Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2017-932-RC2, 2018

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Direct radiative effects of intense Mediterranean desert dust outbreaks" *by* Antonis Gkikas et al.

Anonymous Referee #2

Received and published: 18 January 2018

The paper addresses an important aspect of the Mediterranean radiation budget and climate. Intense Saharan dusts event may produce large perturbations to radiation, and affect surface temperature, heat exchange at the surface, circulation, etc. The study uses satellite data to identify intense events. Effects on radiation and different processes are investigated for the selected cases using a regional model which includes dust and radiation.

The paper is an interesting and useful contribution to the understanding of dust role and interactions in the Mediterranean.

A couple of aspects may be improved.

The radiative effects are strongly related with the aerosol optical depth (AOD). A com-

parison of AOD values produced by the model versus those obtained from MODIS is presented in the paper. However, the comparison is qualitative and for a selection of cases. Given the large role of AOD in determining the radiative effects, a more detailed, possibly quantitative, comparison should be carried out. On the same point, some reference is made throughout the text to the inability of the model in reproducing the amount of dust. This should be better assessed.

Some results, mainly in the shortwave spectral range, may be linked to differences in the surface albedo, in particular between ocean and land/desert. The discussion of this point may be somewhat improved. In some cases averages over the Mediterranean Satellite Domain (MSD) have been used. The domain includes land and ocean surfaces. I would suggest separating the estimates of radiative effects obtained on land from those obtained over the ocean. Summing/compensation effects, also dependent on the fraction of surface type occurring in each event, may be present when the average includes land and ocean surface types.

Minor points are outlined below.

lines 17-19: please, indicate the AOD range attained during the selected events.

l. 21-26: please, specify for what AOD and over what area these vary large radiative effects are found.

l. 66-68: the sentence is not clear; please, rephrase it

l. 153: I would suggest specifying here that the dust outbreaks are identified using daily multi-sensor satellite data

l. 188-: please, clarify the difference between pixel and grid cell: are those the same?

table 1: are all the selected cases classified as "extreme" events? Are there "strong" events among them? Is there information on the time duration of the events?

l. 308: "quadratic" should be "quadrature"

l. 313: the correct web address seems to be: http://rtweb.aer.com/

l. 317: maybe "fraction" insted of "percentage"

l. 324: it may be useful to add here information on the used refractive indices. They play a central role in the determination of the radiative effects, and the reader should be aware of which set of refractive index values are used in the calculations.

section 5.1: as discussed above, the comparison between satellite and modelled AOD seems qualitative. Given the stated limitations of the satellite dataset over land, a quantitative comparison might be carried out over the ocean. Also, the use of different colour scales in figure 3 does not allow a more detailed comparson.

l. 552: may the differences between the results over the MSD amd SDD domains be partly due to the albedo differences? I would expect an effect, mainly for the NETSURF component.

l. 596: does the model produce substantially different dust size distributions over the Sahara and along the coast and in the Mediterranean? It might be interesting to show this effect.

section 5.3. the dust outbreak impact on SH and LE is investigated only over land. It may be worth including in this section the discussion on the SH and LE changes in the marine environment (l. 751-752). This is also needed to support the validity of the estimated temperature biases over the ocean discussed in section 5.4.

l. 734-: it may be worth recalling the AOD value which correponds with these cross sections.

l. 858: although pyrgeometers are sensitive to the wavelength range 4-50 micron or similar, they are calibrated to provide LW irradiances integrated up to 100 micron.

l. 796-803: how is the dust emission calculated? It should be mainly related to the wind intesity, and it seems to me that such a large day/night difference may be explained only

if the emission is calculated as dust entrainment at some altitude above the ground

section 5.6: the varification of the data against surface radiation measurements is a very ambitious task. As the authors state, it would require a very good model description of the dust event evolution and spatial distribution, and a good reproduction of the observed AOD. I would suggest shortening this section, removing the discussion of specific cases and figure 10, and presenting the results as statistical means for all considered sites (a condensed version of tabel S1). Some of the selected events have been previously investigated using satellite/ground based measurements, and radiation transfer modelling (see e.g., Santese et al., 2010; Benas et al., 2011; di Sarra et al., 2011). The authors may consider if it mey be reasonable to compare the radiative effect estimates, instead of the irradiances, obtained during some of these events.

l. 859: I assume that emission from atmospheric gases and from the surface is not included in the way the SW radiation (up to 12.2. microns) is calculated. This might be clarified.

References

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