Comments from the Reviewers:

The reviewer's comments and suggestions were precise and helpful to improve the scientific contents of the manuscript. We appreciate the efforts by the reviewer and editor. Basically we reflected all the comments and suggestions by the reviewers.

==========

Reviewer #1:

General comments

1. Some sections in the manuscript just report the results found but not explain what causes them. Therefore, the authors need to analyze more in detail the results with relevant references.

- *Per reviewer's suggestion, detail and relevant references of results were added throughout the revised manuscript.*

2. The most important scientific issue in this study is the updated aerosol optical properties form the DRAGON-Asia campaign that can improve the AOD retrieval in single visible channel algorithm. However, since in the case of SSA, it is only available under the specific condition (i.e. AOD at 440 nm is larger than 0.4), the LUT based on AERONET INV data could not work well in the single visible channel algorithm when the AOD is small. Therefore, further evaluations with AERONET sun-photometer observations are needed for the cases divided into small and large AOD (i.e. AOD440nm<0.4 and AOD440nm≥0.4).

- *As reviewer's comment, AERONET science team recommend to use the inversion data where the AOD at 440 nm is higher than 0.4. Thus the number of data point for low AOD bin (<0.3 at 550 nm) was clearly lower than that for higher AOD bins as shown in table 2 in the revised manuscript. The insufficient data might raise the uncertainty in the assumed aerosol model for low AOD. Thus, per reviewer's suggestion, the uncertainty related with the number of inversion data was described in lines 601-604. Additionally, the MI AOD was evaluated with AERONET value by dividing into small and large AOD case, and the comparison result was shown in lines 604-608 in the revised manuscript.*

3. Occasionally, it is difficult to follow the logical flow of the text because of weak connection between sentence and sentence or between paragraph and paragraph. The authors need to clarify and

rephrase difficult sentences for delivering more clearly what they want to show in this paper.

- *Per reviewer's suggestions, many sentences and paragraphs were rephrased throughout the revised manuscript.*

Specific comments

,

Pages 10774, lines 5 in Abstract: Please provide the exact period of DRAGON campaign.

- *The exact period (March to May, 2012) was added on line 30 in the revised manuscript.*

Pages 10774, lines 9~11 in Abstract: Please clarify the sentence, i.e. explain, clearly how much "4% difference in SSA" is and why the overestimation of SSA leads to an underestimation of AOD.

- *Per the reviewer's suggestion, the sentence in lines 35 - 40 was revised. Details can be found in the main texts.*

Pages 10774, lines 13~14 in Abstract: Since the authors mentioned that even a small difference in SSA can lead to a large difference in AOD, they need to provide the seasonal standard deviation for each seasonal SSA mean so that the readers can estimate how much the SSA varies at each season.

- *The standard deviation was shown on lines 42 and 44 in the revised manuscript.*

Pages 10774, lines 23 in Abstract: Please clarify what "original aerosol model" is.

- *Per the reviewer's suggestion, the meaning of the "original aerosol model" was explained in lines 45-48 in the revised manuscript.*

Pages 10774, lines 24-25 in Abstract: I don't understand "while the change of the y-offset of -0.08 is significant". What does "significant" mean?

- *The sentence was corrected and rephrased in lines 55-57 in the revised manuscript.*

Pages 10774, lines 22-27 in Abstract: The last concluding sentence is derived from the previous sentences related with the regression slope, y-offset, and correlation coefficient. However, it is difficult to distinguish which values are representative for the “original” or the “new”, and therefore hard to understand how the authors conclude “significant improved”. Please rephrase the sentences.

- *To clarify the meaning of sentences, the paragraph in lines 53-59 was revised in the manuscript.*

Pages 10775, lines 7-8 in Introduction: The authors might want to change “The global aerosol distribution shows high spatial and temporal variability, and many studies …” into “Since the global aerosol distribution shows high spatial and temporal variability, many studies…”.

- *The sentence was corrected in lines 71-72 in the revised manuscript.*

Pages 10775, lines 9-15 in Introduction: Please select some of the most important or representative papers as reference and replace von Hoyningen- Huene et al. (2003) with von Hoyningen-Huene et al. (2011).

- *The list of papers in lines 74-76 was updated as per the reviewer’s suggestion.*

Pages 10775-10776, lines 26-2 in Introduction: Please provide the exact values (i.e. Pearson coefficient, regression slope, and the percentage of data within an expected error bound.) for supporting the sentence.

