Response to Reviewer # 1

The authors report a new aerosol retrieval algorithm to retrieve the aerosol properties over ocean with multi-wavelength and multi-pixel observations. The algorithm is well tested by both synthetic measurements and real measurements considering different water and aerosol conditions. The new algorithm is very robust, and the aerosol retrievals are generally better than those of the conventional single pixel method. The manuscript is well written and scientifically sound, therefore, I think these results merit publication.

Thanks for the reviewer's insightful comments very much, which helped to improve our manuscript greatly. We have revised our paper based on your comments carefully. We also have reworded/rephrased some sentences that may improve or clarify the paper further. Our responses are listed in below after each comment.

1. P6L5 I think you aerosol model only includes three components, i.e., fine, sea salt, and dust. What do you mean using the combined with an internal mixture? Is this the fine particle? Cloud you clarify this?

Response: Thanks for the comments very much. We are sorry for the unclear description on the aerosol model. As the reviewer comment, we assume three kinds of aerosol modes exist in the atmosphere, i.e., fine, sea salt and dust (external mixture), of which each mode independently grows and changes its refractive index with increasing humidity. Moreover, an internal mixture of water-soluble, dust-like and soot exists within the fine aerosol (internal mixture), of which the refractive index is calculated by the sum of each internal component contribution based on its volume fraction. To make the description clearer, we modified as

"For the aerosol modeling, we adopted a sophisticated scattering approach that combines external and internal mixture schemes. It is assumed that three kinds of aerosol modes, i.e., fine, sea salt and dust, exist in the atmosphere, of which each mode grows and changes its refractive index with increasing humidity independently (external mixing). Moreover, an internal mixture of water-soluble, dust-like and soot exists within the fine aerosol (internal mixing), of which the refractive index is calculated by the sum of each internal component contribution based on its volume fraction."

2. P6L9 Aerosol size parameters for each aerosol component or each particle?

Response: Thanks for the comments. We fixed the size parameters for each aerosol particles, i.e., fine, sea salt and dust, as the Table 1 shows. In the fine aerosol, only the refractive index can be dependent on the volume fraction of each component, i.e., water-soluble, dust-like and soot.

3. You always say AOT values for each particle, but I do not think AOT is for each particle.

Response: Thanks for the comments very much. In the revised manuscript, we modified to "AOT of fine, sea salt and dust modes or AOT of each mode".

4. P7L29 what do you mean the larger errors? Compared to what, single pixel method or fine aerosol ? Please clarify it.

Response: Thanks for the comments. The description of "larger errors" means the accuracy of retrieved sea salt AOT and dust AOT are both lower than that of the retrieved coarse AOT (sum of sea salt AOT and dust AOT) compared with the trues values (Fig. 1b, 1c and 1e). Since CAI instrument only has 4 spectral observation signals used in the retrieval, it is difficult to discriminate the retrieved sea salt and dust in a high accurate level due to their similar optical properties, however, their sum, i.e., coarse AOT, can be retrieved well. We modified relative description in the revised manuscript to make clearer.

5. P11L2 indicated -> demonstrated.

Response: Thanks for the comments. Done.

6. P11L7 Cloud you explain why the fine AOTs of CAI are lower than those of the MODIS?

Response: Thanks for the comments. One possible reason is that the volume size distribution of fine aerosol used in this study are different from that used in the MODIS standard algorithm, in particular, we adopt a larger value of standard deviation of size distribution in this study. Moreover, we conduct the sediment retrieval simultaneously to consider the influence of water-leaving radiance in the aerosol retrieval, which is also different to the MODIS standard atmosphere scheme that uses empirical or zero water-leaving radiance assumption during the retrieval. Since the CAI retrieved results shown in Fig.6 are contaminated by the sunglint, some uncertainties are also introduced in the retrieval to some extent.

7. P11L26 Do you think the statement of overestimate is suitable for this case? What is your criterion? Do you know the real values?

Response: Thanks for the comments very much. We agree with the reviewer that it is difficult to say whether such kind of overestimation of AOT is unreasonable or not without in situ validation or other counterpart satellite product comparison, even though the Hangzhou Bay is typically assumed as a high turbid water region. To clarify this statement, we modified to the following sentences as

"Generally, the derived AOTs without using SWIR measurements (Fig. 7a) demonstrate obvious higher values than those retrieved by adding SWIR information (Fig. 7d) near coastal region. It is caused that the satellite reflectance at SWIR channels are much less sensitive to the suspended sediment than those at visible bands in turbid waters, so that the aerosols can be estimated without significant contamination of sediment (Wang and Shi, 2007) based on the SWIR observation. Although we simultaneously conduct the oceanic sediment retrieval in the algorithm, it is still difficult to use 4 spectral measurements to estimate at least 5 free variables (AOT of fine, sea spray and dust, sediment and CDOM) in the high backscattering surface condition, where the retrieval could be degenerated. Nevertheless, such deficiency can be improved using the multi-pixel scheme even though the SWIR measurements are not used (Fig. 7b), which indicates the potentiality of multi-pixel strategy in the aerosol retrieval over high turbid waters, particularly for those multi-spectral instruments without the SWIR observation."

References:

Wang, M., and W. Shi (2007), The NIR-SWIR combined atmospheric correction approach for MODIS ocean color data processing, Opt. Express, 15(24), 15722-15733.