Dear Editor, dear reviewers,

Thank you for the valuable comments, which have helped us to improve the quality of the paper. The detailed replies to your questions are given below point by point.

Best regards,

Linlu Mei on behalf of all authors

General comments:

This paper presents an expansion of XBAER (eXtensible Bremen Aerosol Retrieval) algorithm, which was developed based on previous MERIS (Medium Resolution Imaging Spectrometer), to a new OLCI (Ocean Land Color Instrument) sensor onboard sentinel-3. This contains the details of algorithm and results during December 2016 with specific heavy haze case analysis in Beijing and North China plain region. The scope is well-addressed and the contents are well-organized, thus I recommend it for publication after the responses for some points listed hereafter.

Specific comments:

The XBAER algorithm is based on previous works in Mei et al. (2016a; 2016b), which were applied to MERIS measurement. The authors described the brief explanation of XBAER algorithm in section 3, but some information should be clarified. As the reviewer's understanding, the TOA reflectance, not radiance, is used for the variability test of cloud masking algorithm (line 214) according to the Mei et al. (2016a). And please clarify what is different between cloud height and cloud altitude in line 214. In line 220, please clarify the scale of "space-time" dependent: is the seasonal time scale or day-to-day time scale?

Response: Thanks for the comments. We have changed "radiance" to "reflectance". "height" and "altitude" have the same meaning here and we keep "height" in the revised version. The spatial and temporal resolutions of the database are 10 km and monthly, respectively.

1) Please clarify which channels are used for cloud masking, surface determination, and aerosol inversions as in Mei et al. (2016a). Are the selected channels of OLCI identical with that of MERIS for aerosol retrieval using XBAER although there are additional channels in OLCI?

Response: We have used the same "overlapped" channels between OLCI and MERIS as we described in Line 244 in original version. One more column has been included as presented in Table 1.

2) In section 4.1 description of aerosol scenarios, the radius and variance of fine and coarse mode are presented but the fine-mode fraction and refractive indices (or SSA) are not presented. Please clarify whole aerosol microphysical properties for better understanding. Also, which aerosol model is assumed in retrieved OLCI AOT in December over Beijing and NCP region?

Response: The fine/coarse mode volumes ($\mu m^3/\mu m^3$), which was used to calculate the fine mode fraction, are 0.055/0.038, 0.056/0.057, 0.051/0.040, 0.02/0.157 for weakly absorbing, moderately absorbing, strongly absorbing and dust, respectively. The corresponding SSAs are 0.92, 0.95, 0.87 and 0.95. Aerosol types over land used in the XBAER algorithm designated at 1°×1° grid for different seasons are presented in Fig. 3 below. According to Fig.3, moderately absorbing and weakly absorbing were used for the NCP region for December. All above details have been included in the revised version.

