Atmos. Chem. Phys. Discuss., 14, C11743–C11757, 2015
www.atmos-chem-phys-discuss.net/14/C11743/2015/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "The regime of aerosol asymmetry parameter over Europe, Mediterranean and Middle East based on MODIS satellite data: evaluation against surface AERONET measurements" *by* M. B. Korras-Carraca et al.

M. B. Korras-Carraca et al.

nhatzian@cc.uoi.gr

Received and published: 31 January 2015

We would like to thank the Reviewer for his comments, which are to a large extent similar to those of A. M. Sayer and also partly to Reviewer's 1. We took them into account and revised accordingly our paper, addressing his raised issues and concerns, and providing necessary clarifications and improvements. Below are given point by point answers to the comments (also provided in Italics).

- Having carefully read through the articles of Lyapoustin et al. 2014 and Levy et al., 2010; 2013, it comes out that even if there is no direct reference to the asymmetry parameter, the corrections needed for critical parameters in C5 data that are used to estimate the asymmetry parameter, are crucial for extracting a product trustful for interpreting its long term variability and characteristics. Given the uncertainty of the aerosol asymmetry parameter from both datasets (MODIS and AERONET), even the evaluation via differences that may be well covered by the uncertainties, might be somewhat meaningless. Thus, a great part of the analyses presented in this paper is doubtful regarding the extent into which results reflect physical processes and trends rather than other artifacts.

The concern of the Referee about the validity of the presented asymmetry parameter (gaer) results in our paper, which is also based and in line with the concerns of A. M. Sayer, has been seriously taken into account.

We would like to emphasize the importance of the existence of such a dataset, providing this important aerosol optical property to the scientific community, and to stress that, as explained in our paper, it is along with the aerosol optical depth and single scattering albedo, crucial to radiative transfer and many climate models. Therefore, it is really worth to try to assess its validity in order to ensure its quality and possible use in these models.

Therefore, we addressed in the revised manuscript the concern of the Referee in two ways:

(i) first, we also used another basic aerosol size parameter, which is well tested, the MODIS Aqua C005 Angström exponent at the 550-865 wavelength pair (AE550-865) and compared the asymmetry parameter with it, in order to examine whether they agree or not.

(ii) Second, in order to address concerns about long-term changes related to calibration issues, we also used the more recent available MODIS Aqua Collection 006 AE550-865 data and compared them with the corresponding C005 ones.

ACPD
14, C11743–C11757, 2015

In both cases, a good agreement has been found, which is encouraging and puts confidence on the presented results of MODIS C005 gaer.

Figure 1a displays the geographical distribution of AE550-865 for the study period, i.e. 2002-2010. The main geographical patterns in Fig. 1a are in line with those of asymmetry parameter (Fig. 2 of ACPD paper). For example, note the high AE values in the Black Sea (yellowish-reddish colors), indicative of fine aerosols, the relatively high values in the Mediterranean Sea (greenish-yellowish colors) and the low values (deep bluish colors) off the western African coasts corresponding to exported Saharan dust. The consistency between gaer and AE data is shown by the strong anti-correlation between the MODIS AE550-865 and gaer data at 660 and 870 nm, shown in Figures 1b and 1c, respectively. Strong negative correlation coefficients, larger than 0.7 and 0.8 in Figs 1a and 1b, respectively, relate inversely high/low gaer values with low/high AE ones over the same areas. These results indicate that the spatial patterns of MODIS C005 gaer product are reasonable as compared to the C005 Angström exponent data.

Figure 1. Geographical distribution of MODIS-Aqua C005 Angström exponent (AE565-870) values averaged over 2002-2010, at the wavelength pair of 550-865 nm. The correlation coefficients between AE550-865 and gaer data at 660 and 870 nm are given in (b) and (c), respectively.

Figure 2. Geographical distribution of MODIS-Aqua C006 Angström exponent (AE565-870) values averaged over 2002-2010, at the wavelength pair of 550-865 nm. In (b), (c) and (d) are given the correlation coefficients, the absolute biases and the relative percent biases, respectively, between the C006 and corresponding C005 AE550-865 data. In (e) and (f) are given the computed deseasonalized trends of MODIS Aqua C005 and C006 AE550-865) slope values for years 2002-2010, respectively.

