Response to Reviewer 1

We would like to thank the Reviewer for his comments. We have tried to take them into account and to address the raised issues trying to provide necessary clarifications and improvements. Below are given point by point answers to the comments (also provided in Italics).

- The paper presents a short analysis of the aerosol asymmetry parameter derived from the MODIS radiometer on TERRA and AQUA satellites. The authors focus on some specific areas of the world: North Africa, Europe and the Middle East. They use the collection 5 of MODIS atmospheric products. The asymmetry parameter is retrieved only over ocean surfaces. The paper presents a validation of the MODIS asymmetry parameter with AERONET retrievals. The seasonal and interannual variability for each area is discussed.

Major remarks:

- The introduction is not appropriate. You should introduce the asymmetry parameter in a more general way including its definition and how it depends on the aerosol physical and chemical properties.

Asymmetry parameter is a common term and important parameter in radiative transfer. This is why we avoided referring to its definition and emphasized its spatial and temporal characteristics and comparison against AERONET. In response to the Reviewer request, we inserted in the revised paper a short definition and discussion of its dependency and importance. However, we preferred to do this in section 2 (Data) and not in the Introduction. Hence, at the beginning of sect. 2 the definition and a discussion on aerosol asymmetry parameter are now provided (lines 94-116).

- I would like to have a more qualitative (scientific) presentation of the optical properties you are studying.

Please note that there is only one optical property addressed in the present work. We are not sure to what the Referee refers by "… more qualitative (scientific) presentation". We believe that such a qualitative presentation of asymmetry parameter, apart from its definition and basic discussion of its dependence that has now been given, would be beyond the scope of this scientific paper. The significance and radiative effects of properties like the asymmetry parameter are very thoroughly and fittingly explained in textbooks.

- Avoid awkward sentences like "AOD (…) provides a good measure of the aerosol load over an area".

The notion that AOD is a measure of aerosol load is very widespread. All Referees of this manuscript use in their reviews the paper by Levy et al. (2010), who also embrace this description of AOD, as do also many other research papers and other scientific documents dealing with aerosols.

- A presentation of the retrieval algorithm should be given in details (method, aerosol models used, accuracy…) because you use a parameter that is not the result of the inversion procedure but is rather a by-product of the inversion.

Indeed, the aerosol asymmetry parameter is not a direct product of the MODIS inversion procedure. However, providing a description of the method, aerosol models used, accuracy etc. is beyond the scope of this study, which does not tackle with issues related to its

derivation procedure. More important, such issues and studies are addressed in more appropriate journals like the Atmospheric Measurement Techniques (AMT).

- *The reason why you analyze the data only over a part of the world is unclear. MODIS data are global, AERONET data are global and the paper could be global.*

The paper could truly be global, and this claim could exist for all published regional studies. However, this may produce presentation and clarity problems for physical quantities having geographically distinct and varying behavior. Such a quantity is the asymmetry parameter. For example, the paper by Levy et al. (2013) used by all Referees, reads: "MODIS/AERONET “comparability” (regression slope, intercept, correlation and number within EE envelope) varied as a function of location and season...". There is a valid reason why many regional studies from global datasets are being published. Moreover, this study complements many others of our group (e.g. Papadimas et al., 2008; Hatzianastassiou et al., 2009; Gkikas et al., 2009; 2013) dealing with other aerosol optical properties for this specific world region.

- *The validation exercise is not convincing. You have a small range of asymmetry parameter and a linear model is not appropriate.*

We would like to note that what may be problematic is not the small asymmetry parameter data range per se, but the possibly large AERONET and MODIS errors compared to the data range. The range is constrained by the physical limits of the asymmetry parameter encountered in nature and deciding that it is too small is essentially accepting that meaningful validation for aerosol asymmetry parameter cannot be performed. This in our opinion is not what A. M. Sayer meant. He probably meant on the other hand, that there may be a problem with the uncertainties of both AERONET and MODIS asymmetry parameter and more specifically, with the uncertainty of the AERONET one, which is the independent variable in our comparison. It is known that existing errors in the independent variable result in "regression dilution", i.e. underestimation of the correlation coefficient and of the regression slope. It would be possible to account for this underestimation by using Deming regression, if we had an estimate of the standard error of both sensors. In its absence, R and slope values have to be left uncorrected, while mentioning that their true values are actually larger than the ones reported in the paper.

Finally, we would like to note that we consider that the comparison shown in Fig. 7 can be still taken as a valid predictive model, which given a measured value of g_{aer} from AERONET can predict with 95% confidence where the respective MODIS value falls (based on the definition of the prediction bands). These bands are now shown in Fig. 9 (Fig. 7 in original ACPD manuscript).

Relevant notes to the above issue were made in the revised paper (sect. 4, lines 478-492).

- *The difference between AQUA and TERRA platforms as well as the long-term analysis should include the calibration and inter-calibration issues (see Short Comment).*

We acknowledge that, as extensively indicated by A. M. Sayer, there are calibration issues affecting the analysis on long-term changes of aerosol asymmetry parameter (Fig. 5, section 3.2.2). In the revised paper, reference is made to this issue (sect. 3.2.2, lines 366-377), especially in the framework of providing an explanatory factor for the detected differences in Terra and Aqua aerosol asymmetry parameter. Moreover, we have performed a detailed additional analysis using another aerosol size parameter, i.e. Angström exponent, which largely supports the findings of the present study based on asymmetry parameter. For the sake of brevity, we avoid to place here the results of this analysis, which are thoroughly presented

in the response to A. M. Sayer. We also introduced a new sub-section in the revised paper, sect. 3.2.3 named "Possible uncertainties of MODIS aerosol asymmetry parameter" has been introduced in the revised paper, where the raised important concerns of the Referee-1 (and also of the other Referee and A. M. Sayer) are fully addressed and discussed.

- *Finally, the analysis of the asymmetry parameter alone doesn't provide a lot of information on the aerosol impact on radiation. The paper will be greatly improved by putting the study in a more general context including optical and microphysical properties of atmospheric aerosols.*

Of course, it was not the goal of the present study to study aerosol radiative effects. Our group has performed a number of such studies dealing with the aerosol impacts on radiation either on global or regional scale (e.g. Hatzianastassiou et al., 2004a; 2004b; 2007a; 2007b; Papadimas et al. 2012). On the contrary, as clearly defined already in the Introduction, the purpose of this study is to assess the first real satellite (MODIS) based data on asymmetry parameter, which is one of the key optical properties that determine aerosol radiative effects. Such data are highly required for use in radiative transfer models, like the one used in our previously reported studies. Nevertheless, and this is a strong priority in model studies, before using input data in models it is imperative to assess its quality, and this is usually performed through comparison against surface based data.

Furthermore, we would like to note that, as shown in the present study, already performing an analysis on a single aerosol optical parameter, like the aerosol asymmetry parameter here, requires a lot of work and space for presentation. Including more parameters, optical or microphysical, would enhance the volume of obtained results which could not fit in a single paper presentation.

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