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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol sources and their contribution to the chemical composition of aerosols in the Eastern Mediterranean Sea during summertime" *by* J. Sciare et al.

J. Sciare et al.

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Interactive comments on "Aerosol sources and their contribution to the chemical composition of aerosols in the Eastern Mediterranean Sea during summer time" by J. Sciare et al.

Reply of the authors to the comments given by the anonymous referee #1.

First of all, the authors would like to thank referee #1 for his/her comments, which will definitely contribute to improve the quality of the paper. For clarity reasons, the specific issues pointed out by the referee #1 are reported here together with the reply of the authors.

1) For a short time during the campaign SO2 concentrations measured with filter pack

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and the mist chamber were compared. It is stated that the comparison resulted in a slope of 1.13. Which technique gave the higher value ?

As shown by the slope of 1.13, the cofer mist chamber technique gave the slight higher values. Blank values for the 2 techniques were similar. Air volume sampled were also quite similar, thus blank corrections could not explain the observed difference. Data (low and high concentrations of SO2) are equally distributed around the linear regression. Loss on the Teflon line (cofer mist technique) should be not significant since this technique gives the higher values. The number of data is probably not enough to allow further conclusions which could explain this slope of 1.13. In the final version, the sentence (lines 10-12) will be rephrased to mention, which technique gave the higher value.

2) Question : What particle size range was sampled with the low volume impactor ?

The authors acknowledge that the term "Low volume impactor" (line 21) mentioned in the manuscript is often used to describe cascade impactors and does not adequately describe the sampling system used during the campaign, which collected aerosols with no specific cut-off applied at the inlet. The sentence (line 21) will be rephrased to better describe the aerosol collector and will point out that the results presented in the paper correspond to bulk aerosol sampling.

3) A PSAP was used to approximate the BC concentrations. Were values of the absorption coefficient determined with the PSAP corrected for a scattering artefact and the size of the deposit spot as for Bond et al. (1999) ? Given the amount of sea salt and dust present, the scattering artefact could have been significant.

As recommended by the referee, in the revised version of this paper we will correct the absorption coefficient determined with the PSAP as proposed by Bond et al. (1999). This correction will lower the BC concentrations by about 20% on average and will not alter the conclusions drawn in the paper. Moreover it brings the BC/nss-SO4 mass ratios to lower values (below 10%) and thus strengthens the conclusions derived from

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this ratio (page 1304, lines 3-5).

Since AOT is sensitive to dust aerosols (page 1302, line 19), we agree with the referee that scattering due to dust and sea salt would influence the results of BC obtained using the PSAP. On the other hand, sea salt and dust aerosols did not show any significant correlation with the scattering coefficient measured at 550nm (TSI) during the campaign. This finding is in agreement with the results from the MINOS campaign performed in 2001 at the same site (Finokalia Station) and at the same period of the year (Sciare et al., 2002). It was found that the Coarse Mode (Dust + Sea salt aerosols) contributes less than 10% of the total scattering. Thus the bias in BC calculation due to scattering by sea salt and dust aerosols is not significant and cannot explain by itself the bias found using the source-receptor model calculations. As mentioned in the paper, other bias (such as absorbing aerosols from dust particles) would mainly influence the optical measurements of BC. This assumption has been also verified during the MINOS Campaign: A 7-wavelenght Aethalometer (AE-30) running at a Free tropospheric site on Crete clearly showed absorption in the red (as for Hematite), this absorption being concomitant with dust aerosols.

An estimation of the role of dust and sea salt aerosols can be achieved as following :

Using the formula proposed by Bond et al. (1999), the overestimation of the BC concentrations (in μg/m3) due to scattering is [(0.02 x Sigmascat) / (1.22 x 10)]. (Sigmascat being the scattering coefficient in Mm-1 ; 0.02 and 1.22 being the factors K1 and K2 given in equation 12 (Bond et al., 1999) ; 10 being the MAE given by the manufacturer for PSAP). During the dusty periods Sigmascat reaches values of the order of 50 Mm-1. Thus BC overestimation due to scattering would increase by about 0.08 μg/m3, i.e around 15%, in agreement with the conclusions of the paper (page 1303, lines 15) "influence of dust emissions on the calculation of BC in aerosols using a light absorbance technique".