As for the Referee's questions about possible uncertainties regarding the long-term variability of MODIS C005 aerosol size products, due to the calibration issues discussed in the previous section, the corresponding MODIS C006 AE product was also

ACPD

14, C11743–C11757, 2015

used and it is displayed in Fig. 2a. From Figs. 2a and 1a, a similarity is apparent in the main geographical patterns of the two collections' AE product. The similarity between C005 and C006 AE data is also depicted in the computed correlation coefficients (Fig. 2b), exceeding 0.8, and biases (in absolute and relative percentage terms, Figs 2c and 2d, respectively) which are smaller than 0.1 or 10% in most areas of the study region and 0.2 or 20% almost everywhere. It should be noticed that our AE results are in line with those of Levy et al. (2013, Fig. 15) which refer, however, only to year 2008 (ours are for 2002-2010). In addition, a comparison is attempted in Figs 2e and 2f between the computed trends of C005 and C006 AE data over the common period 2002-2010, in order to assess whether changes are detected, which could be an indication of possible changes in corresponding asymmetry parameter trends. Figures 2e and 2f show the computed deseasonalized trends of slope values for both C005 and C006 AE. The results reveal similar patterns between C005 and C006. Small trends are found in both of them, in agreement with the small trends of asymmetry parameter reported in the ACPD paper's Fig. 5. It is found that the sign of AE trends mainly does not change from C005 to C006. This might be a signal that no changes of aerosol asymmetry parameter are expected in C006. Unfortunately, this cannot be certified presently, due to the current unavailability of asymmetry parameter in the recently released MODIS C006 dataset. However, the similarities between C005 and C005 AE data, puts some confidence on the C005 results given in the present paper.

A new sub-section (3.2.3) named as "Possible uncertainties of MODIS aerosol asymmetry parameter" has been introduced in the revised paper, where the raised important concerns of the Referee-2 (and also of the other Referee and A. M. Sayer) are fully addressed and discussed.

- Overall, I get the impression that this work is one step behind, which is partly understandable since progress in corrections and evaluations are rapid. However, still great parts of the paper are quite descriptive and no insight is provided on the new information that might be provided from this parameter (alone but also in conjunction

ACPD
14, C11743–C11757, 2015

with other parameters not addressed at all in this paper).

We are sorry but we are not sure to what the Referee refers by "... this work is one step behind ...". As for the Referee's phrase "...which is partly understandable since progress in corrections and evaluations are rapid ..." we believe that it is addressed in the revised manuscript by the use of the most recent C006 MODIS Angström exponent data, which show a general nice agreement with the corresponding C005 one both in terms of spatial patterns and temporal trends (this is discussed in the previous point and in the new section 3.2.3 of the revised paper). Finally, as to the phrase "...still great parts of the paper are quite descriptive and no insight is provided on the new information that might be provided from this parameter (alone but also in conjunction with other parameters not addressed at all in this paper) ..." we cannot understand to what the "new information" refers to. Features of satellite based aerosol asymmetry parameter (from MODIS) are presented for the first time to our knowledge in the literature, therefore the provided information is unprecedented and, as shown in this paper, reasonable and useful for use in radiative transfer and climate models, to which is very important. Already, the assessment of asymmetry parameter alone has obviously resulted in our long present analysis and paper. Adding more parameters would make difficult to present together their information along with gaer, which is already very important by itself.

- Statements in the summary and conclusions section like "The results are consistent with the theory and thus prove a good performance of the MODIS retrieval ..." and "The identified weaknesses may provide an opportunity to improve such satellite retrievals of aerosol asymmetry parameter in forthcoming data products like those of MODIS C006" probably support the points I am trying to raise.

We believe that the presented results and analysis in the revised version of the paper now support the statements made in the Conclusions reported by the Referee.

References

ACPD
14, C11743–C11757, 2015

Levy, R. C., Mattoo, S., Munchak, L. A., Remer, L. A., Sayer, A. M., Patadia, F., and Hsu, N. C.: The Collection 6 MODIS aerosol products over land and ocean, Atmos. Meas. Tech., 6, 2989-3034, doi:10.5194/amt-6-2989-2013, 2013.

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/14/C11743/2015/acpd-14-C11743-2015-supplement.pdf

---

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 22677, 2014.

