Pergamon

PII: S0021-8502(96)00096-1

J. Aerosol Sci., Vol. 27, Suppl. 1, pp. S47–S48, 1996

0021-8502/96 $15.00 + 0.00

ANTHROPOGENIC AND NATURAL RADIATIVELY ACTIVE AEROSOL TYPES AT SEDE BOKER, ISRAEL

W. MAENHAUT[1], R. SALOMONOVIC[1], J. CAFMEYER[1], C. ICHOKU[2], A. KARNIELI[2], and M.O. ANDREAE[3]

[1]Institute for Nuclear Sciences, Proeftuinstraat 86, B-9000 Gent, Belgium
[2]Ben Gurion University of the Negev, Sede Boker Campus 84990, Israel
[3]Max Planck Institute for Chemistry, D-55020 Mainz, Germany

KEYWORDS

Atmospheric Aerosols; Aerosol Types; Sulphate; Mineral Dust; Radiative Forcing; Israel

The Eastern Mediterranean is a receptor area for several radiatively active aerosol types from anthropogenic and natural origin. Model calculations (Langner and Rodhe, 1991; Langner *et al.*, 1992) and some earlier measurements suggest high levels of fine non-sea-salt (nss) sulphate that are due to long-range transport from Europe. In order to verify the model calculations, to assess the contribution from the various aerosol types to the fine aerosol, and to evaluate the direct radiative forcing from aerosols in the area, both long-term and intensive chemical, physical and radiative aerosol measurements are being conducted at Sede Boker (30°50'N, 34°40'E, 470 m asl), Israel. For the chemical measurements, 2- or 3-day collections are performed on a continuous basis with a "Gent" stacked filter unit (SFU) sampler, which separates the particles into a coarse (2-10 μm equivalent aerodynamic diameter (EAD)) and a fine (<2 μm EAD) size fraction (Maenhaut *et al.*, 1994). The SFU samples are analyzed for the particulate mass (PM), black carbon (BC), major ionic species and over 40 elements. The total and backscattering coefficients at 3 wavelengths (450, 550, and 700 nm) for the in-situ aerosols are determined with an integrating nephelometer (TSI 3563), and total vertical column optical and physical aerosol characteristics are obtained with an automatic tracking combined sunphotometer/sky radiometer (CIMEL Electronique 318A). The chemical measurements for the period February through August 1995 indicated that the median PM level in the fine size fraction was 18 μg/m^3 (interquartile range: 15-21 μg/m^3). Nss-sulphate was assumed to be present as ammonium sulphate, and its median concentration (<2 μm EAD) for the same period was 8.4 μg/m^3 (interquartile range: 6.2-11 μg/m^3). The atmospheric concentrations of the mineral dust aerosol type were derived on the basis of the data for Al and Ca, and those for sea-salt were obtained from Na. In performing these conversions use was made of compositions for crustal materials and sea water, as given by Mason (1966) and Riley and Chester (1971). In the period February through August 1995, nss-sulphate accounted on the average for 50% of the fine PM, BC for 6%, mineral dust for 25%, and sea-salt for 5%. The time trend with the apportionments (expressed as percentage of the observed fine PM) for these four aerosol types in each of the individual fine filter samples is shown in Fig. 1. With the exception of the first part of the sampling period, the four aerosol types explain the observed fine mass rather well. The sources of the "missing" fine mass are unclear at present, but a major fraction of it may be made up by organic materials. The contribution from the nss-sulphate component shows little variability, and is generally between 30 and 70%. Much

more variation is seen in the apportionment to the mineral dust aerosol. On several occasions more than 50% of the fine PM was attributed to this aerosol type; these were all occasions when dust storms occurred in the region. Presumably, the nss-sulphate originated mainly from long-range transport from Europe, but this will have to be confirmed by further analyses, including the use of air mass back trajectories. The ratio of nss-sulphate to BC increased by a factor of 2 over the sampling period, suggesting changes in sources, gas-to-particle conversion and/or removal processes from winter to summer.

