

Interactive comment on “Significant variations of trace gas composition and aerosol properties at Mt. Cimone during air mass transport from North Africa – contributions from wildfire emissions and mineral dust” by P. Cristofanelli et al.

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General comments

The authors thanks the Referee2 for the valuable comments and suggestions. Here we better address the point indicated by the Referee.

1)Abstract: I strongly recommend to delete the last sentence of the Abstract: “Since in the future it is expected that wildfire and Saharan dust transport frequency could increase due to more frequent and severe droughts, similar events will possibly play an

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important role in influencing the climate and the tropospheric composition over South Europe”. What means “important role in influencing climate” ? Do the authors think in terms of radiative forcing? Is such an event important if it occurs once in several years (I have my doubts) ? Without trying to provide (i) information about the frequency of such events (in the present troposphere and its expected increase in future) and (ii) the expected effect on radiative forcing the link to climate remains very weak. I think the paragraph at the end of the paper is adequate but such a sentence is not appropriate in the Abstract.

Following the referee’s suggestion, we will delete this sentences from the abstract. However, we think that an interaction of emitted aerosol (but also ozone) with solar radiations it was likely and that it could produce a significant radiative forcing. This was also suggested by irradiance measurements (not shown in the work) conducted in the Po Valley during the investigated event. However, since no quantitative estimation of radiative forcing was conducted and since at the moment we are still not able to provide an evaluation of the frequency of this kind of episodes, we decided to delete the sentence from the abstract.

2)NOy and (and possibly) NOx measurements would be useful in this study. Is NOy measured at Mt. Cimone ? If NOy measurements are available I recommend to include them in the paper, if NOy is not measured, I would recommend to include these measurements in the program of the station.

Unfortunately, nor NOy neither NOx measurements were available at Mt. Cimone. The installation of NOy or NOx analysers are foreseen.

3)According to p.7834, line 21-25, backward trajectories with FLEXTRA 3-D were calculated. Please provide information whether these trajectories support the results of the BOLAM model; if they contradict BOLAM please discuss the reasons.

In this paper, we tried to use the best available tool for each different application. For this reason, we used FLEXTRA (section 2.4) to define background measurements pe-

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riod by identifying air-masses that reached CMN originating from a pristine area (the North Atlantic Region). Due to the sufficient time length of back-trajectories (7 days) and considering the valuable skill that this model showed in simulating air-mass transport to CMN (see for instance, Bonasoni et al., Atmos. Environ.,34, 5183-5189, 2000; Fischer et al., Atmos Chem Phys., 3, 725-738, 2003 ; Cristofanelli et al., Atmos. Environ., 41, 1383-1394, 2007), FLEXTRA has been used to this aim. On the other hand, with the purpose to carefully describe the circulation in the Mediterranean basin during the BB event, we applied BOLAM. In particular, BOLAM offers the advantage to have a higher spatial and horizontal resolution, a better resolved flow over the orography (fundamental for the event) and it allows to calculate trajectory clusters in a coherent way with respect to the circulation from the model thanks to the Gheusi et al. approach (see the related reference on the manuscript). Moreover, the ensemble calculation can provide a better description of the coherence of the simulated flow. In this work, we did not present a comparison between FLEXTRA and BOLAM results, since a model comparison is outside from the scope of this observational paper. However, we analysed the atmospheric circulation also in terms of FLEXTRA back-trajectory (but we did not show in the paper): even if with some obvious differences (probably related with the coarser model horizontal resolution, topography and different calculation approaches), FLEXTRA was in good agreement with BOLAM results. In fact, as shown by the figure c1 (reporting the time-travel of FLEXTRA back-trajectories for reaching CMN from the North African coastlines), advection of air masses from North Africa was evident by FLEXTRA simulation during the analysed period.

4) p. 7836, line 12: *Did you explain the meaning of the abbreviation "NAAPS" ? If not please explain*

The meaning of the abbreviation NAAPS (Navy Aerosol Analysis and Prediction System.) was already provided in the section 2.2.

5) p. 7838, line 3 and 4: *You reference the papers of Baltensperger et al., Zellweger et al. and Schuepbach et al in a way (such wind systems can efficiently contribute*

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..) that the (uniformed) readers might get the impression that these studies directly relate to measurements at Mt. Cimone. According to my knowledge, they are based on studies at Jungfrauoch, which is at considerable higher altitude. I also believe that the same types of mechanisms are important at Mt. Cimone but it should be clarified that the studies are based on measurements at Jungfrauoch. The title of the paper of Schuepbach suggests statistical analysis. Is this an important subject in the context of your paper ?

Even if the title of the work by Schuepbach et al. indicated a statistical analysis, however it contains a detailed discussion about the processes leading to the transport of polluted air-mass to Jungfrauoch due to day-time thermal winds. However, we will clarify in the revised manuscript that the papers by Zellweger et al. and Schuepbach et al. refers to other alpine station. We will add the reference by Fischer et al. (2003) and Van Dingenen et al. (2005), already present in the original manuscript, for specifically referring to Mt. Cimone

6) *In Figure 8 the dates and times of the individual Figures need to be changed (e.g. 07082806 confuses the readers, thus please replace).*

OK, the dates and times in the Figure 8 will be changed.

