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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol shortwave daily radiative effect and forcing based on MODIS Level 2 data in the Eastern Mediterranean (Crete)" *by* N. Benas et al.

N. Benas et al.

benas@physics.uoc.gr

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We would like to thank the Referee for the suggestions and corrections. All comments and recommendations have been taken into account. Please find our point-by-point reply below.

GENERAL COMMENT: Based on the comments regarding the validity and reliability of the results, which were evaluated on a mean daily basis using MODIS data acquired at a specific time of the day, we have repeated our calculations for the specific satellite overpass times, instead of the mean daily. All results reported in the revised manuscript are based on these new calculations.

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Interactive Discussion
Discussion Paper

*"The authors compare AODs by MODIS with AERONET AODs collocated in space and time to support the reliability of MODIS AODs. How MODIS AODs are correlated to daily AERONET AODs?"

Based on the new computations for the specific MODIS overpass times, MODIS AOD validation is performed by comparison with the AERONET AOD collocated in space and time, as described in Section 4.1.

*"How the fine-AODs by MODIS are correlated to daily values of AERONET-fine-AODs (e.g. Santese et al., doi:10.1029/2007JD008482, 2007)? How asymmetry parameters by MODIS compare with daily values of the asymmetry parameters by AERONET?"

A comparison of MODIS and AERONET aerosol data, similar to the one for AOD, has also been performed for fine mode AOD and asymmetry parameter. The results are reported and commented in Section 4.1.

*"Why the authors have not averaged aerosol parameters retrieved by Terra and Aqua satellite measurements to get “more reliable” daily-AODs?"

All results reported in the revised manuscript are based on model calculations performed for the specific MODIS overpass time, instead of a mean daily basis. In this new context, average values of aerosol parameters retrieved by Terra and Aqua MODIS were not necessary.

*"AODs and fine-AODs can significantly vary with the time of the day mainly during dust outbreaks (Perrone et al., Atm. Res. 101, 783-798, 2011). In fact, Table 3 shows that the aerosol DREs retrieved by using MODIS-Terra aerosol parameters can be quite different than the values retrieved by using MODIS-Aqua aerosol parameters during a dusty day: e.g. 26/1/2005 and 10/06/2007. Can the authors infer the parameter and/or the parameters responsible for such large changes in DRE values?"

Significant differences between Terra and Aqua MODIS AOT have indeed been observed during dust outbreaks, and are probably the main reason for the differences

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reported in Table 3. In the revised manuscript, the differences are justified by the different overpass times between Terra and Aqua MODIS.

*"Some information on the aerosol vertical distribution used in the model should be provided."

Due to the lack of information on the aerosol vertical distribution from MODIS data, aerosols are treated as a layer among the different atmospheric layers considered by the model, as described in Section 2 (Page 5, lines 3-8).

*"The used surface albedo values appear rather large to my opinion considering that the studied area is considered made by 50% land and 50% Sea, in accordance with line 2, page 19887. The surface albedo spectral dependence of Fig. 2 appear very close to the one reported for some Sahara sites (e.g. Bierwirth et al., Tellus, 61B, 252-268, 2009). Can the authors comment the used surface albedo values? How the used surface albedo values compare with the ones assumed for Crete in the AERONET inversion code?"

Two types of surface are considered in the model, land and sea, as described in Section 2 (Page 5, line 16-22). In the case of sea, the albedo is computed using Fresnel reflection. Figure 2 shows the albedo values only for land, which are available from MODIS Level 2 data. To clarify this point, the description of Fig. 2 in Section 3.2 has been rephrased (Page 8, line 16). A surface albedo sensitivity test was also added in the present study, showing a difference of less than 0.5% in the DSR at surface, when the surface albedo was varied by $\pm$10% from its value. Maximum differences do not exceed 1.5%.

*"The authors have compared the downwelling SW radiation by the model with corresponding ground measurements to support model results. However, they do not provide any data regarding the spectral sensitivity of the ground used pyranometers."

A description of the pyranometers used and their spectral sensitivity has been added

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in Section 4.2 (Page 12, line 14-18).

*"AERONET provides downwelling SW fluxes and aerosol DREs in addition to aerosol parameters (one of which has also been used by the authors in the model). How downwelling SW fuxes and aerosol DREs by the model of this study compare with the corresponding parameters provided for Crete-AERONET site?"

Validation of the DSR at the surface and the DRE at the surface and at TOA have been performed against the corresponding data sets from the AERONET station. The results are discussed in Sections 4.2 (Page 12, lines 29-32) and 4.3 (Page 14, lines 3-8).

*"Probably, aerosol AERONET-DREs referring to Crete can be considered representative of a 50 km x 50 km area, being Crete a background area of the western Mediterranean.Then, some comments on the benefits and/or limits of using 50 km x 50 km MODIS aerosol parameters instead of AERONET aerosol parameters to calculate daily averaged aerosol DREs should be provided."

The aim of the present study is to present a new method for assessing aerosol effect and forcing on local scales, based on satellite data. This method can be applied in any region, where these data are temporally and spatially sufficient. The area of Crete and the FORTH-CRETE AERONET station have been selected due to the unique aerosol characteristics of the wider Eastern Mediterranean region and for validation of the model input and output data against ground measurements. This is clarified in the introduction of the revised manuscript (Page 3, lines 8-13).

*"The authors use the MODIS fine mode fraction to calculate aerosol DREs by anthropogenic particles. Hence, they assume that the fine mode AOD is only made by anthropogenic particles. To what extent this assumption is a good approximation (e.g. Schulz et al., ACP, 6, 5225-5246, 2002)? Sensitivity tests should be provided. Sensitivity tests on the used single scattering albedo and asymmetry parameters values should also be provided."

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According to the literature, aerosols of anthropogenic origin are mainly composed of fine mode particles (Dubovik et al., 2002, Kaufman et al., 2002). The technique we use to discriminate aerosols of anthropogenic origin (fine mode fraction greater than 0.7) was first implemented by Barnaba and Gobbi (2004), showing good correspondence to the actual aerosol distribution, evaluated using other methods. This is clarified in Section 4.5 of the revised manuscript (Page 16, lines 23-27).

A fine mode AOT sensitivity test has been added in the present study, showing a difference of less than 0.5% in the DSR at surface, when the fine mode AOT was varied by $\pm$10%. Similar sensitivity tests have been performed for all aerosol properties (AOT, g, ω). The results are analyzed and discussed in Section 4.2 of the revised manuscript.

References

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