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Atmospheric Chemistry and Physics Discussions

Interactive comment on "African dust outbreaks over the Mediterranean Basin during 2001–2011: PM_{10} concentrations, phenomenology and trends, and its relation with synoptic and mesoscale meteorology" *by* J. Pey et al.

Anonymous Referee #2

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General comments

The present paper deals with African dust outbreaks in the Mediterranean basin over about a decade and addresses their relationship with synoptic and mesoscale meteorology. This is a very interesting topic since dust outbreaks are a frequent phenomenon all over the Mediterranean with important implications in many aspects. The interesting point of this paper is that it addresses the Mediterranean as a whole, while various studies in the past dealt with specific locations.

The methodology is not new, since it has been applied before, but it is essentially an extension of that. It is claimed to be more complete in spatial terms, i.e. has a greater number of stations and covers a longer period, i.e. data for more years. The applied methodology is based on surface measurements of PM10, and seems to be accurate providing meaningful results. The separation of African dust contribution for regional background and sub-urban stations is done in an effective way and the derived information is correct. The paper is appropriately structured and results are discussed satisfactorily with sufficient justification. The number of Figures is reasonable.

Based on the above, I consider that this comprehensive paper represents a substantial contribution to the scientific progress in its topic and falls within the scope of the Journal, therefore it is worth to be published after addressing a few issues of rather minor importance, which are explained below along with a few other details. Moreover, the paper's text and its language has to improve before publication (some suggestions are also made in relation to that).

Main Comments

1. In the Introduction, attention should be paid to the difference in discussing dust (African) as in general and from a PM perspective. The former, if not otherwise defined, refers to the whole atmospheric column, whereas the latter to the surface layer only. Also, the first is more relevant to climate while the second to health. In the Introduction no difference is made between the two, columnar and near surface dust, while essentially, at least after some specific point, reference is made to the second (PM). Some clarification is necessary in order to avoid confusion on that. With regards to that, for example, if reference is also made to the former (columnar) then some references should be also given (e.g. Papadimas et al., 2008).

2. In sect. 2.2, further details are necessary on the interpretation of the various tools used for the identification of African dust outbreaks. It is useful to summarize how the information from different tools is homogeneized, if this is done, and at least how it

is treated. For example, how are situations involving identified dust occurrence from some tool(s) and non-identified from some other(s) are faced. What are the prerequisites for a dust occurrence in the procedure?

3. In the Methodology, the approach followed for deriving a relationship between PM10 and latitude is quite simplified. It does not take into account the different proximity of African deserts to the studied stations throughout the longitudinal range, which is related to the varying latitude of African coasts with longitude. Another problem with the approach is the incomplete spatial coverage of study region by the stations, for example note the absence of stations in higher latitudes in the eastern Mediterranean basin or lower latitudes in the western Mediterranean basin. Related to this issue, in sect. 3.4.1, it is rather dangerous to talk about dependencies of PM10 on latitude and longitude and about eastward and westward gradients, just because of the incomplete spatial coverage of region by the stations. For example, the documented eastward increase is rather associated with a southward shift of stations than an increase with longitude.

Specific Comments 1. Abstract: page 28196, line 9: replace “from 30-37%” with “from 30% to 37%”.

2. Abstract: page 28196, line 10: replace “they take place less than” with “they take place in less than”.

3. Abstract: page 28196, lines 14-15: remove sentence “Our study demonstrates . . . latitudinal position” it is unnecessary.

4. Abstract: page 28196, lines 23-24: replace “with yearly occurrence of various severe episodes.” with “with occurrence of various severe episodes throughout the year.”.

5. Abstract: page 28197, line 2: replace “almost parallel to the NAO” with “almost parallel to that of NAO”.

6. Abstract: page 28197, line 3: replace “progressively more negative since 2006

onwards” with “being progressively more negative since 2006”.

7. Abstract: page 28197, lines 7-10: with regards to that sentence, a sentence should be added making the link with the contribution of African dust to PM10.

8. Introduction, page 28197, line 12: replace “being mineral dust . . .” with “mineral dust being . . .”.

9. Introduction, page 28197, line 16: replace “being the Sahara-Sahel-Chad . . .” with “the Sahara-Sahel-Chad being . . .”.

10. Introduction, page 28197, line 25: replace “trade winds more constrained” with “trade winds are more constrained”.

11. Introduction, page 28198, line 5: replace “describing an anticyclonic gyre” with “along an anticyclonic gyre”.

12. Introduction, page 28198, line 29: replace “Mediterranean implies that” with “Mediterranean imply that”.

13. Introduction, page 28199, lines 10-11, “Yearly, variations . . . elsewhere”: the meaning of this sentence is not clear, probably “elsewhere” needs to be replaced by another more appropriate word.

14. Introduction, page 28199, lines 18-20, “Such meteorological changes . . . Cusack et al., 2012).”: please clarify or re-write this sentence.

15. Introduction, page 28199, line 27: to what “contributions” refers to?

16. Introduction, page 28199, lines 28-29: “. . . may be indicative of atmospheric changes”: this is very general statement. It should be specified, so please define to what it refers, e.g. atmospheric circulations (transport), wet removal or so?