- *The statistic values were added in lines 98-99 in the revised manuscript.*

Pages 10777, lines 14 in Introduction: Please explain briefly “critical reflectance method”.

- *Detail of the "critical reflectance method" was described in lines 435-442 rather than in introduction.*

Pages 10777, lines 20-22 in Introduction: Please clarify the difficult sentence.

- *The paragraph in lines 133-146 was revised, and the sentence was changed as lines 143-146 in the revised manuscript.*

Pages 10777, lines 22-23 in Introduction: Please explain why the BAOD correction is used in this study, but the critical reflectance method is not.

- *As mentioned in lines 145-146, the critical reflectance method was not adopted here to evaluate the effects of aerosol model assumption in the AOD retrieval. Additionally, the critical reflectance method can be assured when the aerosol distribution is optically homogeneous over heterogeneous surface. Thus it can be limited where diverse source of emission lead large spatial variation of aerosol condition.*

Pages 10778, lines 2 in 2.1 AERONET: Please present the kind, version, and level of AERONET data used in this study at the subsection title.

- *The subsection title was changed into "DRAGON-NE Asia Campaign" on line 160 in the revised manuscript.*

Pages10778, lines 15 in 2.1 AERONET: Generally, the "trend" has the meaning of "temporal change or variation towards something new or different". It might be good to be changed into "behavior".

- *The "trend" on line 181 was changed to "behavior" in the revised manuscript.*

Pages 10778, lines 26-27 in 2.1 AERONET: Please enhance the sentence with relevant references and further discussions about the spatial AOD and AE over East Asia.

- *The sentence was enhanced with a reference of [Park et al., 2014] on line 192 in the revised manuscript.*

Pages 10779, lines 1 in 2.1 AERONET: Is there any special reason why the “daily” data are used. If yes, please mention it.

- *The reason was mentioned in lines 196-199 in the revised manuscript.*

Pages 10779, lines 3 in 2.2 Meteorological imager: The authors might want to change the subsection title into “2.2 COMS meteorological imager”.

- *The subsection title was changed into the “2.2. COMS Meteorological Imager” on line 210 in the revised manuscript.*

Pages 10779, in 2.2 Meteorological imager: Since many readers might not know well about COMS, please provide more information about COMS calibration status, available, products, and web address with relevant references.

- *The paragraph in section 2.2 was revised in lines 221-226 as per the reviewer’s suggestion.*

Pages 10780 in 2.3 MODIS AOD: Please explain why the authors choose MODIS- AQUA AOD products to estimate BAOD over East Asia. Furthermore, the expected error of BAOD can be over ±100% when BAOD is smaller than 0.05. Since generally BAOD is very small value, the authors need to mention or discuss the possible error range in the BAOD correction.

- *The reason of using the MODIS products was explained in lines 234-237 in the revised manuscript, and the demerits of using the MODIS products were shortly mentioned in lines 239-242. And the uncertainty related with the BAOD assumption was described in lines 477-494 in section 3.5.*

Pages 10781, lines 5 in 3 Single channel algorithm: The authors might want to put a new subsection title, “3.1 Cloud masking”, before the opening paragraph of threshold method for distinguishing cloud and aerosol pixel.

- *The subsection title was put on line 270 in the revised manuscript.*

Pages 10781, lines 13-19 in 3 Single channel algorithm: Please briefly explain what each threshold value is targeting at.

- *The target of each threshold was shown in lines 279-282.*

Pages 10781, lines 20 in 3.1 Surface reflectance and BAOD: The authors might want to change the subsection number, “3.1” into “3.2”.

- *The subsection number was changed into “3.2” in the revised manuscript.*

Pages 10781, lines 24 in 3.1 Surface reflectance and BAOD: I cannot find Kim et al. (2015) in the reference list of the manuscript.

- *The paper is in preparation. There was a mistake during type setting process.*

Pages 10781, lines 24-25 in 3.1 Surface reflectance and BAOD: “An underestimation of BAOD results in an overestimation of retrieved AOD” is wrong and contradictory to the explanation at Pages 10777, lines 17-20. Please correct it.

- *The “overestimation” was corrected by “underestimation” on line 297 in the revised manuscript.*

Pages 10782, lines 6-8 in 3.1 Surface reflectance and BAOD: I don’t understand why authors mention the BAOD median values over land and ocean. Please explain what you want to show with the median values.

