**Atmospheric
Chemistry
and Physics
Discussions**

Interactive comment on "A multi-angle aerosol optical depth retrieval algorithm for geostationary satellite data over the United States" *by* H. Zhang et al.

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We thank reviewer #1 for the helpful comments and have made a lot of revisions about the manuscript following the suggestions.

The manuscript describes the use of the MAIAC algorithm to retrieve aerosol optical depth using GOES data. The results are compared to the retrieved optical depths in GASP, the GOES standard aerosol retrieval product. Both results are validated using AERONET data at six sites in the continental U.S.. Differences between the two retrieval approaches include 1) GASP uses assumption of a

Lambertian surface reflectance, derived from a 28 day period whereas MAIAC uses a non-Lambertian surface reflectance derived from MODIS BRDF data over a relatively short time period; 2) choice of an appropriate aerosol model; different cloud screening techniques. The study shows that the two approaches provide similar results for the 4 eastern AERONET sites, where the surface is relatively dark and timewise highly variable but the MAIAC algorithm provides superior results at the two western AERONET sites where the surface reflectances are typically more stable. In general this is a well-written draft which provides the reader with a good understanding of the retrieval issues involved in the two methods. As such, I recommend it for publication. However, there are some improvements which can be made and these are listed in the comments.

Comments: 1) Section 4.1 Image co-registration should be removed (both text and Fig.s 4 and 5). The subject matter is divorced from the main topic and serves only as an impediment to the flow of the manuscript. We can assume that the authors know what they are doing in this regard. My original comment was that this section was not clearly written and should be improved but even after that, this section comes across as being off-thetopic. It's a necessary step in the MAIAC analysis but so are a lot of other steps not explicitly called out like this one.

This section is removed in the new version.

2) Many of the plots are poorly printed, are too small or lacking all the needed information, which hopefully will be improved in the final draft. a) In Fig. 7 the contour values are impossible or hard to read.

The figure is replotted with clearer contour values.

b) In Fig. 10 there are no AERONET site labels. I assumed that the plots are arranged as in Figs. 8 and 9. Also there is no labelling within the plot as to which column of numbers pertain to MAIAC and which to GASP; the reader has to determine this from the main text. Also one cannot differentiate GASP symbols from MAIAC symbols.

The suggested revisions are made.

c) Fig 14 and the associated main text are hard to understand. I presume that the axis labeled "surface reflectance" is the surface BRDF and that the plotted values of the BRDF are derived from a GASP surface retrieval. If so, this should be stated explicitly in the main text and in the figure.

The surface reflectance is retrieved using GOES channel 1 TOA reflectance and AERONET AOD in $20 \times 20 km^2$ areas at the AERONET sites. Such description is added in the main text and the Figure description text.

3) Finally, it is not clear to me whether the MAIAC approach to retrieving aerosol prop-erties using GOES data (or aerosol properties from GASP, for that matter) is a valuable endeavor to persue. Figure 15 (b) shows that the MAIAC approach with GOES data can provides better coverage than the operational MODIS product shown in Figs. 15 (d) and (e) and probably better quality than the operational GASP product shown in Fig. 15 (c). But using MAIAC on MODIS data (Terra and Aqua) would also lead to a better MODIS aerosol product. So the question becomes, can the unique temporal nature of the GOES data provide

unique temporal aerosol information (in spite of the various issues associated with the data), that is not available with the MODIS data or is the analysis of GOES data, even with MAIAC, insuffiently accurate to do this? This issue was not directlt addressed in the current draft but some comments along this line of thought should be included in the Conclusion section.

The following text is added in the conclusion:

The half-hourly temporal resolution of GOES AOD retrieval is especially useful for air quality monitoring of events with rapid development and motion such as smoke and pollution transport. Although MAIAC for MODIS also can retrieve accurate AOD over western US, it only provides twice daily retrievals. It is hard for air quality forecasters and researchers to tell the aerosol motion from these two snapshots from MODIS AOD retrievals. With the help of the animation of half-hourly GOES AOD retrieval imagery, air quality forecaster and researchers can easily tell the motion of the aerosols. Moreover, due to the block of clouds, it is possible that none of the two MODIS instruments have retrievals in some areas at the times of the satellites passes. At some other times during the day, the cloud may move out and the areas are clear to be observed by the geostationary satellites. Thus, high temporal observation from geostationary satellite can also have improved daily AOD retrieval spatial coverage than MODIS.