ACPD

14, C11743–C11757, 2015

Interactive Comment

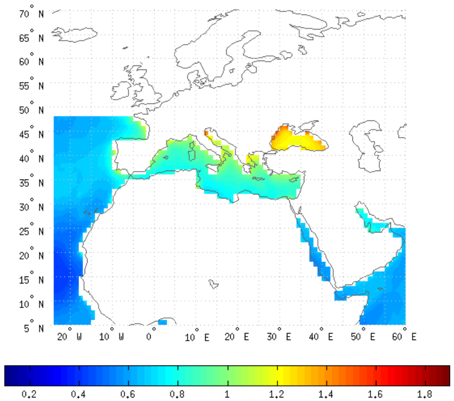

Fig. 1. Figure 1a

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

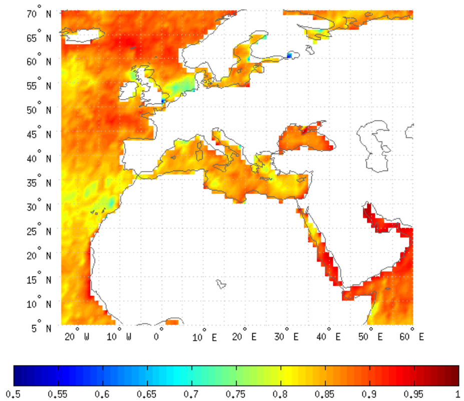

Fig. 2. Figure 1b

ACPD
14, C11743–C11757, 2015

ACPD

14, C11743–C11757, 2015

Interactive Comment

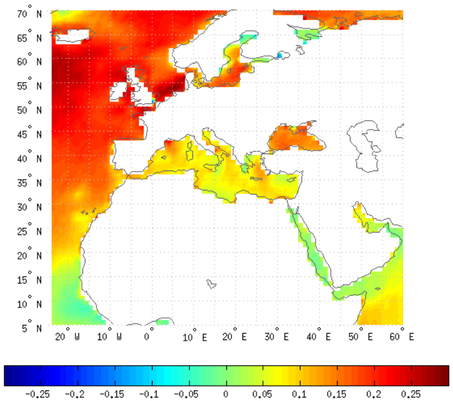

Fig. 3. Figure 1c

ACPD
14, C11743–C11757, 2015

Interactive Comment

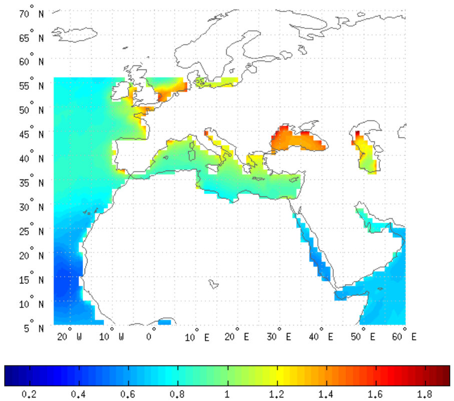

Fig. 4. Figure 2a

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

ACPD
14, C11743–C11757, 2015

Interactive Comment

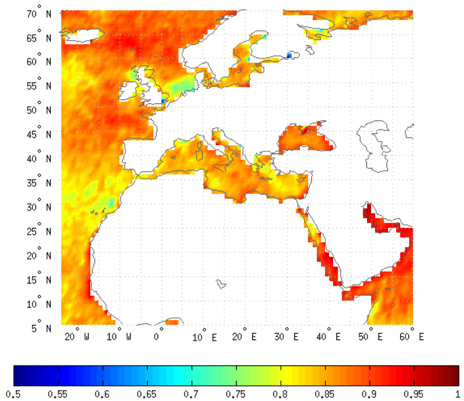

Fig. 5. Figure 2b