- *The sentences were revised in lines 304-308.*

Pages 10782, lines 17 in 3.2 Aerosol model: The authors might want to change the subsection number, “3.2” into “3.3”.

- *The subsection number was changed into “3.3” in the revised manuscript.*

Pages 10783, lines 11-12 in 3.2 Aerosol model: AERONET INV data provide four spectral SSAs at 440, 675, 870, and 1020 nm. I guess that authors choose the SSA at “675 nm” because it is the closest wavelength to the COMS MI central wavelength. Please explain why.

- *The explanation was shown in lines 349-351 in the revised manuscript.*

,

Pages 10783, lines 12-15 in 3.2 Aerosol model: Please provide the seasonal standard deviation (±1σ) with each seasonal SSA mean.

- *In the revised manuscript, the sentence which describes the seasonal variation of the SSA was removed, but the standard deviation of the SSA for MAM was shown on line 355 and 366.*

Pages, 10783, lines, 20-21 in 3.2 aerosol model: since SSA is only available under the specific condition (i.e. AOD at 440 nm is larger than 0.4), it is difficult to understand how to calculate the SSA mean for an AOD bin of 0.15. The authors need to explain more about how to derive the mean value for each bin, and also to add the bin size, range, and number of data fall into each bin.

- *Since this study used daily inversion data, which provides diurnal average value of each product, there are data points with AOD lower than the threshold. In the compiled inversion dataset, the minimum AOD obtained with SSA was 0.157at 550 nm.*
- *As reviewer’s suggestion, the bin sizes were described in lines 347-349. The data number was also shown in Table 2 in the revised manuscript.*

Pages 10784, lines 13-22 in 3.2 Aerosol model: Please enhance the sentences by citing relevant references.

- *The paragraph was revised with relevant reference in lines 372-380 in the revised manuscript.*

Pages 10785, lines 7 in 3.3, sensitivity to assumed aerosol optical properties: the authors might want to change the subsection number, “3.3” into “3.4”.

- *The subsection number was changed into “3.4” in the revised manuscript.*

Pages 10785, lines 10-15 in, 3.3, sensitivity to assumed aerosol optical properties: Please explain why the authors perform the sensitivity test with “assumed conditions”, i.e. a ±4% variation in SSA relative to the reference condition, the surface reflectance of 0.05 and 0.10, and the scattering angle from135.7° to, 173.2°.

- *The explanation was shown in lines 402-403 in the revised manuscript.*

Pages 10786, lines 6-9 in 3.3 Sensitivity to assumed aerosol optical properties: Please, put “+” in front of a positive error in the manuscript.

- *We put “+” symbols in front of a positive error in lines 427-430 and 435 in the revised manuscript.*

Pages 10787, lines 5-7 in 4.1 Comparison with MODIS AOD: The authors might want to cite Yoon et al (2014) with mentioning another advantage that the AOD derived from geostationary satellites can minimize the uncertainty caused by the different/limited sampling of polar-orbiting-satellite in the trend estimate.

- *We cited Yoon et al. (2014) and add a sentence in lines 518-520 in the revised manuscript.*

Pages 10787, lines 17-19 in 4.1 comparison with MODIS AOD: I don’t understand the meaning of “…03:00 UTC 55” and “… 05:00 UTC 15”.

- *The time was revised by "03:16 … UTC" on line 523 in the revised manuscript.*

Pages 10789, lines 1-4 in 4.2 Comparison with AERONET: DRAGON-Asia: Please clarify and rephrase difficult sentences, and explain more in detail why the comparison results (i.e. slope, correlation coefficient, and percentage of the comparison dataset distributed within ±30% on the basis of the one-to-one correspondence) in Fig.8(d) are worse than the results in fig.8(c).

- *The sentence was revised with detail of the comparison results in lines 587-596 in the revised manuscript.*

Pages 10790, lines 7-14 in 4.2 Comparison with AERONET: This part just reports the results found in the manuscript but not explain what causes them. Please analyze more in detail the results with relevant references.

Pages 10790, lines 15-27 in 4.2 Comparison with AERONET: The authors need to categorize the AERONET sites as e.g. improved and worsened results compared to the original, and explain more in detail the leading causes of the results with relevant references.

- *Per the reviewer's suggestion, the paragraphs in lines 634-682 were revised to show detail of the comparison for each site.*

Pages 10792, lines 29 in 5 Summary: I cannot find Choi et al. (2015) in the reference list of the manuscript.