4) p. 1293 : As the authors state, the use of absorption coefficient to derive BC con-

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centrations can result in a high level of uncertainty. Recent field experiments focused on measuring aerosol optical properties and chemical composition (e.g. INDOEX and ACE ASIA) have reported mass absorption efficiencies (MAE) ranging from 8 to 20 m2/g. The uncertainty of the BC concentrations presented here should be presented. This could be done by assuming a range of MAE and propagating it through the calculation of BC. This should be then applied to the reported BC/nss-SO4 ratios.

The main topic of this paper is the characterization of different Aerosols sources (and thus probably different MAE). Bias in the calculation of BC can originate from the influence of dust (as shown in the paper and has been discussed above) but also can originate from different combustion sources / different aerosol lifetime inducing different MAE as shown by Liousse et al. (1993). Then, the uncertainty in MAE will be presented and discussed (as mentioned by the referee). More efforts will be put in the revised version of this manuscript to highlight the role of MAE in the calculation of BC from optical measurements.

5) p. 1294 : At the first mention of the measured (BC/nss-SO4) ratios, the ratios should be reported - both the stable value and the high values during the dusty periods.

The authors propose to rewrite the sentence (lines 22-24, p. 1294) as following : As a result, the plot of the BC/nss-SO4 mass ratio, which was quite stable during the campaign (11.6 + - 3.8 % for the non dusty periods), showed high values during these three periods (18.9 + - 4.8 %).

6) p. 1296 : It is stated that "the great proximity of Turkey compared to Algeria, as well as the difference in altitude in the transport of the dust.." What was this altitude ? Based on what ? The trajectories appear to only have been calculated for the 500m height.

We agree with the referee that the sentence (p. 1296, lines) appears to be confusing. The authors wanted to notify that (1) the air masses arriving above Finokalia station (at 500m height) originated from the surface level over Turkey (2) On the other hand the air

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masses arriving above Finokalia station (at 500m height) and originating from Algeria were travelling at 2000-3000m altitude above surface over Algeria. The air masses over Turkey have been closer to the surface and thus to the dust source compared to Algeria and have been therefore expected to present with higher mass loadings of dust.

The authors propose to rephrase part of the sentence (p. 1296, lines).

7) p. 1298 : The MSA/nss-SO4 ratio - Temperature relationship (Bates et al., 1992) is also a function of particle size. Again - what was the size range of the particles sampled in this study ?

As mentioned before under point 3, the sentence (line 21) will be rephrased to better describe the aerosol collector and will point out that the results presented in the paper correspond to bulk aerosol.

We do agree with the referee that MSA and nss-SO4 can have quite different size distributions (see for instance in Andreae et al., 1999; Huebert et al., 1996 and 1993). As a consequence, their lifetimes will be different, causing the MSA/nss-SO4 ratio to change as they are transported far from their source region.

During most of the campaign (10-31/7/2000) size-segregated samples were collected at Finokalia using Berner type low pressure cascade impactor. The impactor had an inlet providing approximately 15 ìm upper cut-off particle size and operated at a flow rate of 25 l min-1. Sampling was carried out approximately in 24 - hour intervals (starting at 10:00 LT). A quarter of the foil was dedicated to ion chromatography analysis. More details on these results can be found in Bardouki et al., 2002.

On average, during the ELCID campaign, 90.3% and 87.4% of nss-SO4 and MSA respectively were found in the sub micron range having equal distribution centred on 0.3 μm (figures not allowed in the ACPD website). As a result, one can expect MSA and nss-SO4 to have the same lifetime in aerosols, allowing the use of the MSA/nss-

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SO4 ratio as proposed by Bates et al. (1992). The equation used by Bates et al. (1992) linking the MSA/nss-SO4 ratio with the air temperature was based on aerosol measurements with a cut-off diameter of 0.6 μm (which would represent here more than 80% of both MSA and nss-SO4). In our study, we reported the MSA/nss-SO4 ratios for bulk aerosol. We calculated that, on average, the error made by using the MSA/nss-SO4 ratio for bulk aerosol (instead of diameter $<$ 0.6 μm) is around 7% and thus not significant.

The authors propose to add the previous sentences in the revised version of the paper.

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