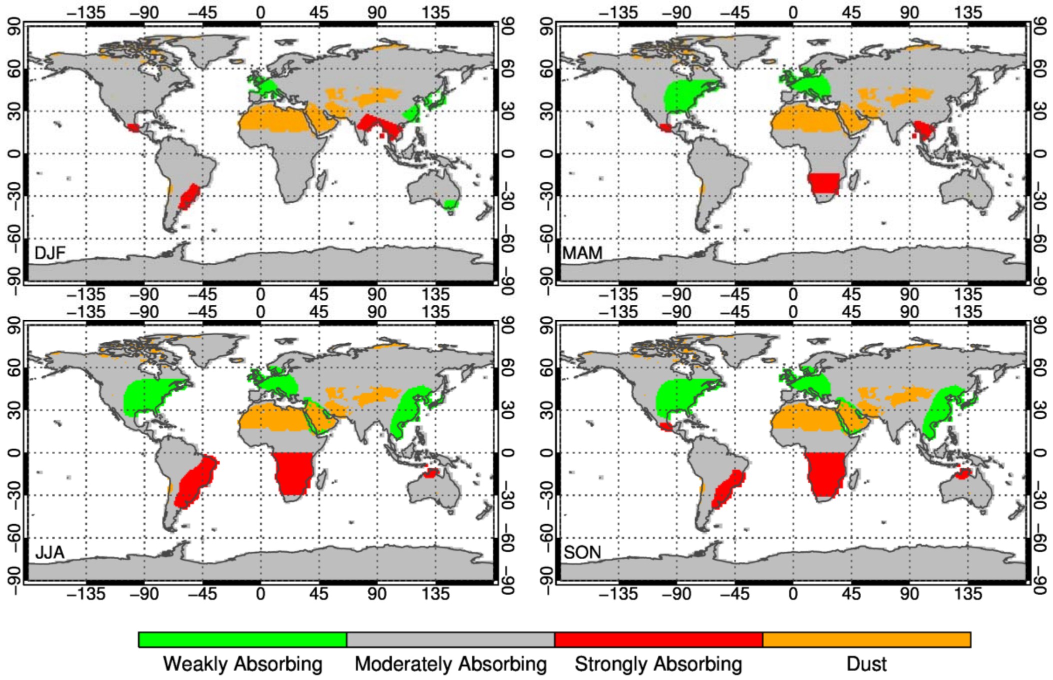

Fig.3 Aerosol types over land used in the XBAER algorithm designated at 1°×1° grid for different seasons. The four sub-figures represent four seasons. Upper row: left – December, January and February (DJF), right-March, April and May (MAM). Lower row: left-June, July and August (JJA), right- September, October and November (SON).

3) In line 319-320, the OLCI AOT shows higher R (0.82) compared to the MERIS (0.78), but the MERIS results are in 2009 July according to Mei et al. (2016a). The validation period is different. The period of MERIS and OLCI are not overlapped unfortunately as the authors mentioned in introduction. Then, please compare the accuracy of AOT from OLCI and MERIS for December if possible.

Response: The correlations coefficient with AERONET is about 0.70 for December, 2009 for XBAER version 1.6 product, we are still ongoing for the reprocessing of XBAER version 2.0.

4) Please notify the spatial resolution of the figure 4. Also, the fire product is hard to identify thus larger symbol is required. And, the reviewer checked the MODIS AOT data in figure 4, and it seems to the "AOD_550_Dark_Target_Deep_Blue_Combined_Mean_Mean" product, not DarkTarget-only AOT. Then the MODIS product should be referred as like "Dark-Target (DT) and Deep-Blue (DB) combined product".

Response: The figure and tile have been improved.

5) In line 350, please clarify the "first term". In this paper, a SAVI or NDPI equation is substituted by referred previous studies without detailed explanation. Also, the reason for the DT like over dark surface and DB like over bright surface is insufficient to understand.

Response: The definition of SAVI and NDPI are given below:

$$SAVI = \frac{R(\lambda_{14}) - R(\lambda_7)}{R(\lambda_{14}) + R(\lambda_7) + L}(1 + L), \quad (1)$$

$$L = 1 - \frac{2R(\lambda_{14}) + 1 - \sqrt{(2R(\lambda_{14}) + 1)^2 - 8(R(\lambda_{14}) - R(\lambda_7))}}{2}, \quad (2)$$

where R is the SSR and the subscript for the wavelength denotes the MERIS channel numbers defined in Table 1.

$$NDPI = \frac{R(\lambda_2) - R(\lambda_5)}{R(\lambda_3)}, \quad (3)$$

XBAER uses a one-parametric approximation of SSR, it is assumed that the SSR for a given surface type at a given wavelength is determined by the use of a linear relationship to a particular and selected vegetation index, SAVI, if SAVI values are very small over regions like desert, the non-vegetation component (B vector as presented in Mei et al., 2016b) dominates the surface treatment, and XBAER becomes a DeepBlue-similar aerosol retrieval algorithm. If SAVI values are large over regions like Amazon, the vegetation component (A vector as presented in Mei et al., 2016b) dominates the surface treatment, and XBAER becomes a DarkTarget-similar aerosol retrieval algorithm.