„Aerosol-fingerprint" of Europe in the atmosphere of Debrecen, Hungary

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Keywords: backward trajectory, source analysis
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Aerosol pollution is one of the main problems in the urban environment, because of the negative health and environmental impacted of particulate matter.

In cities, aerosol particles can arise locally (e.g. resuspended dust caused by traffic or soot from heating) or from distant sources (e.g. sea salt or Saharan dust). In this work we studied the possible distant source areas of the aerosol detected in Debrecen using backward-trajectory modelling.

In the center of Debrecen aerosol samples have been collected regulary in two size fractions: PM10-PM2.5 (particles with aerodynamic diameter between 2.5 and 10 μm) and PM2.5 (particles with aerodynamic diameter < 2.5μm) since 1993 twice a week. The aerosol concentration is measured by gravimetry and the elemental composition (for Z >13) is determined by Proton Induced X-ray Emission (PIXE) method at the macro-PIXE chamber in the IBA Laboratory of Atomki. By today the database contains more than 1200 sampling days and ~ 65.000 concentration data.

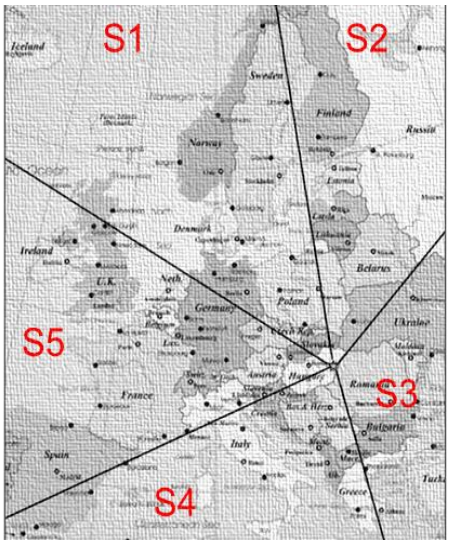

Figure1: Five sectors used to the classification the backward trajectory

The NOAA-HYSPLIT model was used to determine the spread of the aerosol particles. The backward trajectories were calculated for 72 hours periods at three different heights. We investigated what kind of aerosol composition is representative for the different European source areas. In a previous study (Borbély-Kiss *et al*, 1999) five sectors were assigned according to the most frequent wind directions (Fig1). Each trajectory has been classified to one sector. The origin of the air mass on high or low pollution levels were studied too. 513 days were found in the investigated period (1993-2006) when the sector was univocal.

Table1: Average concentration in the five sectors and the percentage contribution

	S1	**S2**	**S3**	**S4**	**S5**	**Sum**
events	89	58	127	88	151	513
PM10	30.9	29.8	35.7	42.5	28.8	33.3
PM2.5	18.1	16.9	19.6	23.2	17.0	18.9
>50 μg/m^3	23	15	39	42	40	159
% to sector	26%	26%	31%	48%	26%	

Table1 shows the number of events (row 1) when the body of air originated from the given sector and average aerosol concentration in both size fractions in μg/m^3 (row 2 and 3). The number of days when the measured PM10 concentration exceed the 24-h air quality limit (50 μg/m^3) are also included in the table. The ruling air mass trajctory directions are east-west. 70% of the high polution level episodes air masses originated from Southern and Eastern Europe.

Correlation analysis and receptor modelling (EPA PMF) were applyied to identify elemental fingerprints of the five sectors. This way we could separate local sources (for example road dust: high Mn and Pb content, bimass burning: K and Zn) from remote sources. In the case of NW Europe (S1) Al, Fe, Mn, Cl and Pb showed strong correlation with each other ($r > 0.7$, $p < 0.01$), which could be connected to iron mining and metallurgy. For NE Europe (S2) K, Si, Ca and Fe correlated with each other, which could be attributed to plastic industry. For SE (S3) Europe strong Br/Pb correlation were characteristics, which could aries from waste burners. In the case of Southern Europe (S4) sources attributed to Cr mining, mettallurgy and Saharan dust intrusions could be identified.

Borbély-Kiss I., Koltay E., Szabó Gy., Bozó L., Tar K. 1999. *Composition and sources of urban and rural atmospheric aerosol in Eastern Hungary*. Journal of Aerosol Science, 30, 369-391

Acknowledgement

This work was supported by the TÁMOP-4.2.2/B-10/1-2010-0024 project and co-financed by the European Union and the European Social Fund and the János Bolyai Research Scholarship of the Hungarian Academy of Sciences.