=e^{-\tau(\lambda)/\mu}+t_d(\mu)$$

$$S=1-\int_0^1 \mu T(\mu)d\mu$$

The simple paramterization method for the estimation of these parameters can be found in Kokhanovsky et al.(2005).

Kokhanovsky A. A., Mayer, B., and Rozanov, V. V.: A parameterization of the diffuse transmittance and reflectance for aerosol remote sensing problems, Atmos. Res., 73, 37–43, 2005.

5. Abbreviations such as the BAER (line 21, page 2231))and LACE-98 (line 7, page 2232) should be given their full names for their first appearance in text to help the reader.

Response: BAER stands for Bremen AErosol Retrieval, LACE-98 is a symbol

for a experiment and LACE-98 is already a full name, which are described in (von Hoyningen-Huene et al, 2011)

6. page 2232, lines 19-21: If you assume the TOA reflectances at 2.1 and 3.75 microns are equal to surface reflectances, you must have assumed the atmospheric contributions can be neglected. Is there any reference to support this assumption?

Response: The scattering effect of aerosol for long wavelength (2.12μm) can be neglected; this has been operational used in MODIS DDV algorithm (Kaufman et al, 1997). Since most aerosol types have small particle size and imaginary index in 3.75μm, the aerosol effect can also be neglected in 3.75μm (Holben et al, 1992). However, for 3.75μm, the absorption effect cannot be neglected, especially for the exaction of emission part from the reflective part. We remove the water vapor and other gas effect follows the idea of Roger and Vermote (1998).

Kaufman, Y. J., Tanre, D., Remer, L. A., Vermote, E. F., Chu, A., and Holben, B. N.: Operational remote sensing of tropospheric aerosol over land from EOS moderate resolution imaging spectroradiometer, J. Geophys. Res., 102, 17051–17067, doi:10.1029/96JD03988, 1997

Holben, B., Vermote, E., Kaufman, Y.J., Tanre, D. and Kalb, V., 1992, Aerosol retrieval over land from AVHRR data – application for atmospheric correction, IEEE Transactions on Geoscience and Remote Sensing, 30 (2), 212-222.

Roger, J.C. and Vermote, E.F., A Method to Retrieve the Reflectivity Signature at 3.75 μm from AVHRR Data, Remote Sensing of Environment, 1998, 64(1), 103-114.

7. page 2232, lines 24-25: You mentioned Eq.(7) is the reflectance of 3.75 microns yet you actually used radiance in Eq. (7), why? What's the relationship between the radiance and reflectance in this manuscript?

Response: Eq (7) is the general equation for the explanation of 3.75μm and we re-wrote Eq (7) in a form of how to calculate reflective part of 3.75μm. The detailed equation of how to obtain the reflective part of 3.75μm is Eq (16) in Roger and Vermote (1998). We have changed Eq (7) to the same equation as in Roger and Vermote (1998) for the estimation of reflectance of 3.75μm. The relationship between reflectance and measured radiance defined as follows:

$$R = \frac{\pi L}{\mu E_s}$$

E_s is the solar flux at the TOA, μis the cosine of sun zenith angle.

7. page 2233, line 2: "B(3.75micron) is the Planck function at 3.75 micron," what is the parameter T (temperature) in this Planck function and how to obtain its value?

Response: The temperature of Channel 3 in Planck function is estimated using brightness temperature in AVHRR Channel 4 and 5 as well as NDVI in order to estimate the emissivity as follow form:

$$T_3 = T_4^m + m_0 + m_1(T_4^m - T_5^m) + m_2(T_4^m - T_5^m)^2$$

Where m_0,m_1 and m_2 are function of NDVI described in Roger and Vermote (1998).

8. page 2233, Eq. (8): How was Eq. (8) obtained?

Response: Eq (8) was obtained by using statistic analysis results for the study area.

9. page 2233: What is the relationship between R(3.75micron) and R'(3.75micron)? Are they the same quantity?

Response: R(3.75μm) is the surface reflectance of 3.75μm and R'(3.75μm) only stands for the estimated 3.75 surface reflectance. But they are equal in quality. We have revised Eq (8) and Eq (12) to make it clearer.

10. page 2234, 1st paragraph: The "simplified LUT method, adopted from BAER algorithm…" should be briefly described here.

Response: The simplified LUT is not a general LUT calculated by radiative transfer model, it has been parameterized as polynomials of second degree as follows:

$$R_{aero}(\lambda, \mu_0, \mu, \phi) = c_0 + c_1\tau + c_2\tau^2$$

Where c_0,c_1 and c_2 are constant. And the aerosol reflectance is a air mass corrected aerosol reflectance(von Hoyningen-Huene et al, 2011).

12. Figs.4 and 5: You mentioned MODIS channel 0.66 microns (or 660 nm) in Fig. 4's caption yet in Fig. 5 the MOD09 reflectance is labelled as 670 nm.

Response: We have revised this in the revised version.

13. page 2235 and Fig. 7: You included the humidity data here here but I don't see much discussion on this. These data are used to support which of your conclusions?

Response: We have deleted Fig.7 according to the suggestion of both two reviewers. But we keep the discussions about the humidity and wind effects to the particle grow and transportation of aerosol in this region, which can explain the reason that the AODs in the southern part are larger than those in northern part of Beijing.

14. Why there is no cloud masking algorithm applied to improve the retrievals?

Response: Cloud mask is always a problem for aerosol retrieval. Here we only use AVHRR standard cloud product, which is not enough in our future

research. We are intending to adapt more cloud detection algorithm such as using the reflectance of 3.75μm (Heidinger et al 2004), which can improve the cloud detection accuracy.

Heidinger, A.K., Frey, R. and Pavoloonis Michael, Relative merits of the 1.6 and 3.75μm channels of the AVHRR/3 for cloud detection, 2004, Can. J. Remote Sensing, 30 (2),182-194.

15. Fig. 6: AVHRR AOD (640nm): AVHRR TOA reflectance has calibration issue in this region? How was this “line” formed?
Response: Yes, the line comes from the TOA reflectance, which due to the calibration.