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Atmospheric Measurement Techniques Discussions

Interactive comment on "Evaluation of BAER surface model for aerosol optical thickness retrieval over land surface" *by* Y. S. Chiang et al.

Anonymous Referee #1

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General comments and recommendation

This paper describes two methods to model surface reflectance considered for use in the Bremen Aerosol Retrieval (BAER) as applied to Medium Resolution Imaging Spectrometer (MERIS). The surface reflectances produced by the models are compared against Moderate Resolution Imaging Spectroradiometer (MODIS) estimates of surface reflectance. The two surface models are compared by performing retrievals with both over Taiwan.

Surface reflectance estimation is one of the major factors which limits the accuracy of aerosol optical thickness (AOT) retrievals from passive instruments such as MERIS, MODIS, and others. In that regard it is welcome to evaluate different surface models and their effects on aerosol retrievals. However, I feel that the paper falls short of that

goal. It reads more like a chapter of an ATBD than as a scientific paper, is very limited in scope, and I do not see broad applications of this outside of the BAER team. The authors mainly reference their own previous works on BAER, rather than the many other ways satellite aerosol retrievals deal with surface reflectance, which further indicates how these results are not likely to be of use to others outside of their team. It is not clear to me after reading the paper how the authors arrive at and justify their conclusions. Additionally, I have some issues with the methodology, the writing style can be difficult to follow, and some figures need improvements in quality.

For these reasons, I recommend that the paper is rejected from AMT. If the authors were to perhaps prepare and release a dataset of AOT over Taiwan (or Germany; see specific comments) from the MERIS record and perform some scientific study with that, then a summary of these results could be included as a section of that paper. Otherwise, the authors need to make some general statements about surface modelling for AOT retrieval which have broader applications (both for different sensors and geographic regions) for the paper to be of scientific use to others. I encourage the authors to do one of these as aerosol remote sensing is not a solved problem so new ideas are welcome. I do not wish to sound too negative because I am sure this analysis was useful for the BAER team. But I feel both of these options would require the paper be almost rewritten from scratch, hence this recommendation.

Specific comments

I have some specific comments concerning the analysis method, which I include here in case the authors decide to prepare a new manuscript based on these results.

Section 2 and figure 2:

You show comparisons with AERONET for 3 days in Taiwan and present this as justification for changing the surface reflectance model. I have several problems with this. Firstly, this sample size is very small. Secondly, you are using a prescribed aerosol model from Lindenburg, Germany and applying it in Taiwan. That alone has the po-

tential for introducing a large error, as I suspect aerosol properties in Germany from an experiment in 1998 could be very different from aerosol properties in Taiwan in 2007! This aspect does not make sense to me and surely is just introducing additional sources of error in the analysis. You should at least be using more appropriately matched data: different aerosol model, different geographic region, or both. Most of your points are for moderate or high AOT, which is exactly where aerosol microphysical model errors play a big role in AOT retrieval accuracy.

Section 3:

If I understand correctly, you compare your models to MOD09 data. However, I don't think these have any BRDF correction, i.e. they are the effective reflectance of the surface without any atmosphere in the way for that specific viewing geometry. These values are therefore not appropriate to compare directly with MERIS simulations, because the geometries will be different. Solar geometry may be similar but viewing zenith angles could be very different; if they are not for these cases, because the orbits overlap, then you should state that.

You also did not discuss the accuracy of the product or provide an up-to-date reference. You do cite a 1999 paper but don't discuss the results; also, that paper predates the Collection 5 version you use by quite a few years so may well no longer be applicable. I would suggesting asking someone on the MODIS team about this.

You note differences between the sensor bandwidths but don't estimate how large an effect these will have on your results.

The notation used is sometimes clumsy, with very long subscripts in the variable names and some near-replication (e.g. F used in the text for equation 4, f used in equation 4 itself, and a different f introduced on page 2659).

Section 4.4:

In the last paragraph of this section you say that using the alternative surface model

makes the AOT go in the right direction in reference to your previous AERONET comparisons. However, given the limited nature of your AERONET sample size, plus aforementioned aerosol microphysical model assumption limitations, I do not find this convincing. In particular, this could just be some compensating errors in the retrieval, i.e. getting closer to the 'right' answer because you are making cancelling errors in both surface and aerosol properties, rather than getting either surface or aerosol more correct. To be more convincing you should really look at more statistics, compare retrievals directly with AERONET, and do something better about your aerosol model.

Figure 2: You don't mention the color scales, how the comparison is performed, where the error bars come from, etc.

Figure 3: This is unclear and would be improved with colored lines.

Figures 8, 9: This does not look like a linear relationship to me; there is definite curvature, and multiple clusters in Figure 9. Did you consider some non-linear fitting process instead? I am not sure what the message I am supposed to get form Figure 9 is.

Figure 12: You should define the different symbols in the caption, not just the text.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 2645, 2012.