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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The regime of desert dust episodes in the Mediterranean based on contemporary satellite observations and ground measurements" *by* A. Gkikas et al.

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Response to Reviewer 2

We would like to thank the Reviewer for the useful comments that helped us to improve our manuscript. We tried to reduce the length of the manuscript, according to his suggestions. Below are given point by point answers to the comments (also provided in Italics).

"Line 97: Tropical Atlantic Ocean is by far more affected by Saharan dust (see paper JGR of Moulin, 1998)"

The relevant text has been modified (lines 99-102).

“Line 183: The daily temporal resolution is fine for a climatological based study but might be too coarse for case study analyses of DDs - pls comment on this issue.”

Done (lines 193-194).

“Line 187: Retrieval of AOD over arid regions is by using the deep Blue MODIS, however, it could not be used here. How this drawback is compensated?”

As stated in the text, lines 204-208 of original version of the manuscript, for those regions they are not performed computations with our algorithm because of the reasons explained there. However, in the future, when Deep Blue products will become more available and validated a similar study to the present will be repeated also including the Saharan desert. Nevertheless, note that this attempt will be refrained by the non availability of fine fraction Deep Blue data which are necessary to the algorithm.

“Line 226: Is the fact that the mean annual cycles of AI products derived from Earth Probe and OMI enough to legitimate using them as a consistent and homogeneous data base?”

This is exactly what Li et al. (2009) argued as explained in our text (lines 243-246).

“Line 232: The author should give an argument for the adjustment made on AI values of OMI-Aura.”

These data are produced and processed by the TOMS and OMI team while we only used them. Therefore, to address this issue we just make reference to the production teams (ftp://toms.gsfc.nasa.gov/pub/omi/data/aerosol/1README.txt).

“Line 235:How the 21 surface PM sites were defined as background sites?”

The surface PM sites are classified as regional background since most of them belong to the EMEP network, only composed by this type of monitoring sites. The other no-EMEP sites are classified as regional background sites by the different state members

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according to the eligibility criteria given in the 2008/50/EC Directive (ANNEX VIII). In our study, however, we have used two monitoring sites (in the areas where no regional background sites were found) that are classified as suburban sites, thus located only few km away from important emission sources

“Line 237:Surface PM data measurements are missing over the most dust polluted regions, i.e., the North African Coast and the Middle-East. This is especially important for extreme DD episodes as shown in Fig.5(ii) Please comment.”

The selection of the considered PM stations has been made based on specific criteria on data availability and quality which led to the omission of some sites that might be located in ‘key’ regions for dust episodes. In the present study, all the potential monitoring sites reporting data to public databases were included. Unfortunately this is really scarce from most regions across the Mediterranean Basin where the absence of regional background monitoring sites is patent.

“Line 243:Is precision and accuracy of real-time instruments consistent with the gravimetric measurements?”

The EMEP monitoring sites are giving gravimetric concentrations, thus, being the reference ones. The different member states in Europe are encouraged to submit only corrected data. The member states must assure the quality control of their data. Thus, since only official data were used in this study the quality control is guarantee.

“Line 371:The distribution of the surface stations are biased with a denser coverage over the western basin. Please comment how this might affect the results.”

Indeed, most of surface stations are found in the Iberian Peninsula, i.e. in the W. Mediterranean basin, which may have some implications for the station-satellite data comparison. Thus, it is well established in literature that the major activity of dust transport in the W. Mediterranean is observed in summer. So, because the 15 out of 21 PM stations are located in the Iberian Peninsula, most of the selected DD episodes

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(170 out of 249 or 68.3%) for which the AODs are compared against PM measurements occur in summer. Since for this season, for the reasons explained in the text (lines 447-468) there is a poor correlation due to upper level dust transport, it might be inferred that the obtained results can be affected. This is actually reported in the text (lines 438-441).

“Line 413: The poor correlation obtained for the summer should be expressed as a hypothesis.”

