

Source Origin and Spatial Distribution of Aerosol Particles in Budapest

A contribution to subproject SATURN

L. Bozó¹, J. Pinto², A. Gyovai³, I. Kiss³ and S. Kelecsényi⁴

¹*Hungarian Meteorological Service
H-1675 Budapest, P.O.Box 39.
HUNGARY*

²*U.S. Environmental Protection Agency
Research Triangle Park, NC 27711 U.S.A.*

³*DASY Decision and Systems Ltd.
H-1537 P.O. Box 446.*

⁴*Ministry of Environment
H-1394 Budapest P.O.Box 351.*

Summary

The concentration of different species in the atmospheric aerosol is influenced significantly by human activities, so the study of the source origin of elements in aerosol particles is of crucial importance for environmental management on urban scale. Receptor modeling applied in present paper provides quantitative estimates of the impacts of sources on ambient air. In contrast to dispersion modeling it applies only minimal meteorological and emission inventory information. Based on ADMS dispersion model computations (Singles and Carruthers, 1999) spatial distribution of PM₁₀ is also estimated for Budapest to get a general picture on the particle pollution level at different locations in Budapest.

Introduction

Aerosol particles are of great concern due to their adverse health effects. Regional scale investigations on the transport and chemical composition of particles were performed for Hungary in previous papers (Bozó, 2000; Havasi et al., 2001). Fine aerosol sampling and related source-receptor modeling for Budapest was started in 1997. In addition, ADMS model computations for PM₁₀ distribution in Budapest were performed by DASY as well.

Objectives

Local sampling and measurements, as well as the Chemical Mass Balance method has been applied to estimate the source contributions to ambient concentration levels of trace elements in Budapest. Its general aim is to reach minimum cost emission control strategies that will be effective in reducing the ambient concentrations of pollutants considered. ADMS model computations provide a useful tool to pin-point the most polluted areas in Budapest. In addition, based on multiyear running, temporal variation of particle concentration levels can also be evaluated.

Activities

Source profiles of Cd, Cu, Ni, Pb, V and Zn for *waste incineration, traffic, oil and coal* burning were applied for model calculations. Aerosol sampling for fine size range aerosol particles was carried out by Harvard-type impactors at the sources and at two receptor point, in the downtown of Budapest during November-December, 1999, and summer month in 2000 and 2001. One of the sampling sites (OKI) is located at the SE edge of the downtown with relatively heavy traffic in its vicinity while another site (ELTE) is located next to the River Danube that crossing the city in N-S direction. This site is rather intensively ventilated so it can be expected that a good mixture of source categories are detected here (Figure 1.) ADMS model computations were performed among others for PM10 in Budapest. High resolution emission inventory includes contribution from both point and line sources in the city. Meteorological input of the model is based on data gained from surface measurements as well as vertical sonding in Budapest.

Results

It was found that high amount of Zn, Pb and Cu is emitted from a waste incinerator in Budapest, while regarding the traffic profile, the most important element is still Pb, however, its relative contribution decreased rapidly during the past 5 years. Highest particle concentrations occur in the vicinity of major roads in Budapest (Figure 2.)

Conclusions

It was concluded based on multiyear sampling and measurements that *waste incineration* provides the most significant contribution to the toxic metal load in Budapest (65-70%). The relative contribution of *traffic sources* is between 11-17% (Table 1.) Coal burning has no significant importance in Budapest regarding the contribution to the receptor profile. It can be explained by the fact that coal consumption was significantly reduced in Budapest during the past decades since it was replaced by natural gas at most of the industrial, energetical and residential sources. In co-operation with NOAA, three dimensional backward trajectories were also computed so that to estimate the origin of air masses on different days. It was found that episodes with relatively high concentrations of Ni and V measured in Budapest are accompanied by S winds indicating the effects of an oil refinery located 25 km South of Budapest.

Measurement campaigns are being continued at 3 receptor points in Budapest as well as in the plumes of relevant point and line sources so that to extend the investigations towards the relationships between *meteorological conditions* and *receptor profiles*.

