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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol-ozone correlations during dust transport episodes" *by* P. Bonasoni et al.

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Answer to Referee #1

General comments:

Taking in account Referee's suggestions we clarified the methodology used to identify Saharan dust events at Mt. Cimone. Moreover, we more highlited possible influence of radiative role of mineral dust on photolysis processes affecting ozone chemistry. Finally, we improved the analysis of dust influence on PM10 and O3 concentrations recorded in Italian cities of the Po valley area.

Major issue:

1) A section (2.4) concerning the methodology applied to select dust event at MTC ("Identification of Saharan dust reaching Mt. Cimone") has been inserted in the 2nd

paragraph ("Site, experimental procedures, and methods"). See text. As better pointed out in the section 3.2.1, for classes (a: "Saharan dust events") and (b: Africa outside "Saharan dust events") we analysed ONLY mean de-trended ozone values calculated for the 3-hour period centered around the time of back-trajectory arrival at MTC. To select north Africa origin we selected air mass back trajectories coming from the box described in the section 2.4.

Table 1 has been inserted indicating the duration and strenghts of dust events with information on coarse particle and ozone concentrations recorded.

2) The statistic methodology based on back-trajectories analysis has been already applied with good results in many studies (e.g. Wotawa and Kroeger, 1999; Ferrarese et al., 2002), also to analyze transport of particulate sulfate in Europe (Stohl, 1996). An explaination about the maxima visible (not only for fine and coarse aerosol, but also for TOMS-AI analysis, north of Canary Islands is now reported in the text (section 3.1.1): "The maximum of coarse and fine aerosol as well as of TOMS AI concentration field nort of Canary Islands is likely an artefact of the statistical methodology applied. It is possibly caused by dust (fine and coarse mode) mobilized over north Africa and transported along an anticyclonic pathway first north-westward over the Atlantic ocean and then north-eastward over the Mediterranean basin (Rodriguez et al., 2001)". Also, the large branch of apparent coarse aerosol sources in Spain and France could be linked to this transport pathway. The Referee noted that the agreement between Fig. 6 and Fig. 4 is not clear. In order to compare the concentration field for TOMS-AI and coarse particle, we performed correlation analysis by calculating linear correlation coefficient. The obtained results (r=0.62) confirmed the agreement between the pictures. Moreover, in a more general meaning the uncertainties linked to back-trajectories are already discussed and evaluated in the text (page 6, par. 2.2). In particular, we reported that: " Typical trajectories errors are about 10-20 % of the travel distance, but individual trajectories can have much larger errors depending on the meteorological situation." Obviously these errors could affected the calculation of concentration fields

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shown in par. 3.1.1 and 3.2.1.

3) According with the Referee's suggestions, the radiative role of mineral dust on photolysis processes has been highlighted on the text. In particular, the paragraph Discussion (par. 3.2.3) and Conclusions (par. 4) are re-drawn taking in account also the possible role of dust with solar radiation in atmosphere. Moreover, we defined "Saharan dust events" as those transport episodes characterized by STRONG dust transport at MTC (see par. 2.4). Following this definition we considered the following classes: (a) north African origin during "Saharan dust events"; (b) north African origin outside "Saharan dust events"; (c) all the other data

Concerning the significance of ozone differences in "Saharan dust events" and outside "Saharan dust events" in effect, due to the large variability of hourly ozone data, a simple mean and standard deviation analysis could not be the best way to point out statistically significant differences. For these reasons, we investigated the correlation between ozone concentrations and air mass classes using the one-way ANOVA methodology and Student's t-test. In this way, variances of the different ozone population can be analyzed to estimate whether the means of the population are significantly different or not. The results (reported in table 3, see text) claimed the significance of calculated differences. Figure 12 has been substituted by table 3.

4) We think that the inclusion of Po valley PM10 analysis in the paper is relevant for different reasons. First of all, they represent the first scientific results concerning the possible impact of dust events on PM10 measured in urban and rural areas in the Italian territory. According to the Referee's notes and in order to better fit this topic in the paper, we extended it with additional statistical information on the relevance of Saharan dust at these urban/rural measurement sites both for PM10 (subsection 3.1.2) and O3 concentration (subsection 3.2.2).

References:

Wotawa, G., Kröger, H.: Testing the ability of trajectory statistics to reproduce emission

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inventories of air pollutants in cases of negligible measurement and transport errors, Atmos. Environ., 33, 3037-3043, 1999.

Stohl, A.: Trajectory statistics - A new method to establish source-receptor relationship of air pollutants and its application to the transport of particulate sulfate in Europe, Atmos. Environ., 30, 579-587, 1996.

Rodriguez, S., Querol, X., Alastuey, A., Kallos, G., Kakaliagou, O.: Saharan dust contribution to PM10 and TSP levels in Southern and Eastern Spain, Atmos. Environ., 34, 25, 4215 Ű 4240, 2001.

Ferrarese, S.; Longhetto, A.; Cassardo, C.; Apadula, F.; Bertoni, D.; Giraud, C.; Gotti, A. A study of seasonal and yearly modulation of carbon dioxide sources and sinks, with a particular attention to the Boreal Atlantic Ocean, Atmospheric Environment 36, 5517-5526, 2002.

Minor comments:

1)Corrected in the text

2)1deg X 1deg (now included in the text, section 2.2)

3)limit inserted (see section 3.1.2)

4)Corrected in the text

5)The field presented in the text is for ozone (not de-trended). Using de-trended ozone the minimum over north Africa is confirmed and a series of quasi-equal higher ozone concentration are present over Europe.

6)See table 1, now.

7)Due to the non-linear chemistry reaction determining ozone chemistry itŠs difficult find a linear correlation between ozone decrease and mineral aerosol increase. Moreover, considering only heterogeneous ozone destruction on mineral aerosol, it has

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been evidenced that the rate of ozone destruction is dependent not only from the quantity of mineral aerosol, but also from different parameters as the dust temperature and the ozone concentration (Hanisch and Crowley, 2003 in the text). Considering all the 12 Saharan dust events as reported in Fig. 10 (showing daily O3 and coarse particle concentration), the hourly maximum O3 reduction, calculated in respect to monthly mean, ranged between 13% (26-28 Aug.; 8-9 Dec.) and 42% (4-7 Oct.). See Table 1.

8)Corrected in the text

9)Corrected in the text

10)Corrected in the text

11)Corrected in the text

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 2055, 2004.