Potential reasons explaining the poor correlation in summer are provided in the text (i.e. the vertical extension of aerosols, lines 447-468).

“Line 479: Could the authors argue please on this increasing south-to-north gradient of DD episodes frequency?”

As reported in the text (lines 525-528) this gradient is due to the proximity of the study region to the Saharan and Middle East deserts.

“Line 566: This result showing a maximum frequency in strong DD episodes in the spring is not fully consistent with Dayan et al. (2008) who classified the synoptic systems dominating the EM region in observed dust-days for 37 years. They found that about 60% of the dust yield was observed in Feb-Mar., generated by Cyprus Lows. - Please discuss the possible reasons for this discrepancy. Ref: Dayan U, Ziv B, Shoob T, Enzel Y (2008) Suspended dust over Southeastern Mediterranean and its relation to atmospheric circulations. Int J Climatology, 28, 915-924.”

We believe that there is no discrepancy between our results and those by Dayan et al. (2008). It should be noted that our results (frequency of occurrence, Table 1) are reported on a seasonal basis and not on a monthly one like done in the work by Dayan et al. On the contrary, there is an agreement when the results of Dayan et al. are estimated on a seasonal scale as well. Thus, spring is found to be the season with the primary occurrence of dust days (episodes) like in our study.

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“Line 648:As regarded to the trend in DDs frequency: Due to the large interannual variability and the rather short record, it is suggested to express this trendline with reservations, if at all.”

As explained in our text (lines 698-701) just because of the large interannual variability, we also repeated the analysis by reproducing time series of monthly anomalies and annual values (the relevant figures are provided in the supplementary material). The obtained results, now shown in Figure S4 of Supplement file, are in agreement with the conclusions drawn from paper’s Figure 9. As for the short period and the ‘trend line’, we believe that it is not very short (seven years) although it is indeed relatively short. For this reason we preferred to use the term ‘tendency’ and not ‘trend’. Finally, in accordance to the comment of other referee (Dr. Dulac) we only kept the linear regression fit lines for cases that tendencies are statistically significant at 95% which are those for frequencies of DD episodes over land.

“Line 665-698: The relationship between the NAO and DD episodes should be checked for each sub-basin separately for the following reasons: Moulin et al. (1997) found that the interannual variations in dust transport over the Western Mediterranean is well correlated (R = 0.66,p = 0.027) with the NAO index during summertime. They explained this positive correlation by the frequent passage of cyclones sweeping the western basin during positive phases of the NAO and mobilizing dust from North Africa. Contrary to this finding over the western basin, Dayan et al. (2008) presented evidence on the role of the negative phase of the NAO in controlling dust transport during winter to the Eastern Mediterranean. Moreover, in another study, Avila and Roda (2002) could not ïnËĞAËŻnd any correlation between the NAO and wet deposition of African dust over a rural western Mediterranean site in north-east Spain. They suggested that contrary to the Eastern Mediterranean, the two variables controlling wet deposition over the Western Mediterranean vary in an opposite direction with respect to the NAO, i.e., precipitation inversely and dust updraft directly, therefore, cancelling each other effects. Ref: Avila A, Roda F (2002) Assessing decadal changes in rainwater alkalinity

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at a rural Mediterranean site in the Montseny Mountains (NE Spain). Atmos Environ 36:2881– 2890."

We would like to clarify that in the present manuscript there is no reference made to the relationship between NAO and DD episodes.

"Line 700-717:It is suggested to omit this section due non-significant trend and the short record of data."

The part dealing with the linear trends (ACPD, Page 16271, line 27 through Page 16272, line 5) has been removed from the revised manuscript.

"Line 718-768: As regarded to the author's attempt to trace the origins of the DDs: As the authors stated DD events extend to wide areas. Since the HYSPLIT Model is very sensitive to the location of the receptor, it is not surprising that the superposed trajectories figure is complicated and not very representative. The authors should consider omitting this whole chapter."

The relevant section has been removed from the manuscript as suggested by this and the other two Reviewers.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 16247, 2013.