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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Modulation of Saharan dust export by the North African dipole" *by* S. Rodríguez et al.

S. Rodríguez et al.

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Thanks to Referee #2 for his useful and very detailed analysis and comments that contribute to improve the original manuscript. Please, find below a point-by-point reply to each question and suggestion:

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C1) About description data included in the supplement and data management. 1. Although the authors provide additional information of the dust surface concentrations in the supplement I consider that important information should be provided in the text. The authors mention daily data in the text but the analysis is done in terms of monthly data. How is the monthly average computed, more specifically how is the NAFDI computed,

taking only days with surface concentration data or taking all days? Same is valid with respect to the satellite data. Furthermore, the authors mention that two databases of dust surface concentration exist for the analysed period, which one was used for the study? This should be clarified.

REPLY: We agree with this suggestion and part of the methodology of dust measurements will be transferred to the text of the article. Aerosol samples for chemical analysis have been collected every day, so dust records in our database have a daily time resolution. Time series of dust presented and analysed in the article (Fig.1A-1B) is based on monthly averages calculated with the daily data available for the month. The requested details on the measurements, used databases and calculation of the monthly averages of dust and satellite information will be included in the main text (not supplement) of the final version of the manuscript.

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C2) About high and low NAFDI summers. 2. Although the high and low NAFDI summers are defined in caption of Figure 2, this should be made explicit in the text. In addition, the authors should explain why the define high and low NAFDI summers only taking 3 years. Why were the years 1994 (high NAFDI) and 2002 (low NAFDI) excluded?

REPLY: We agree with this comment. A detailed description will be added in the text. We selected the three years with the three highest and three lowest NAFDI for which dust data at Izaña and satellite AI and reanalysis. These details will be added in the text. We will increase from 3 to 5 the number of years used in each group with the highest and lowest NAFDI values (we have already checked the results and there are no relevant changes when using 5 year in each group rather than 3 years).

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C3) About back-trajectories. 3. Section 2.3 mentions that back trajectories were ana-

lyzed but no mention is made of this analysis neither in section 4 presenting the results nor in the conclusions. Either include some of the results in the text or remove this analysis completely from the manuscript. The supplement is made to provide additional information or to support the results presented in the study. If the back trajectories is not linked somehow to the results and is not even mentioned then I don't see the point of having it in the supplement at al.

REPLY: We also agree with this comment, the back trajectories analysis will be transferred to the main document (removed from the supplement).

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C4) About surface dust concentrations movement. 4. Section 2.4 describes how the dust surface concentrations are processed. I suggest moving this paragraph to section 2.1 where the surface concentrations are presented.

REPLY: We agree, it will be transferred.

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C5) About surface dust concentrations. 5. The authors make references to the supplement throughout the text but without specifying which figure, table and/or section they refer. The authors should facilitate the task to search the information in the supplement to the reader and specify which part is meant each time the supplement is referenced.

REPLY: Thanks for this comment. References to the specific figures of the supplement will be included in the main text.

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C6) Correlation of NAFDI with other parameters. 6. Figure 4 presents correlations between the NAFD with different parameters (zonal wind, MDAF and precipitation). Is this done for all summers, high NAFDI summers or Low NAFDI summers? I'm surprised by the negative correlations over ocean and continent in the subtropical band. From

Figure 2 we see that low NAFDI summers we have weaker winds than summers with high NAFDI, shouldn't that give a positive correlation? A negative correlation between NAFDI and zonal wind tells me that while one increases the other one decreases. Doesn't a negative correlation contradict the result that enhanced dust transport is linked to the NAFDI and is associated to stronger easterly zonal winds? Please clarify. How exactly is this figure produced?

REPLY: Fig 4 was calculated using all summer-averaged data (1987-2012). The negative correlation is due to the direction of the zonal component of wind vector is indicated with a sing: negative for westward wind (e.g. - 1 m/s) and positive for eastward wind (e.g. + 1 m/s). The very negative correlation between NAFDI and zonal wind in Central Algeria means that in high NAFDI summers there are strong westward winds over Central Algeria, and this is in agreement with the results plotted in Fig 2. Similar for winds over the ocean and the other regions included in the plot. That is the reason because arrows highlighting the wind direction pointed by the resulted of the correlation were included in fig 4A. Thanks for this comments, this will be explicitly described in the text.

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C7) Correlation of NAFDI with other parameters. 7. The results show that in general, enhanced dust surface concentrations in the summer coincide with and increase in the NAFDI. This is illustrate in Figure 5a and is seen for most of the years in Figure 1a. The authors then analyze the meteorological largescale condition and link the enhanced surface concentration to increase of zonal wind in the subtropics. Only three summers are used to define the high NAFDI summers and three for the low NAFDI summers. Yet, years exists where low dust surface concentration is not matched with low NAFDI (1991 and 1994), in particular for the year 1994 with a NAFDI equivalent to the year 1987. The latter was defined as a high NAFDI year and used in the analysis. The authors should explain or at least discuss why

REPLY: This is an interesting comment; I guess you meant to 1988 (which has a high

NAFDI similar to 1991 and 1994) and not to 1987 (low NAFDI). Yes, effectively, in 1991 and 1994 the NAFDI was rather high whereas dust concentrations were not as high as expected for these NAFDI values (compared to other summers). There are many factors that may have prompted this, e.g. vertical distribution of dust, dust deposition processes, meteorological processes that may have a scale rather low to be studies with the resolution of the re-analysis data. The correlation coefficient between the times series of summer mean values of NAFDI and dust at Izaña is +0.74, this means that the processes explained by the NAFDI accounts for most of the variability of dust, whereas other processes not properly described by NAFDI accounts for a rather low variability of dust ($\sim$25%). Thanks for this comment which will be included in the text.

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Specific comments

S1. Page 26691, lines 15-18: I suggest reformulating these lines with parenthesis within parenthesis. REPLY: thanks, will be considered.

S2. Page 26693, lines 10-16: I suggested reformulating these lines, too long and unclear. REPLY: agree, thanks.

S3. Page 26693, line 18: remove “the” in “in the summertime”. REPLY: thanks.

S4. Page 26696, line 6: include “the” after “studying”. REPLY: thanks.

S5. Page 26699, Eq 1: why is there a 0.1 in the equation? Please clarify. REPLY: thanks.

S6. Page 26704, line 6: replace “latutudes” with “latitudes”. REPLY: thanks.

S7. Page 26715, Figure 2: Although the latitudes are provided in Figure 2d, please include them again in Figure 2a and 2b, it makes it easier to read them. REPLY: thanks.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 26689, 2014.