- *The paper was accepted in AMTD, and was updated in the reference list.*

Pages 10793, lines 1-2 in 5 Summary: The authors need to explain briefly why.

- *The sentences were revised in lines 746-748 in the revised manuscript.*

Pages 10799, in Table, 1: It is difficult to distinguish the italic font. Please mention again the period for dRAGON2012.

- *The period was shown in bottom of Table 1.*

Pages 10800, in Table 2: It is difficult to distinguish the italic font. Please add the bin size, range, and number of data fall into each bin, and provide the seasonal mean with 1 standard deviation.

Pages 10801 in Table 3: Please add the bin size, range, and number of data fall into each bin, and provide the seasonal mean with 1 standard deviation.

- *Table 2 and Table 3 was combined and revised as Table 2 in the revised manuscript.*

Pages 10802, in Table 4: please add a new column of "relative difference between DRAGON AOD and, MI AOD".

Pages 10803, in Table, 5: Please add a new column of "relative difference between DRAGON AOD, and, MI AOD".

- *The difference between DRAGON AOD and MI AOD was added in Table 3 and Table 4 in the revised manuscript.*

Pages 10808, in Figure 5: It is difficult to distinguish the colors for different AODs. Please change it.

- *The Figure 5 was revised to show the compiled size distribution from the original model and the new model. The color bar was changed also.*

Pages 10812, in Figure 9: Please put the labels (a) and (b) on the figures.

- *We put the label (a) and (b) in the Figure 10.*

Additional references used in this review

- *Those references were cited in the revised manuscript.*

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.

Yoon, J. Burrows, J. P. Vountas, M. von Hoyningen-Huene, W. Chang, D. Y., Richter, A. and Hilboll, A.: Changes in atmospheric aerosol loading retrieved from, space-based, measurements during the past decade, Atmos. Chem. Phys., 14, 6881-6902, doi:10.5194/acp-14-6881-2014, 2014.

Reviewer #2:

General comments

The title is misleading. Although Seoul and Osaka are situated in Asia, the aerosol models applying over these regions are unlike to apply over all Asia and hence cannot contribute to retrieval improvement over Asia, only over part of SE Asia. As explained in my comments below (detailed comments, 10788), the improvement in the AOD retrieval is questionable. The goal of the paper is to improve the single channel retrieval algorithm applied to MI to retrieve AOD, as mentioned the title and the discussion. The study builds on earlier work by Kim et al. published in RSE in 2014. Since the retrieval method is key to the work described here, the authors should provide a brief summary how a single channel algorithm can be used for aerosol retrieval, what the assumptions are, what the status was before this study, and what improvements are made in the current paper with respect to the previous work. In particular, with only a single channel available, only one parameter can be retrieved of the many which determine the radiance at the top of the atmosphere observed by the instrument. Since the parameter the authors are after is the AOD, all other parameters have to be assumed or estimated. How well is this done and what are the implications due to uncertainties in the assumptions?

- *The title was changed to "**Aerosol Optical Properties Derived from the DRAGON-NE Asia campaign, and Implications for a Single Channel Algorithm to Retrieve Aerosol Optical Depth in spring from Meteorological Imager (MI) On-board Communication, ocean, and Meteorological Satellite (COMS)**", to clarify that this study focused on the effects of the DRAGON-NE Asia campaign to AOD retrieval algorithm using satellite measurement. The focus was shown in lines 116 -118.*
- *Since the detail of the single channel algorithm was described in section 3, short introduction of the algorithm was shown in lines 118-124 in the revised manuscript. An addition, difference between the algorithms shown in the Kim et al.(2014) and in this study was described in lines 133-146.*
- *As per the reviewer's suggestions, the uncertainties in the AOD retrieval related with other assumed parameters were added in section 3.5 in the revised manuscript.*

The authors put a large emphasis on the improvement of the aerosol model used in the retrieval, in particular they use data from the DRAGON-Asia campaign in 2012. Since this campaign had a

limited duration (3 months), how do these data apply to the rest of the year and what has been done to extend for the full year? How are seasonal variations taken into account (Tables 2 and 3, bottom)? How can the results in these tables change for other seasons than those for which DRAGON was deployed? Seasonal variation appears to be an input parameter to the retrieval! Especially because the authors mention that the largest improvement was due to the use of the DRAGON campaign, while the use of an extended time series of other sun photometers with 2 more years made hardly any difference (10783, 15-21). This would imply that the aerosol properties over Asia had hardly changed over these years.