7) *It looks to me, that CO and BC concentrations significantly start to rise about 12 hours prior to the date, when BOLAM data indicate the influence of fire over Africa (see Figure 9). Please comment on this point in the paper. If you attribute this effect to mixing, this probably implies that the BOLAM trajectories have a temporal uncertainty in the order of 12 hours, which should be clarified, since 12 hours is relevant in the context of an event that lasts for two days.*

As shown by Fig. 6 and widely described in the section 3.2, during the afternoon-evening on 28 August 2007, a plume of pollution from North Italy affected atmospheric compound measurements carried out at Mt. Cimone. Thus the increase in BC and CO concentrations observed at CMN starting from 12:00 on 28 August 2007 were ex-

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plained in term of pollution advection. Thus, it is no contradictory that BOLAM started to show fire influence starting from 00:00 on 29 August 2007. However, to better address this point, we will add the following sentence to the paper: "Note that the increase in CO and BC concentrations observed in the afternoon-evening on 28 August 2007, was not directly related with the BB product transport but with the advection of polluted air-masses from North Italy, as shown in the section 3.2."

8) According to Figure 10a it looks to me, that sulphate is a rather large contribution in the fine particulates during the BB plume. Please comment (in the revised version of the paper) on the origin of large sulfate concentration in the fine particles during this event.

Although a number of literature studies have shown that sulphate provides only a moderate contribution to particulate matter in biomass burning plumes, it should be noted that: a) the contribution and composition of inorganic ions in biomass burning particles vary strongly with burning conditions and fuel type (e.g., Iinuma et al., JGR112, D08209, doi:10.1029/2006JD007120, 2007), b) the contribution of secondary compounds like sulphate to particulate mass is expected to increase during long range transport especially in environments like the Mediterranean basin where the concentration of oxidatants is very high, c) there are only few literature studies dealing with the chemical composition of aerosols emitted by fires in the Mediterranean areas. For instance, Pio et al. (Atmos. Environ. 42, 7530-7543, 2008) reported aerosol chemical composition data for summer fires in Portugal, showing concentrations of sulphate of 13 and 4 $\mu\text{g}/\text{m}^3$ during two episodes of intense burning in the region. Such concentrations must be compared with an OC concentration of about 7 $\mu\text{g}/\text{m}^3$ (i.e. about 12 $\mu\text{g}/\text{m}^3$ of OM) during both episodes. This study indicates that sulphate contribution to PM1 is not necessary low in biomass burning particles from Mediterranean fires.

9)p. 7844, line 22-24: According to my understanding of this sentence you frequently find the effect of North African BB at MTC (. . . the strongest observation of wildfire product transport to MTC, usually considered representative for the background . . .).

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Is this true ? How often to do find such events ? Please comment, and include such information in the manuscript.

Transport of wildfire emissions were already observed at Mt. Cimone during summer 2003 (see Cristofanelli et al., 2006) but from North Italy. At the moment, does not any study exist which provides a full climatology of the seasonal or multi-annual frequency of BB emission transport to CMN. This important issue will be the object of a future activity. Nevertheless, in our knowledge there are no study, providing observations of the impact of North Africa BB on atmospheric compound measurements over Mediterranean Basin. Thus, we will reformulate the sentence in a clearer form: "Even if BB transport to CMN were already observed during summer 2003 (Cristofanelli et al., 2006), this North African BB event constitutes the first investigation concerning an episode of wildfire product transport mixed with mineral dust at this measurement site, often considered representative for the background conditions of southern Europe/Mediterranean basin (Bonasoni et al., 2000; Fischer et al., 2003)".

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 7825, 2009.

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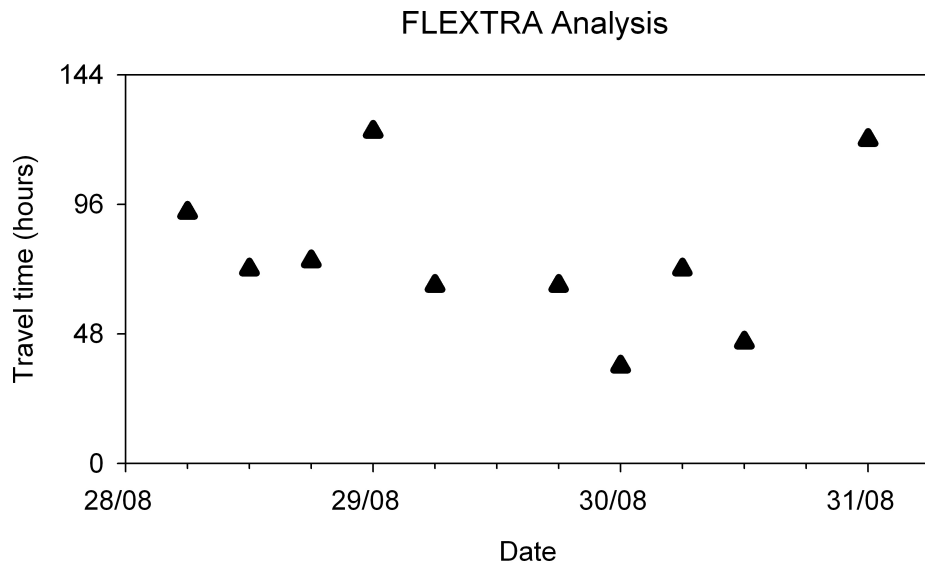


Fig. 1. FLEXTRA back-trajectory travel times from the North Africa coast-lines to CMN at each 6-hour time step.