

Interactive comment on “Evaluating the assumptions of surface reflectance and aerosol type selection within the MODIS aerosol retrieval over land: the problem of dust type selection” by T. Mielonen et al.

Anonymous Referee #2

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The manuscript describes a study of the surface-related assumptions and assumed aerosol types on retrieval of AOT and Angstrom Exponent (AE) by MODIS aerosol algorithm MOD04. The main result of this work suggests that the NDVI-dependence of the spectral regression coefficient (SRC) in the parametric model of Levy et al. (2007) should be reversed. Indeed, in the current MOD04 model the SRC increases with NDVI whereas this and other studies indicate that this dependence should be opposite. This result is rather important and deserves publishing. However, the manuscript requires

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a major revision before this work can be published: 1) The language requires major improvement. The second co-author of the paper may certainly help in this regard. Here are few examples from the manuscript:

“Our study suggests that the aerosol model combining is sensitive . . .”

p. 3428: “algorithms made to retrieve information from satellites are underdetermined”. Algorithms can be good or bad, but they cannot be underdetermined.

Everywhere: change “fine aerosol” or “coarse aerosol” to fine mode aerosol or fine aerosol particles. Everywhere: please, don’t use the word “dominated” with respect to aerosols, rather use some other terminology. For example, you can explain in the beginning that the regional (or baseline) aerosol model based on AERONET climatology will be called “a fine aerosol model”.

p. 3429: Uncertainties in the surface reflectance, as well as aerosol absorption are too large. Should be “as well as in aerosol absorption”.

“The slope(660/2130) also depends on the scattering angle, however, it does not have as large effect as the NDVI.” Where does it follow from? Is this the law of nature or what? At least, you should say that “In parameterization of Levy et al., (), . . .”.

“However, this second slope does not have as strong effect on the aerosol model combination.” You may say “retrieved dust fraction” instead of “aerosol model combination”.

3435: “are equal for the over and under classes” You may re-phrase it as: .. for $AE > 1$ and $AE < 1$ cases.

3437: “for single pixels” Correct to “a single pixel”.

2) The current logic of the paper is very “fuzzy”. The link between the causes and the consequences is not thought through. For this reason, I had to read some sections several times before I could arrive at conclusion of what authors tried to say, mainly based on my knowledge in the field rather than on what’s written. What is also missing

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in the paper is a clear discussion of why these specific parameters are studied. How can you expect improve aerosol retrievals given huge uncertainty in the surface parameterization (see Fig. 5)? A small theoretical sensitivity study would tell you what can be expected at this level of uncertainty. In other words, this would help to answer the question of what accuracy in surface parameterization is required to derive AE using MOD04 algorithm.

3436: "This raises the question whether absorption capacity of the fine dominated aerosols would affect the combination of the aerosol models in the MODIS aerosol retrieval?" So, where is the answer? Without any further discussion you switch the subject.

"In the next step, we investigated the surface reflectance values from the C5 data for single pixels and divided the data into two classes based on MODIS AE as before. Then we calculated the monthly mean surface reflectances at 660 nm from all measurements and normalized the surface reflectance values with these mean values to remove seasonal variations."

I cannot understand what was done. The predicted surface reflectance in MOD04 algorithm based on measurements at 2.1 μm and parameteric formula does not depend on AE. Normalization does not make sense either.

As a continuation: "Surface reflectance should not depend on the AE, as the AERONET AE data shows." ??? How can you make any conclusion about surface based on AERONET measurements?

3) Some statements of the manuscript are either incorrect or unfounded.

3433: "The dust model has always larger TOA reflectance values at 660nm than the fine dominated model." That may not be a true statement.

3434: Please, explain the choice of selected resolution ($60 \times 120^\circ$) of surface albedo. You only get 9 points across the globe. How can you use these data for analysis of

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MODIS retrievals made at 10 km resolution? Using 0.5° by 0.5° resolution seems to be much more logical for this analysis.

"Surface albedo is the ratio of the radiant flux reflected from a unit surface area . . . , thus it is not angle dependent." This is not true. By definition, albedo is a ratio of reflected to the incident radiative fluxes at the surface, and it depends on solar zenith angle (SZA).

p. 3430: Please, provide a reference to the MODIS instrument which is relevant.

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