- *As per the reviewer's suggestions, the Table 2 and Table 3 were updated as Table 2 in the revised manuscript. To avoid confusion, the values for other seasons were removed in table 2, and the description about the AOP changes were revised in lines 353-370. In lines 370-380 in the revised manuscript, changes in volume size distribution and refractive indices were mentioned, also.*

- *Lyapustin et al. (2011a) shown that the SSA in eastern China increases from 2000 to 2010 by about 0.02 at 470nm The change corresponds with the increase of average SSA by 0.005 from 2010 to 2012. In addition to the SSA increase, changes in particle size distribution and refractive indices were found in the expended inversion dataset. This study focused on the effects of the change on the AOD retrieval using single channel algorithm.*

How does the single channel algorithm select the aerosol model? How are spatial variations taken into account? In Tables 4 and 5 I see validation statistics for 39 sites but it is hard to believe that the aerosol models are invariant over the wide area considered in the study (cf. Figure 1: 15x10 degrees!) For example, Figure 3 shows a very strong variation in the average AOD and AE over the study area which strongly indicates that the aerosol models vary spatially. I'd also like to see how the measured (AERONET & DRAGON) and derived (model) compare, in particular how well do the derived properties describe spatial and temporal variations during the DRAGON campaign and over the long time series (cf. Table 1). How representative was the DRAGON period for the whole time series?

- *The biggest limitation of the single channel algorithm is in the selection of aerosol type. Thus the algorithm focused on the optimization of the aerosol model to represents dominant state of aerosol properties over North East Asia. The limitation was mentioned in lines 122-123, and uncertainty related with the limitation was shown in Figure 6 in section 3.4. Because of*

the limitation in detection of temporal and spatial variation of aerosol type, the comparison of retrieved products with AERONET AOD shows different statistics depending on location and time. The locational difference was shown in Table 3, 4 and lined 631-666. In Figure 11 and lines 645-657, the DRAGON AOD and the MI AOD were shown by time series to show more detail of the spatial and temporal correlation.

An aerosol model is described by a size distribution, preferably multi-modal to take into account at a minimum the fine and coarse mode fractions, plus the imaginary refractive index for each mode. However, the authors only report the real and imaginary parts of the refractive index which makes it impossible for others to use their results. I see no metrics indicating a measure of the quality of the model parameters as obtained from the analysis, i.e. what is the accuracy with which the real and imaginary parts of the refractive index are obtained?

In 10792, 27 is mentioned that the use of the DRAGON data resulted in an increase of SSA of 1.1% while a few lines below (10792, 4) they mention that the assumed SSA error is 3% resulting in an AOD error of -20% to +23% for the situation given in that para. Furthermore, since the authors don't provide the particle size distribution, it is impossible to estimate the effect on the SSA of a change of about 0.001 in the imaginary refractive index, combined with a change of about 0.01 in the real part.

- *As per the reviewer's suggestion, Table 2 and Figure 5 were edited to describe about volume size distribution. In the table, the standard deviation of analyzed refractive index and number of compiled dataset were shown also. As mentioned previously, the description about the changes in volume size distribution was shown in lines 372-380 in the revised manuscript.*
- *We used quality assured dataset by following criteria suggested by AERONET science team (http://aeronet.gsfc.nasa.gov/new_web/Documents/AERONETcriteria_final1_excerpt.pdf), but the accuracy of the complex refractive index was not evaluated here. Instead, standard deviation of analyzed refractive index was described in Table 2.*
- *The sensitivity test with 4% SSA variation was conducted to cover the standard deviation of compiled SSA as revised sentence in lines 402-403.*

Another issue is the wavelength dependence. Where AERONET provides data in discrete wavebands, the MI measures in a single VIS waveband (0.55-0.80 micrometer). How is the variation of the aerosol optical properties over this quite broad band accounted for? How is AOD at 550, as reported

e.g., in Fig. 8, obtained?

- *The conversion of AOD was mentioned in lines 349-353 in the revised manuscript.*

The authors write several times that a goal of their work is to improve their understanding on the aerosol optical properties over the study region (e.g. 10791, 5 and 21). However, they don't report what in their understanding has improved, what have they learned from this study? They only report changes in the numbers they use to describe the aerosol properties, and correlations.

