**Atmospheric
Chemistry
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Discussions**

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Interactive comment on "Evaluation of the MERIS aerosol product over land with AERONET" *by* J. Vidot et al.
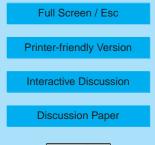
J. Vidot et al.

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The authors thank Referee 4 for his comments and have responded to them below.

Response to the general comment:

Vidot et al.: Both algorithms are performed during the same retrieval but level2 aerosol optical thickness product has been changed from 865 nm (1st Proc.) to 443 nm (2nd Proc.). The aerosol optical thickness product over land at 865 nm has been defined to ensure continuity with the aerosol optical thickness over oceans but the retrieval is based on blue and red channels (where surface reflectance is the lower). When first retrievals have been tested on MERIS data, a problem of weak aerosol product coverage appears and developer decisions has to be taken. To reduce the algorithm changes, we decided to extent the DDV concept to brighter surfaces by keeping the surface re-

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flectance LUTs and added a simple linear correction versus ARVI. The estimation of the linear correction coefficient have been done thanks to MODIS surface albedo maps and explanations are given in Santer, R., Ramon, D., Vidot, J. and Dilligeard E.: A surface reflectance model for aerosol remote sensing over land, Int. J. Remote Sens., 28, 737 8211; 760, doi: 10.1080/01431160600821028, 2007.

Responses to specific comments:

1. Which MERIS channels are used for aerosol retrieval, and what is its resolution?

Vidot et al.: MERIS uses the 412, 443, 670 and 865 nm bands. The first three bands are used for the aerosol optical properties retrieval where the slope of the linear regression of the natural logarithm of optical thicknesses is used to fit the Angström coefficient. The last three bands are used for the ARVI calculation (the equation is given at the next specific comment). MERIS spatial resolution is 1.2 by 1.2 km (at nadir) in normal resolution and 0.3 by 0.3 km (at nadir) in full resolution.

2. Please define ARVI, and explain how it should be related to surface reflectance in other channels.

Vidot et al.: ARVI has been defined as follows: $\text{ARVI} = \frac{\left(\rho_{aG}^{865} - \left(\rho_{aG}^{670} - \gamma\left(\rho_{aG}^{443} - \rho_{aG}^{670}\right)\right)\right)}{\left(\rho_{aG}^{865} + \left(\rho_{aG}^{670} - \gamma\left(\rho_{aG}^{443} - \rho_{aG}^{670}\right)\right)\right)}$

Where ρ_{aG} is the reflectance corrected from gaseous absorption and Rayleigh scattering. γ is a coefficient fixed to 1.3 for DDV (Santer, R., Carrère, V., Dubuisson, P. and Roger, J. C.: Atmospheric correction over land for MERIS, Int. J. Remote Sens., 20, 1819-1840, doi:10.1080/014311699212506, 1999.). The advantage of the ARVI is that it allows giving a relation between NIR (where aerosol contribution is low) and red and blue (where surface contributions are low).

3. Why use Junge aerosol models, when almost every other algorithm uses lognormal assumptions?

Vidot et al.: The Junge size distribution was selected at the beginning (more than 10

years ago) simply because of the absence of spectral dependence of the phase matrix, that simplify the algorithm and the calculation of LUTs of aerosol optical properties.

4. How does MERIS "choose" between aerosol models?

Vidot et al.: A double loop (for α between 0. and 2.5 by step of 0.1 and for τ between 0 and 1.5) is done. When the spectral dependency (given by the slope of the linear regression) of the logarithm of the 3 calculated τ (at 412, 443 and 670 nm) is the closest to the alpha used in the loop, then the model is chosen.

5. Why is the "valid" alpha defined as 0-2.5, when AERONET data (Table 1) shows a larger range (at least to 3.4)?

Vidot et al.: This range has been extended from the first processing (that was 0-1.5) to take into account much aerosol types. But we did not expect to get a lot of retrievals with the very high value of α at 3.4. We think that the range 0-2.5 is enough for most of aerosol types.

6. Page 3729: As for the MERIS/AERONET co-location, how much real-estate does a 10x10 box of MERIS represent?

Vidot et al.: A 10x10 box represents a surface of 12x12 km2 at nadir.

7. With only two to eleven matchups at some locations, I do not think the results should be reported in Tables 2-3.

Vidot et al.: We agree with that but because those matchups are used for the rest of the comparison, we kept them.

8. Pages 3729-3730. Relating to cirrus. Since cirrus is relatively homeogenous, how does the sigma filter help screen out cirrus?

Vidot et al.: The sigma filter does not help screening out homogeneous cirrus, that is what we explain page 3730 line 1. It is why, in the case of cirrus contamination, we think that a filter based on the O2 A-band should be developed.

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9. Table 4: are the "red" entries for 1st proc/June models and 2nd/proc Junge models, reversed (to compare with the text suggesting that 1st processing derives in the red?

Vidot et al.: Both processing needs the red to derive aerosol products. In this algorithm, aerosol models are defined by their spectral dependencies (alpha). To be able to select an aerosol models, you need at least 2 bands (here blue and red, where the surface reflectance is low). We used 3 bands (2 in the blue and one in the red) to be more accurate in the spectral dependency calculation. In the first processing, aerosol product was the aerosol optical thickness in the NIR because of synergy with aerosol product over oceans. In the 2nd processing, It was decide to output the aerosol optical thickness in the blue because of the bad retrieval in the red and then the extrapolation in the NIR was even worst than the first processing.

10. Because I am confused by the order of 1st processing/2nd processing/ Junga/IOPA/ARVI/LARS, etc, I do not understand the differences between Figs 2,3,4,5, 9, 11, 12, 13. It seems that by showing Fig 13, that this is the best case. But there are also some matchups (x=1.5, y=0.2) that were not present in the previous (worse) comparisons.

Vidot et al.: We could not see the problem. I think all figures are well defined with all matchups.

11. Also, with the same figures (comment 10.) I feel that the axes are reversed. Usually I think of AERONET as the independent variable (the truth) and the satellite retrieval as the dependent variable (as the y-axis).

Vidot et al.: We agree with that but changing the axes will not change the results.

12. Fig 7 is so small (in the print version) that it is unreadable. Why are the phase functions so different for small alpha (=0.0, =0.3), and also for large alpha (=2.0, 2.2). Are there "shape" (non=spherical) issues as well?

Vidot et al.: In our inversion process, we consider that the corrective factor (f) of the

multiple scattering is the same irregardless of the shape of the particle. In practice, if we consider particles randomly disposed, for small particle we have the same inherent optical properties and this assumption is justified. However, if we consider large particles (α = 0 or 0.3), we reach the Rayleigh-Gans; scattering regime for which the shape of the particle is important. For this scattering regime, for a typical scattering angle of 120°, a difference in the IOPs (namely the aerosol phase function) appears generally as we can see on Figure 11. For small particles (α = 2.0 or 2.2), we have actually a mono-dispersed mode (namely the nuclei one). Indeed, for large values of alpha, we observed, for our aerosol models, a decrease of the extinction coefficient which corresponds to a modification of the scattering regime. This decrease does not appear for Junge models. This is the reason why we observe differences on the aerosol phase function.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 3721, 2008.

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