17. Introduction, page 28200, line 2: “. . . for a few sites.”, please specify how many.

18. Introduction, page 28200, line 16: replace “. . . the effects derived from African

dust." with "... the effects of African dust.".

19. Section 2.1, page 28200, line 24: replace "to assess on their" with "to assess their".

20. Section 2.1, page 28201, line 5: replace "from 2001-2011" with "from 2001 to 2011".

21. Section 2.2, page 28201, line 11, "is akin ...": please use correct word.

22. Section 2.2, page 28202, line 19, "three Spanish RB sites": is a similar evaluation planned for other Mediterranean sites?

23. Section 3.1, page 28203, lines 18-20, "This augment is ... part of the Basin": Given that such a west to east increasing gradient is also seen in Fig. A1, in which African dust contribution is absent, it is essentially suggested that this gradient in PM10 is attributed to increasing regional pollution from west to east. Since this problem (sulphate, carbonaceous aerosols) is dominated by fine-mode particles one would expect a similar gradient in PM2.5 along with a significant PM2.5 contribution to PM10. Are there such indications?

24. Section 3.2, page 28203, line 26, "... a summer maximum is observed throughout the basin ...": this is not entirely true for the sites (at least those shown in Fig. 3) of eastern Mediterranean basin (APK, AYM) where a spring maximum also appears.

25. Section 3.2, page 28203, line 27, "... reduced dispersive conditions ...": what do you mean by "dispersive conditions"? Do you probably refer to removal (mainly wet one)?

26. Section 3.2, page 28204, line 12, "... of Saharan dust episodes.": significant precipitation should be also mentioned.

27. Section 3.2, page 28204, line 16, "... a rainy season over this area.": this is also rainy season in the eastern part.

28. Section 3.3, page 28204, line 20: replace "frequency South to North..." with "fre-

quency from South to North...".

29. Section 3.3, page 28204, lines 27-28, "The linear relation ... different to the central": what are the limits for western, central, eastern parts of the basin, and why eastern-western were put together and central alone. I would suggest to show separately results (points and linear fits) for each one of the three parts, and linear fitting for all three together.

30. Section 3.3, page 28205, lines 11-16, "The transport of African dust ... following sections": it is not clear how these conclusions were drawn from Fig. A2, especially since this Figure (and in particular its labels of isopleths) are not readable. Please improve the quality of Figure in this aspect.

In any case, this is an interesting finding. However, maps in Fig. A2 are presumably drawn on a climatological basis. The explanations would be more realistic if they were drawn only for the days of dust occurrence. Furthermore, with regards to the heights of dust transport in the eastern Mediterranean, reference to previous studies (e.g. Kalivitis et al., 2007) could be also made.

31. Section 3.4.1, page 28206, lines 13-21, "Despite that slight ... following sections.": I am afraid that this is somewhat dangerous to say. The statistics from which it is derived is poor (small number of stations for each latitudinal bin). Moreover, the most serious problem with is the non-uniform and incomplete spatial coverage of the study region, more specifically in terms of longitudinal versus latitudinal coverage. For example, if stations in northern African coasts or in the Anatolian peninsula were also included/available, the results would probably change. Therefore, it is more appropriate to state that the derived relationshiop is valid either for the regions where stations are found or near them.

32. Section 3.4.2, page 28207, line 13, "... for 50% of PM10 ...": do you probably mean up to 50%? Furthermore, comparing the results of Figs 5 and 2 (4.4 and 18 micrograms per cubic meter) for Sicily an annual basis, would give a percentage of

25%, which is smaller than results of Fig. 7. How is this explained?

33. Section 3.4.2, page 28207, line 22: replace "... is given by external mineral dust ..." with "... is contributed by African mineral dust ...".

34. Section 3.4.3, page 28208, line 2: replace "... concerns to their intensity." with "... concerns their intensity.".

35. Section 3.4.3, page 28208, line 13, "... reduced (ïĂij1-1% ...": identical numbers, probably mistaken.

36. Section 3.4.3, page 28208, lines 13-14, "... in equivalent ... Sicily).": please re-write this sentence.

37. Section 3.4.3, page 28208, line 28, "intricate transport mechanisms.": just shortly explain what these mechanisms (of dust transport in the western and central Mediterranean) consist in.

38. Section 3.4.3, page 28209, line 13: replace "seasonal distribution" with "seasonal variation".

39. Section 3.4.3, page 28209, line 15: replace "Concerning intensity," with "Concerning the intensity of dust occurrences,".

40. Section 3.5, page 28211, line 21: replace "address on the influence" with "address the influence".

41. Appendix A, page 28213, line 18, "of these areas": which ones?

42. Appendix A, page 28212, line 8: replace "frequently in from October" with "frequently from October".

43. Appendix A, page 28212, line 11: replace "... of the Mediterranean, giving" with "... of the Mediterranean, leading".

Figure 5: you may also produce this figure in percentage terms (%).

Figure 13: provide a better caption, especially since labels in this figure panels are not readable.

Figure A2: improve readability of this figure, probably filling contours with colors.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 28195, 2012.