- *As mentioned in lines 116-118 in the revised manuscript, the goal of this study lies on understanding the effects of AERONET measurement campaign to the AOD retrieval algorithm. The phrase in lines 104-107 describes a general role of the ground-based measurement in the satellite-based aerosol measurement. Though the AOP change was insignificant, this study showed the effects of the AOP assumption to AOD retrieval utilizing single channel algorithm. Nonetheless, the limitation of the algorithm in the aerosol type selection and BAOD assumption increased the uncertainties in AOD.*

For these and other reasons summarized below, the manuscript is not ready for pub- lication in ACP. Major revision and a second review are required. I further suggest thorough proofreading: I noticed several sentences which should be corrected (e.g.10790, 13-16, see also minor comments), and some references are missing (e.g. Frey et al. 2008; Kim et al., 2015; Choi et al. 2015; there may be more, I checked only a few).

- *As per the reviewer's comments, several sentences were corrected throughout in the revised manuscript. The Kim et al. 2015 is in preparation and the Choi et al. was accepted by AMTD in July, and was updated in the reference list. There was a mistake during type setting process. All of the references were checked again, and revised in the revised manuscript.*

Minor Comments

10775, 10-15: I miss here the more recent retrieval improvements, in particular for LEO there are no references after 2010 for, e.g., MODIS (C6), MISR, SeaWiFS or European efforts (AATSR, MERIS), which all have significantly improved over the last 5 years and provide similar validation metrics.

- *The reference list was updated in lines 74-76 in the revised manuscript.*

10775, 16-20: surface reflectance can be accounted for using dual (AATSR) or multiple (MISR, POLDER) view algorithms, or for single view algorithms using certain assumptions (MODIS) or modelling approaches.

- *The approaches to estimate surface reflectance was edited in lines 84-89 in the revised manuscript.*

10776, 5, 6: references are needed for each statement

- *Relevant references were added in lines 105 and 107 in the revised manuscript.*

10776, 22: which satellite algorithm?

- *The phrase was revised as lines 114-115 in the manuscript.*

10776, 24: I think this study would better be done for a multi-channel algorithm? Hence some justification is needed for using a single channel. The sensitivity of a single-channel algorithm to the assumptions in AOPs (10776, 28) is not explicitly tested. Only improved statistics from using an improved aerosol model are presented, but I see no explanation where this improvement comes from. (see also general comments)

- *The multi-channel algorithm was tested by using GOCI measurement, but the effect was insignificant than that shown in this study. That was mentioned in lines 744-748 in the revised manuscript.*

10777, 5: typo

- *The sentence was revised by lines 138-140.*

10777, 7: when an aerosol model is representative, how can it be improved?

- *The description about the important of the aerosol model assumption was edited in lines 124-126 in the revised manuscript.*

10777, 14-end of para and Section 3.1: it seems awkward to use a minimum reflection method over a heavily polluted region like SE Asia, cf. the AOD values in Figure 2. The BAOD most likely has a substantial contribution to the total TOA radiance. How can this ever result in a realistic surface reflectance value? Most likely uncertainty in surface reflectance has a much larger influence on the retrieved AOD than the choice of the aerosol model, or tweaking the aerosol model as done in this MS. This method should be evaluated for the study area before it can be applied in the retrieval study.

- *The uncertainty in surface reflectance related with BAOD assumption was analyzed in section 3.5 (lines 477-495 and Figure 7(c,d)). The sensitivity of AOD error to error in surface reflectance was shown there. The test shown that the error in surface reflectance is significant for low AOD condition, while the error in aerosol model has great role in high AOD condition. The limitation of the BAOD correction was shown in lines 749-753 in the revised manuscript.*

Section 3.1 discusses the BAOD which ranges from 0 to 0.56, as determined from 7 years of MODIS AOD data. But how do these and other numbers connect with the numbers in Figure 4 which shows a maximum BAOD of 0.3 as the 'absolute minimum AOD' (caption) rather than an average value (10782, 6). I wonder about the representativeness of the surface reflectance data determined using the BAOD for atmospheric correction. The result is at best an average for these 7 years, but does not take into account year-to-year, seasonal or other temporal variations. Hence large surface reflectance errors are likely to result and hence large errors in the retrieved AOD.