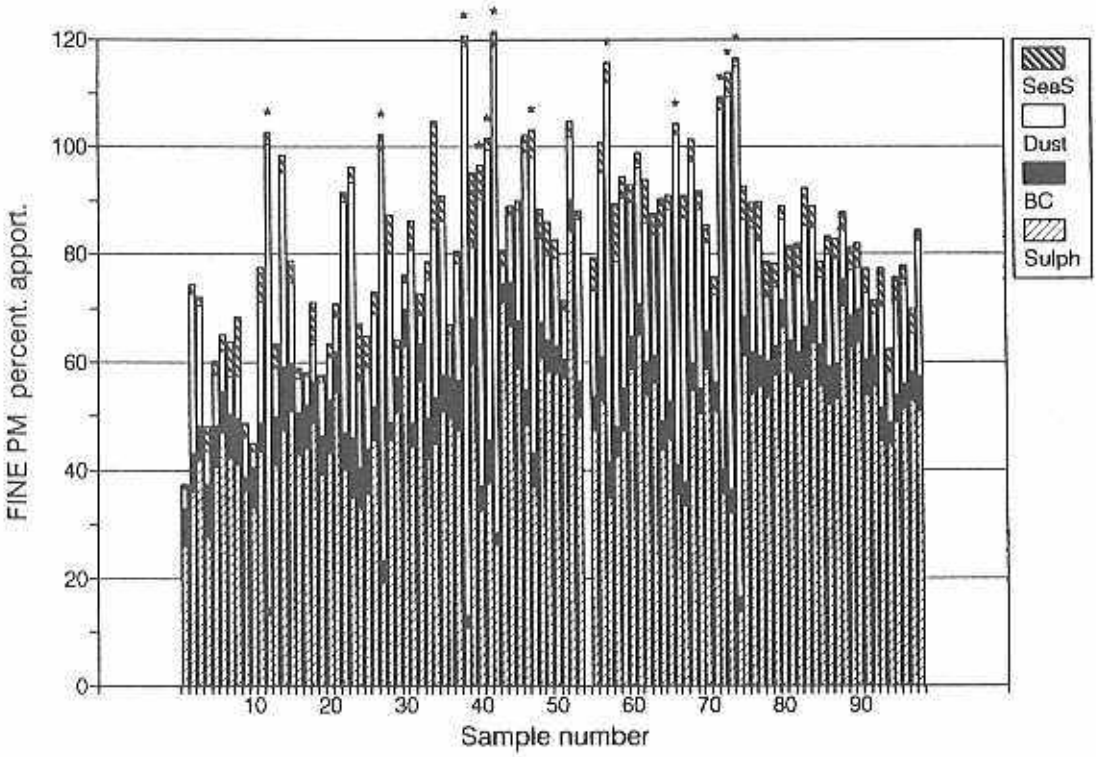

Fig. 1. Percentage contributions from the nss-sulphate, black carbon (BC), mineral dust and sea-salt aerosol types to the observed fine (<2 μm EAD) particulate mass (PM) in 98 individual samples, collected at Sede Boker, Israel, from 23 January to 31 August 1995. The mineral dust aerosol is occasionally responsible for more than 50% of the fine PM; these cases are marked with an asterisk above the stacked bar.

ACKNOWLEDGEMENTS

We gratefully acknowledge the financial support from the Belgian NFWO and OSTC.

REFERENCES

Langner, J. and H. Rodhe (1991) A global three-dimensional model of the tropospheric sulfur cycle, *J. Atmos. Chem.* **13**, 225-263.

Langner, J., H. Rodhe, P.J. Crutzen and P. Zimmermann (1992) Anthropogenic influence on the distribution of tropospheric sulphate aerosol, *Nature* **359**, 712-716.

Maenhaut, W., F. François and J. Cafmeyer (1994) in: *Applied Research on Air Pollution using Nuclear-Related Analytical Techniques*, NAHRES-19, IAEA, Vienna, 249-263.

Mason, B. (1966) *Principles of Geochemistry*, 3rd Edition, Wiley, New York.

Riley, J.P. and R. Chester (1971) *Introduction to Marine Chemistry*, Academic, New York.