References

- Bozó L., 2000: Estimation of historical lead (Pb) deposition over Hungary. *Időjárás* 104, 161-172.
- Havasi Á., Bozó L. and Zlatev Z., 2001: Model simulation on the transboundary contribution to the atmospheric sulfur concentration and deposition in Hungary. *Időjárás* 105, 135-144.
- Singles R.J and Carruthers D.J., 1999: ADMS-Urban Air Quality Management System: Some Examples of Applications and Validation in the UK. *Proceedings of EUROTRAC Symposium 98*, 821, WIT Press Southampton.



Figure 1. Sampling locations in Budapest

	OKI	ELTE
Waste incineration	65	70
Traffic	17	11
Coal burning	5	6
Oil burning	6	6
Other sources	7	7

Table 1. Relative contribution (%) of source categories to ambient trace element concentrations

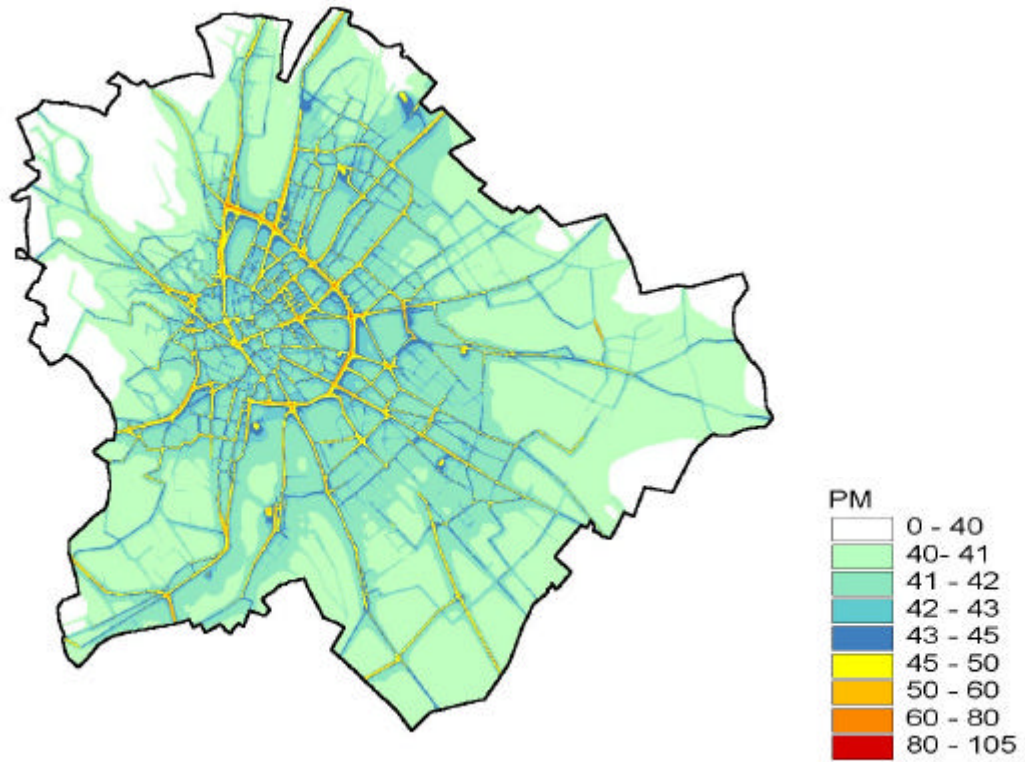


Figure 2. Daily average distribution of PM₁₀ concentration in Budapest in July ($\mu\text{g m}^{-3}$)

List of Publications in 2001

Havasi Á., Bozó L. and Zlatev Z. (2001): Model simulation on the transboundary contribution to the atmospheric sulfur concentration and deposition in Hungary. *Időjárás* 105, 135-144.

Osán J., Alföldy S., Kurunczi S., Török S., Bozó L., Worobiec A., Injuk J. and van Grieken R. (2001): Characterization of atmospheric aerosol particles over Lake Balaton, Hungary, using X-ray emission methods. *Időjárás* 105, 145-156.

Bozó L. and Pinto J. (2001): Investigation of the Source Origin of Fine Aerosol Particles in Budapest. SATURN Annual Report 2000, 52-54.

Vaskövi É, Vámos A., Merétei T. and Bozó L. (2001): Spatial and seasonal variability of traffic-related air pollution in central area of Budapest. *Proceedings of the ISEE Conference*, Garmisch-Partenkirchen, September 2001.

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