- *Figure 4 was changed to cover the BAOD variation between 0.0 and 0.6, and the description was revised in lines 304-308. The inconsideration about temporal variation of the BAOD was mentioned in lines 239-243.*

10778, 20-end of page: needs some proofreading: 'was decreased', 'values of Japan', 'AE represents the change of particle size', 'where'

- *As per the reviewer's comment, the paragraph in lines 186-190 was revised.*

10778, 25: I see AE changes from blue (1.1) to red (1.4): these are certainly not 'not significant' changes in particle size distribution.

- *The sentence was removed in the revised manuscript.*

10779, 10: likely the authors mean that they kept part of the data apart from the model analysis and used them only for validation. Please reformulate this sentence.

- *The sentence was reformulated in lines 204-206 in the revised manuscript.*

10780, 11: one-to-one relationship between two variables: what do you mean: which variables?

- *The phrase was revised in lines 247-250.*

10780, 12-25: **see my general comment**: authors need to provide more detailed info on the aerosol model parameters used

- *As mentioned above, Table 2 in the revised manuscript was edited to show detail of aerosol model parameter. Accordingly, paragraphs in lines 341-380 were revised.*

10780, 26 to end of para: **see comment above on surface reflectance**

- *As mentioned above, the uncertainty in surface reflectance was analyzed in lines 489-494 and Figure 7(d) in the revised manuscript.*

10781, 10-end of para: how well does the cloud screening work? Could this be evaluated form comparison with collocated AERONET measurements?

- *The performance of cloud masking was qualitative evaluated by comparing the result with GOCI RGB image. In this study, the threshold of cloud pixel was adjusted to avoid removing aerosol pixel rather than perfectly detect every cloud scene. Thus, remaining cloud can be retrieved as thick aerosol plume.*

10782: section 3.2: what is the methodology used?

10793,1: how does the algorithm select an optimized aerosol type at each measured pixel? I don't think I have seen that in this MS. The flow chart in Figure 3 doesn't explain it, nor the text in Section 3. Since this is the key subject of the paper, this should be explained.

- *The aerosol model was obtained by averaging each variable (refractive index, volume size distribution) with respect to season, and the AOP variation depending on AOD was considered as Levy et al. (2007).Then, an aerosol model is applied for the RTM simulation in order of season and AOD. Thus, a single LUT is adopted for a season in which the measurement was taken as described in lines 260-262.*

10782, 19: what is 'radiative absorptivity'?

- *The words were changed into "scattering properties" on line 321 in the revised manuscript.*

10782, 23: 'regionally integrated aerosol model': what is meant with that in view of large spatial variations as shown in Figure 2? Are spatial variations not accounted for?

- *Since the algorithm cannot detect aerosol type for each pixel and time, a single aerosol model was used for whole region, and that is main uncertainty in this algorithm. The limitation causes the spatial difference of comparison statistics shown in Table 3 and 4.*

10783, 3: was the original data set re-analysed, or are the results from Kim et al. (2014) used for comparison?

- *The original dataset was re-analyzed in this study by using same dataset shown in Kim et al. (2014)*

10783, 6: 40 new sites? Table 1 lists only 35, including the original sites …. When the measurement period was extended by 2 years, was this for the additional sites? Which two years? How was temporal variation accounted for, i.e. were time series inspected on temporal variation over the extended period (previous period plus two new years)? Was this in some way accounted for in the application in the MI retrieval?

- *Table 1 lists 69 sites. Please check right column in the table. The two years represents the extension of the period of sun-photometer measurement from the 2010. While the original group includes the dataset measured between 1999 and 2010, the new group covers the period between 1999 and 2012. The temporal variation was accounted by extending the period of inversion dataset. With the increase of period, the number of AERONET site was increased due to the DRAGON-Asia 2012 campaign. Thus, the effect of temporal extension in the integrated AOPs was analyzed in Table 2 and section 3.3.*

10783, 12: AOP for 675 nm are shown, how about the wavelength dependence?

- *The wavelength dependence of AOPs were analyzed and applied to the RTM simulation as described in lines 349-353, not shown in this manuscript.*

10783, 22 and 24: which AOD bins?

- *The description of the AOD bin was edited in lines 347-348. The range of each AOD bin was also shown in Figure 5 and Table 2.*

10783, 23: increase of SSA above 0.005? I assume that here the authors mean an increase with 0.005, which is still very small considering that a few lines above the SSA was reported with only 2 significant digits and hence this is an increase with less than 1 %! What is the uncertainty in this analysis and how significant is an increase with 0.005? Especially since only 3 months in the spring are considered here versus a long term data set? Is this a seasonal variation? An anomaly for spring 2012? Does such a minor change indeed warrant a change of aerosol model in the retrieval which already carries other important uncertainties?

