

## ***Interactive comment on “Retrieval of aerosol mass load (PM<sub>10</sub>) from MERIS/Envisat top of atmosphere spectral reflectance measurements” by G. J. Rohen et al.***

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The manuscript "Retrieval of aerosol mass load (PM<sub>10</sub>) from MERIS/ENVISAT top of atmosphere spectral reflectance measurements" of G. J. Rohen et al., submitted to Atmospheric Measurement Techniques, covers an important valuable application of the retrieval of aerosol properties from space-based measurements for air quality monitoring. The authors show that a linear correlation between aerosol optical depth and PM is not sufficient to explain the natural variability of PM. By adding other parame-

C2746

ters like boundary layer height and humidity, the correlation is improved. Nevertheless, the results presented here show that space-based PM retrieval is particularly valuable in rural area (proved by Fig. 11) where in situ measurements are very sparse and then should help to understand the transport of PM over large areas. Over cities, the correlation found is only based on 7 points (Fig 10), which makes the conclusion a bit optimistic. Overall, the manuscript is well written but the structure of the paper is not good. I recommend the author to ask a scientist outside of his group to carefully read the manuscript to check inconsistency (for example the wavelengths of the MERIS bands are different in line 7 of page 5435, line 20 in page 5453 and in table 1).

I have some general comments: There is a lack of recent publications on this topic in the manuscript. A lot of papers have been published in the field and must be added. It should be mentioned also that PM is a gravimetric measurements of dry particles (the tubes where the particles are trapped are heated).

Finally, I do not recommend this manuscript for publication in AMT in this form but after a major revision that fulfil the AMT standard.

General comments: See also our response to the general comments of reviewer 1: we agree that the structure has to be improved and actual publications have to be added. Both has been done now: we structured the text, added sections and a dedicated section with a critical discussion as demanded by the other reviewer. The humidity of the particles has been treated at p. 5441. We describe the differences of the compared measurements in the discussions, in particular about the humidity content of the particles. We deleted inconsistencies and made major revision of the text. The impact on the radiative transfer caused by humid particles has been considered by correcting scattering coefficients and radii. In particular we made remarks about the different physical state of the particulate matter in both measurements.

PLEASE NOTE THAT WE HAVE MADE MAJOR REVISIONS OF THE PAPER WITH SUBSTANTIAL CHANGES OF THE INTERPRETATIONS AND CONCLUSIONS AS

C2747

WELL AS FIGURES. A REVISED MANUSCRIPT CAN BE PROVIDED ON REQUEST.

Specific comments: Page 5431 Last sentence: I do not think that space-based measurements of PM will be able to replace ground measurements for at least two reasons (1) we need ground measurements for validation or calibration as the authors did ; (2) most of ground measurements are made in cities where the retrieval of aerosol optical depth is really complicated due to lack of surface reflectance model of urban area.

We have made a new assesement of the results and revised text and in particular conclusions in details. We now state that the retrieval gives promising results for German sites where particle radii is about up to 1  $\mu\text{m}$ . Potential applications are the observations of movements of particulate matter and to fill gaps in rural regions where no measurements are available. Over cities, the bad resolution as well as the different aerosol types lead to larger imprecisesness. The benefits of the here presented retrieval are based on the new methodology to infer information about the radii through a smooth ANGSTROEM coefficient.

Page 5431 Line 14: the reference to von Hoyningen et al., 2003 is not correct for aerosol retrieval over water.

We revised the text and omitted the retrievals over water and therefore this reference.

Page 5431 Line 23: "many assumptions" is not enough; can you give some example like surface or aerosol models? What do you mean with local models?

Assumptions have been described and effects have been estimated now in the added critical discussion. Local models are misleading. We aimed to describe the different size distribution models, ie., aerosol types, in particular wrt bimodal size distribution functions by adding information from AERONET stations. We revised the passage accordingly.

Page 5432 Line 20: Remove references to Levy's papers since they did not work on PM retrieval.

C2748

Removed.

Page 5432 Line 20: rephrase by including that they use AERONET to get aerosol absorption properties.

We added this information to the text passage now.

Page 5433 Line 1: I am surprised by the sentence "For instance, . . .". I thought that the definition of PM is clear. Could you tell a bit more about that and give some examples?

The definition of particulate matter itself is clear but not that of PM<sub>2.5</sub> and PM<sub>10</sub> at different devices. Filters are commonly used to extract the particles of the air. Those filters exhibit not a sharp cut-off as assumed for satellite date retrievals but a smooth transition. We have described this feature in an extra paragraph (Adaption of PM<sub>10</sub> defintion) and dicussed this in a critical way in the added discussion paragraph.

Page 5433 Line 8: According to the reference list, the year of the reference is wrong.

Corrected.

Page 5433 Line 10: Is there any European group that work on assimilation of space based aerosol optical depth for PM transport modelization?

There are several studies dealing with the relationship between AOD and PM, using models or ground based measurements for assimilation products: (Timmermans et al., 2010: They used a model to infer from OSSE satellite and ground based PM<sub>10</sub> measurements to an assimilated product. Schaap et al. (2008) used also AERONET data for an assimilation product. van Donkelaar (2010) used a combined chemical transport model inferring PM<sub>2.5</sub>. Pére (2008) presented a study about a potential retrieval using the relationship from AERONET stations. Pelletier et Santer et al., (2007) presented an semi-analytical approach for finding a relationship between AOT and PM, at least, they involved auxiliary meteorological information.

Page 5435 Line 1: Last sentence, why?

C2749

The spatial resolution of MERIS is about 1x1 km or 300x300 meters at best. This averaging effect makes it difficult to compare with the point measurement of ground stations. Averaging over several gauging station measurements makes no sense because of the much worse resolution of those measurements.

Page 5435 Line 13: Do you mean "surface" pressure? if yes please add.

added

Page 5435 Line 16: At which wavelength the TOA reflectance must be lower than 0.2.

We now omitted the section about cloud retrieval because it's not relevant to the paper's purpose. We selected cloud-free scenes above Germany by viewing to the AOD maps.

Page 5435 Line 25: What is the CAMELEO database? Do you have a reference for it?

We have now made proper citation. Changes in Arid Mediterranean Ecosystem on the Long term and Earth Observation, Escadafal 2001.

Page 5437 Last part: What is the explanation of the increase of the bias with the wavelength? Is that related to the surface model or to the spectral dependency of the aerosol models?

This is due to the difficulties with the surface model for the retrieval of AOD. Radiation changes stronger in the radiation wavelength of (green) vegetation.

Page 5438 line 4: define m. why rho is humidity corrected?

There is an internal derivation of the lighter mass due to humidification of the particle.

Page 5438 Line 10: add "height" to the end of the sentence

Added

Page 5439 Line 21: "a" is missing in uncertainties.

Corrected.

C2750

Page 5440 Line 10: I do not think that the air mass factor depends on T and P in this formulation.

The air mass factor depends on the geometry and the scattering, and latter is affected by T and P. This may be a small effect, but existent. We revised the passage adequately.

Page 5440 Line 13: why is SEAWIFS appears?

We stroke this. It's simply wrong.

Fig. 5: what stand for WASO, SSAC and SUSO ?

Water soluble, sea salt accumulation mode and sulphate soluble, we choose the water soluble mode. We revised the plot adequately. (outstanding . . . , we will deliver next submission . . .)

Fig. 12: Make figures more readable. What is the black shape on the bottom of the bottom figure

Black indicates "no retrieval possible", we made a remark in the caption adequately.

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Interactive comment on Atmos. Meas. Tech. Discuss., 3, 5429, 2010.

C2751