Anonymous Referee #1

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General comments

This paper addresses biomass burning from agricultural fires in Central and East China, by using a combination of products derived from remote sensing instruments in space. This idea is not new, but the authors also combine a novel algorithm developed by them, currently under discussion in AMTD (Xue et al., 2011). This paper lacks critical analyses and key in-depth discussions as described below, making the manuscript sketchy and unacceptable for ACP. Inasmuch as this paper mainly focuses on describing advantages of a new tool, it is not within the specific scope of ACP. I recommend it to be rejected and to be resubmitted to AMTD after thoroughly addressing the issues discussed below.

Thanks so much for your comments. We have revised our manuscript and responses are in situ.

Specific comments

(1)Proposing a new integrated aerosol product must start with a discussion about the physical basis that define the background and the rationale for the new product. In the case of merging products, how to address the different assumptions and constraints considered in their development? What key factors determine the accuracy of the retrievals in the merged product? What about differences in the original algorithms about the necessary signal strength for deriving aerosol products? All these key issues need to be addressed in a consistent way.

Responses: This paper focused on the analysis of biomass burning procedures using merged AODs. The real AOD at one location and one time is only one value although different AODs may be retrieved from different algorithms and different satellite sensors. Besides, different AOD products have different advantages. In this paper, we intend to show that merged AODs from those different AOD products could be more useful for applications such as biomass burning monitoring.

Currently, NASA/Collection 5.0 and Collection 5.1 will merge to get Collection 6. The main principle is:

1) For a pixel with Collection 5.0 value only, pick Collection 5.0 value for Collection 6 value. So do Collection 5.1.

2) For a pixel with both Collection 5.0 and Collection 5.1, pick the AOD value with higher QAC value.

We applied a merging method to merge two different MODIS AOD product and MISR AOD product in order to show more information on biomass burning monitoring. We implemented an optimal interpolation technique similar to the methodology described by Collins et al. (2001) for INDOEX aerosols using the MATCH model.

(2)MODIS and MISR have many advantages in what they can provide products to analyze aerosol spectral dependence, or Angstrom exponent, derive particle size, phase function and other optical properties. What can we learn from the new product proposed in the manuscript? It only includes AOD from MODIS and

MISR, why not combining more information, that's already available, and thus gain a true synergistic approach?

Responses: The other MODIS products such as particle size etc. are not recommended for quantitative analysis by NASA. This is the reason we used the AERONET and CARSNET data. Actually, it is very hard to have daily coverage from other satellites except Terra and Aqua.

(3)The main source of information in the new product comes from the SRAP-MODIS algorithm described by the same authors in a paper currently under review (Xue et al., 2011). This can be inferred from the comparison of Figures 2d and 2e, where maybe _90% of the information in the final product comes from the SRAP-MODIS input. However, the paper by Xue et al. (2011) describing SRAP-MODIS has gotten rejection recommendations from both reviewers that have analyzed it. Thus the core around which the new product in this manuscript is built still lacks the ballast of acceptance by the scientific community.

Responses: The new merged AOD results did not include the SRAP-MODIS AOD.

(4)The authors never really address in the manuscript the issue on how to compare AOD derived from their product, which represents a time snapshot of the atmosphere with large spatial variability, and the AOD from AERONET or CARSNET, which correspond to point measurements with time variability. On page 10470, lines 9-10, the authors simply mention "The time interval between an AERONET measurement and a satellite passing overhead is less than 30 min." Then, on page 10472 lines 23-25 the authors say "In the comparison with AERONET AOD data (. . .) we required that the time difference between satellite overpass and the AERONET AOD measurement within half an hour." The authors must follow a formal procedure to convert spatial and temporal scales, like for instance the one discussed by Ichoku et al. (2002), who describe how to convert spatial averages of 50 x 50 km into 1 hour of AERONET data.

Responses: The paper follows the procedure proposed by Ichoku et al. (2002). During the comparison process, spatial mean of the AOD datasets and temporal mean of the AERONET observations are used. For calculating MODIS AOD spatial statistics, a grid of 5 by 5 MODIS aerosol retrieval pixels is created, with the AERONET station in the middle. Since each MODIS aerosol pixel represents approximately a 10 km area, the subsetted 5×5 area is approximately 50 km by 50 km. For each satellite overpass of each AERONET site, every AERONET observation within ±30 min of the overpass time was extracted. For calculating MISR AOD spatial statistics, a grid of 3 by 3 MISR aerosol retrieval pixels is created, with the AERONET station in the middle. Since each MISR aerosol pixel represents approximately a 17.6 km area, the subsetted 3×3 area is approximately 50 km by 50 km. For each satellite overpass of each AERONET site, every AERONET observation within ±30 min of the overpass time was extracted.