- *The sentence in lines 363-368 was revised to clarify the meaning in consideration with the standard deviation of the compiled SSA for spring.*
- *The 0.005 change in SSA represents the anomaly for spring from the values of the original model shown in Table 2(a).*
- *The paragraphs which describe the change of AOPs were edited including volume size distribution and complex refractive index in lines 362-363 and 370-377 in the revised manuscript.*

10783, 24-end of para: the numbers shown here for other months than MAM, and thus using other sites than from the DRAGON campaign, are larger than the SSA increase of 0.005, and thus the extension of the number of sites and the longer period seems to have more influence than the higher density of sites, which contradicts the conclusion on

10784, 1-5. Furthermore, when the authors say 'is believed to have caused this change (10783, 29), why don't they just checked it rather than believe?

10784, 6- end of para: I don't see how this discussion contributes to 'better understanding'. Furthermore it contradicts earlier statements that particle size distributions don't change. Also, the parameters describing the volume size distributions in Fig. 5 should be provided, they are not listed in table 2 as suggested in the caption.

- *To avoid the confusion, the descriptions about AOPs for other seasons were removed in the revised manuscript, and Figure 5 and Table 2 were updated. The sentences in 10784, 1-5 in the original draft were removed also.*

10784, 23: a new para should be started with 'Using ..'

- *The paragraph was edited on line 381 in the revised manuscript.*

10785, 3: what are the assumptions in the retrieval? Is there some iteration to obtain the optimum solution? Any converging criteria used for this?

- *The assumptions in this algorithm was represented and testes in section 3. The other iteration or conversion tests were not applied here.*

10785, 10 and further: 4% variation in SSA corresponds to about 0.04 in absolute value, i.e. more than discussed above and more than the effect of a new aerosol model as compared to the old one.

- *The reason of the 4% variation was shown in lines 402-403 in the revised manuscript.*

10786, 5: negative SSA? Probably a negative error in the SSA is meant?

- *The words were rephrased on line 425 in the revised manuscript.*

10786, 14: 'were ranged' or 'ranged'? 10786, 21: surface reflectance at which this occurs is (insert 'at which this occurs')

- *Per the reviewer's suggestion, those phrases were revised in lines 434 and 441 in the revised manuscript.*

10787, Fig 7 and discussion in first para: the Figure annotations are too small to see the meaning of the colour bar and also the figures are too small. After enlarging I determined that red means an AOD of 2, and there seems to be much more red in the MI than in the MODIS images in which the AOD is about a factor of 2 lower. Hence I don't understand what is meant with 'spatially well matched', and that values are 'slightly higher'. Also, which MODIS images match up with which MI images?

- *As per the reviewer's comments, Figure 8 was revised for easier viewing, and the description was edited in lines 526-535 in the revised manuscript.*

10788: section 4.2 and Figure 8: The authors claim the success of their updated aerosol model by the slope in Figure 8b which now is one, at the cost of more scattered data and lower r. However, if I compare Figures 8c and d, where, if I understand it correctly, independent data are used for the comparison, i.e. data which have not been used in the model improvement, the comparison becomes worse with the improved model: slope becomes smaller than one, and all other metrics are also decrease slightly. So in contrast to the conclusion of the authors, my conclusion would be that independent validation shows that the new model does not lead to improvement of the retrieval and hence the improvement in Figures 8a and b is due to using the same data sets for model improvement and testing. Also the Taylor diagram in Figure 9 and the data in Tables 4 and 5 do not convince me of a clear improvement: changes are visible, mostly small and are sometimes a bit better, sometime a bit worse. Were the numbers used here with the independent data or with the full data set?

- *As reviewer's comments, the performance of this algorithm is spatially inconsistent due to the limitation in aerosol type selection. The problems and detail of the comparison were discussed in lines 587-593 and 632-682.*

10789, 5-14: see my comments above on the accuracy in SSA and related AOD uncertainty.

- *The uncertainty related with the SSA assumption was mentioned in lines 593-596 in the revised manuscript.*

Section 5: several comments which have been given in the above.

- *Several sentences in lines 712-713, 725-727, and 745-748 were rephrased in the revised manuscript*.