SOURCES OF ATMOSPHERIC COARSE AND FINE PARTICLES IN BUDAPEST

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INTRODUCTION

To address the needs for a comprehensive characterisation of airborne particulate matter and its effects, and to assess human exposure to toxic air pollutants in Budapest, Hungary, a research project was undertaken (Salma *et al.*, 2000). The program involves chemical characterisation of elemental, main ionic and organic composition of size-fractionated urban aerosols, principal component analysis in two size fractions, and determination of detailed elemental mass size distributions together with deposition probabilities in the human respiratory system (Balásházy *et al.*, 1993, 1999) so that air pollution control measures could be implemented most effectively. The present paper reports on the source types, their relative intensities, and on the relationships between the source apportionment and actual meteorological circumstances (backward trajectories, macrosynoptical types, boundary layer characteristics, etc.).

EXPERIMENTAL

The aerosol samples were collected by PM10 stacked filter units into coarse (10–2 μm equivalent aerodynamic diameter, EAD) and fine (<2 μm EAD) size fractions at an urban background (KFKI campus) and downtown (Széna Square) sites in a field campaign conducted over 33 semi-consecutive days in a non-heating season in April-May 1996. Daily aerosol samples were taken. Basic meteorological parameters were measured, and some criteria pollutants were also recorded. The aerosol samples were analysed by panoramic instrumental neutron activation analysis (Salma and Zemplén-Papp, 1999), particle-induced X-ray emission analysis (Maenhaut and Raemdonck, 1984), a light reflection technique and gravimetry. The quantities measured include atmospheric concentrations of black carbon, elements (from Na practically through U), particulate matter, of NO, NO_2, SO_2, CO and total suspended particulate matter, and ambient temperature, pressure, horizontal wind speed and direction, and relative humidity. The total number of parameters determined is 61.

RESULTS

The analytical results were used for characterisation of the concentration levels, elemental composition, time trends, enrichment of and relationships among the aerosol species in the coarse and fine size fractions, and for studying the fine-to-coarse concentration ratios. The data sets were subjected to absolute principal component analysis as well. In the fine size fraction, the following source types were identified: transportation-related sources (high loadings of Pb, Br, BC, CO, NO, NO_2 and Cu), coal-fired power plants (high loadings of S, As and Se), oil-fired power plants (high loadings of V and Ni), a mixed industrial and incineration (or waste burning) component (high loadings of Cu, Zn, Cr, K, Cs and Sb), and a soil-derived component. Influence of the long-range transport on the fine-size aerosol composition was studied by air mass trajectory analysis. Five-day three-dimensional backward trajectories were calculated

for a starting point of 47.51° N, 19.03° E (Széna Square) for arrival levels of 800, 850 and 925 hPa, and for the arrival time of 18:00 UTC each day by the Hysplit model (Hysplit4, 1997) utilizing Medium Range Forecast archive data. The trajectories for the arrival date of 23 April are displayed in Figure 1 in order to illustrate the role of meteorology. These trajectories were controlled by a high-pressure weather situation, and they were inflected sharply by a slowly moving anticyclone over the Mediterranean. The dry and warm weather situation caused an increasing tendency in the daily atmospheric concentrations. Based on similar evaluations, an attempt was made to relate the aerosol burden in Budapest to the contribution from different faraway regions.

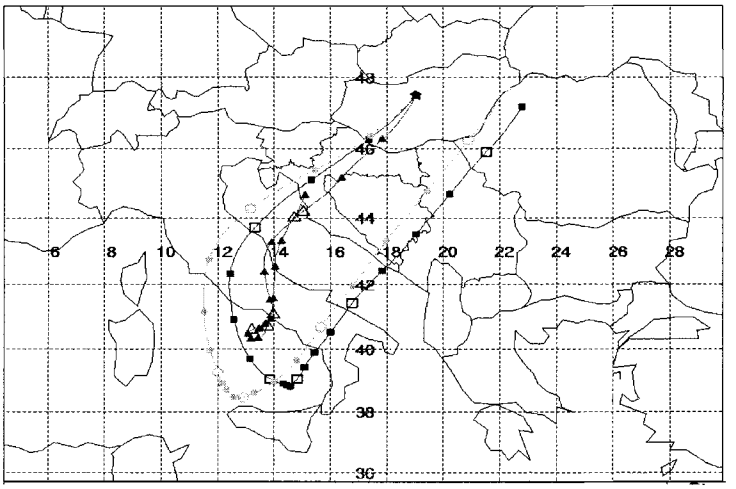

Figure 1. Five-day three-dimensional backward trajectories calculated for a starting point of 47.51° N, 19.03° E (Széna Square, Budapest) for arrival levels of 800 (●), 850 (■) and 925 hPa (▲), and for the arrival time of 18:00 UTC 23 April 1996.

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