(5)Validation issues. The authors correctly point out that validation efforts should be considered as a continuous process, but still they should have produced more results: there are several years available with plenty of MODIS and MISR data, but the authors show only a few days worth of data, which is unacceptably scarce. If the focus is only on biomass burning season, still there are several years available to analyze that season. Another issue is the lack of validation against CARSNET observations. The authors indicate they have used this network, but Figure 3 shows comparisons only with AERONET measurements. When discussing data available for the sake of validation, the authors fail on citing the seminal paper by Holben et al. (1998), not properly crediting that landmark work for AERONET measurements. On page 10470, lines 7-9 the authors report using AERONET level 1.5 data, when usually it is recommended to use level 2.0

calibrated data for validation efforts. Level 2.0 data usually takes longer to be available for analyses, but since the studied period was from 2007, most likely this level 2.0 data could be used in the manuscript, otherwise the authors should make the case for their use of level 1.5 data.

Responses: "Holben et al. (1998)" is cited in the revised version. Normally, Level 1.5 data are cloud-screened and are sufficient for this study. Besides, Level 2.0 data are not always available. We use the Level 1.5 data when there is no Level 2.0 data. When there is Level 2.0 data, we use Level 2.0 data.

6) Statistical issues. Throughout the manuscript there's a lack of care about the proper statistical treatment for the data. All results are shown with 4 significant figures, even for cases where the number of data points is as scarce as 6 (Figure 3a). The largest dataset for validation has 72 data points (Figure 3d), so the statistical analyses also cannot be presented with 4 significant figures. The authors do not mention any regard to uncertainty in their estimates for the AOD retrievals using their proposed product. From a purely statistical point of view one needs to address the uncertainty in an estimated quantity in order to attribute any meaning to the results.

Responses: We have removed this part as we didn't use SRAP data any more.

7) Methodological issues. Considering the merging of data products derived under very different conditions and assumptions, the authors mention on page 10472: "The sensors have varying designs and characteristics, and there are differences "associated with radiometric calibration, assumption of aerosol properties, cloud contamination and correction of the surface effect" (Li et al., 2009)." There's no further discussion on these complex issues, or how they should be tackled when merging the data. The manuscript mentions the merging of data from SRAP-MODIS, Deep Blue MODIS, Dark Target MODIS, and MISR data. However, the method section starting on page 10471 describes only SRAP-MODIS and Dark Target MODIS, nothing else. The model description on page 10471 is confusing and lacks a better structured discussion.

Responses: We have removed this part as we didn't use SRAP data any more.

8) Conceptual issues. Section 4.2 on pages 10473-10474 seeks to compare satellite retrievals with ground-based observations. There is no discussion about whether insitu measurements on the ground can reflect or how they can be related to the satellite retrievals. The authors simply put these results together without a word of caution or any mitigating circumstances about when a comparison is properly in order. The use of the cloud mask product MOD/MYD35 is not enough accurate for aerosol retrievals, that's why the MODIS team has developed their own cloud mask which is embedded in the MOD/MYD04 aerosol product. Seeking to infer cloud information only from MOD/MYD35 datasets as discussed by the authors will likely lead to misidentification and to completely missing out small clouds under the 1-km resolution for that product, and again no discussion on these flaws is offered by the authors. Figures 5 and 6 show time series of AOD and Angstrom exponent derived from AERONET and CARSNET. The results in Figure 5 and 6 are interpreted without linking them to the retrieved values from the product discussed in the manuscript. Also, the authors attribute AOD spikes seen in Figure 5 to "thin cirrus clouds" (page 10473 lines 26-28, page 10474 line 1), but the data should had been cloud-screened, so the AOD series should only contain optical depth information attributed to aerosols, not clouds. This is also another reason why level 2.0 AERONET data should be used (cf. issue 4 above). Moreover the data is inconsistent: if there are cirrus clouds why the Angstrom exponent remains unchanged before, during, and after the spikes in the AOD series in Figure 5?

Responses: Section 4 has been rewrite in the revised version. The temporal and spatial variation of one procedure China agricultural biomass burning in 26 May 2007 to 16 June2007 has been analyzed using satellite data (merged AOD data and Active fires data) and ground observation data (PM2.5 data, AERONET data and CARSNET data). The cloud mask product MOD/MYD35 is only used in the study to explain the extreme high AOD values in Beijing.

9) Minor issues.

Tables 1 and 2 can easily be combined in just one table.

Yes, Table 1 and Table 2 have been combined into one table in the revised paper.

Table 3 shows a lot of information about the spectral channels in MODIS and MISR that are just not used on the manuscript.

Responses: Table 3 has been removed.

Figure 1: why is it necessary to have 2 maps shown? The map on the left shows the names of provinces in China that are just referred to once in the paper. The colors chosen to represent the maps are confusing: mainland China is represented in white, and so is the ocean. The 2 maps in Figure 1 are also confusing because the names of AERONET and CARSNET sites cannot be easily read from the Figure. To improve the readability the authors should change the names to letters or numbers, and assign them in the Figure caption. This should also be made to Figure 4.

Responses: Figure 1 has been modified.

Figures 2 and 3 legends show items a,b,c, etc., but these identification letters are not shown in the graphs.

Figure 2 and Figure 3 have been revised in the latest version.