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

ACPD

14, C11743–C11757, 2015

Interactive Comment

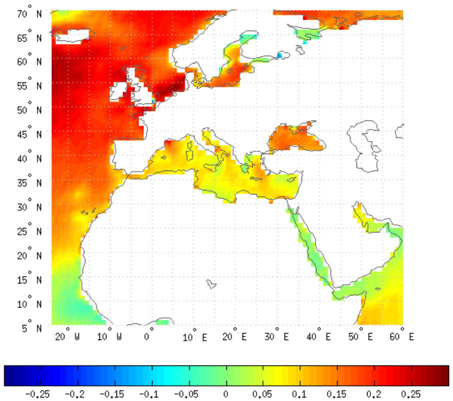

Fig. 6. Figure 2c

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

ACPD

14, C11743–C11757, 2015

Interactive Comment

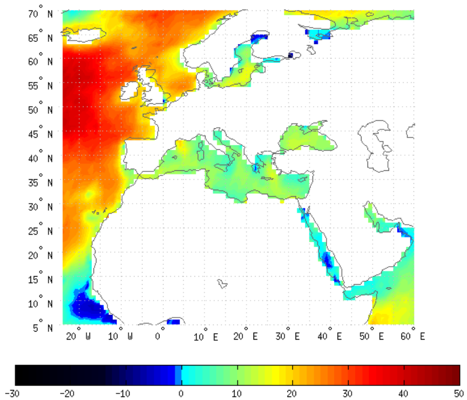

Fig. 7. Figure 2d

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

ACPD
14, C11743–C11757, 2015

Interactive Comment

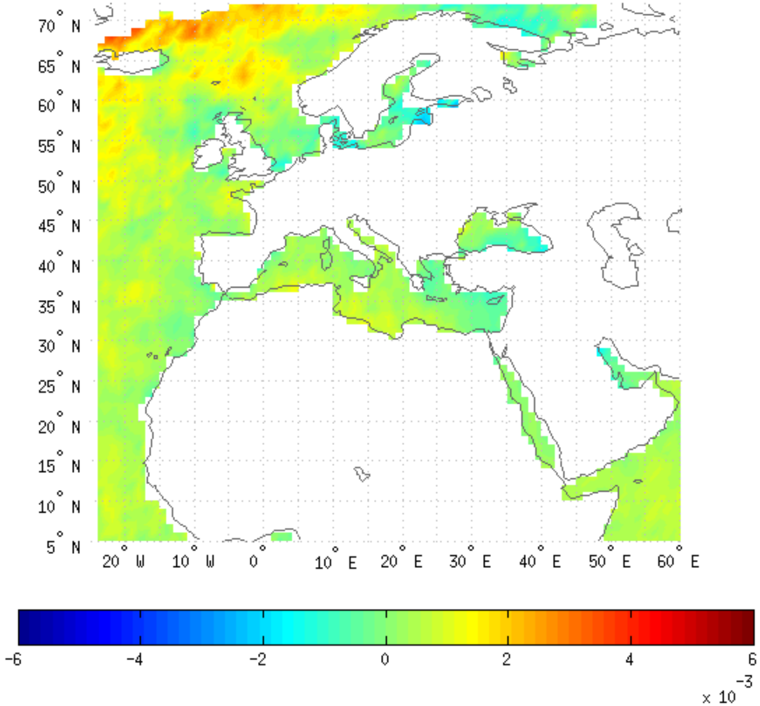

Fig. 8. Figure 2e

ACPD
14, C11743–C11757, 2015

Interactive Comment

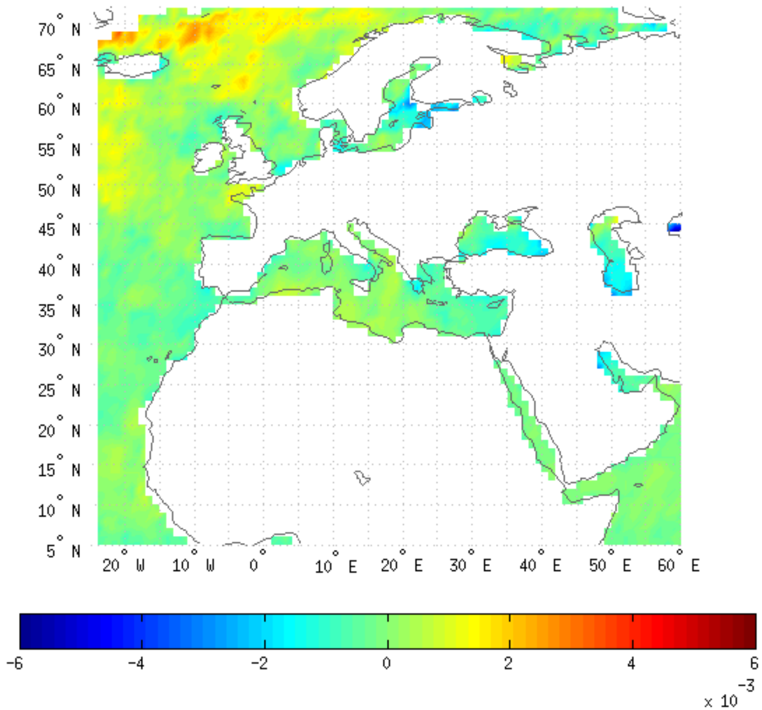

Fig. 9. Figure 2f

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper