# MASS SIZE DISTRIBUTION OF PARTICULATE MATTER IN URBAN ATMOSPHERE

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## INTRODUCTION

Size distribution is one of the most basic characteristics of the atmospheric particulate matter (PM) because it determines or strongly influences the physicochemical and radiative properties, behaviour in atmospheric processes, environmental and health effects and fate of particles, and because it provides information on the sources and source processes of the particles or species. Accordingly, a vast number of detailed studies all over the world in very diverse environments has been devoted to measuring the size distributions of elements and main ions. As a result of the investigations, the size distributions for these species and their importance are understood and classified. The role and size distributions of carbonaceous aerosol are, however, still much less known due mainly to the large number of organic compounds present in the aerosol, their complex and similar chemical structure, and to some specific problems associated with their sampling.

## METHODS

As part of an international research project on urban PM, aerosol samples were collected during an intensive field campaign in downtown Budapest, Hungary, separately for daylight time and nights from 23 April to 5 May 2002. Use was made of a 10-stage micro-orifice uniform deposit impactor (MOUDI) (Marple *et al.*, 1991) at a flow rate of 30 l/min with calibrated impaction cut-points in the range of 18–0.053 μm on ungreased aluminium foils, which had been pre-baked. Altogether, 11 samples over daylight time, and 12 over night were collected. The samples were weighed on a microbalance (with a sensitivity of 1 μg) for particulate mass under controlled conditions (20°C and 50% relative humidity), and will be analysed by a thermal-optical transmission (TOT) technique for elemental (EC) and organic carbon (OC) using an instrument from Sunset Lab at the Ghent University (Birch & Cary, 1996). The mass data were inverted into smooth size distributions by the computer program Micron (Wolfenbarger & Seinfeld, 1990), and the inverted data were then fitted by lognormal distributions (Winklmayr *et al.*, 1990) so that the mass concentrations, geometric mean aerodynamic diameters (GMAD) and geometric standard deviations (GSD) of the different contributing modes could be obtained for each size distribution.

## RESULTS

Experimental data, inverted size distribution and fitted curves obtained for the night of 26 April are displayed in Fig. 1 as examples. It shows that the distribution consists of several modes; the accumulation mode contains a doublet: a condensation and a droplet submode. The droplet submode was generally more dominant (it contained about 30% of the mass) than the condensation submode, which was even absent on some days. The coarse mode was also made up of two submodes. The coarse submode 2 characterised by the largest GMAD was always present, and is most likely generated by resuspension of the dust from roadways or exposed soil; it accounted for about 25% of the mass. The other coarse submode (1) with the smaller GMAD is created probably by direct disintegration and erosion processes. It can contain typically 25% of the mass. The mean modal characteristics as obtained by averaging the subset of corresponding parameters for daylight times and nights are given in Table 1. It appears that the GMADs for nights are larger than for daylights, except for the coarse submode 2 (resuspension), which is possibly shifted toward smaller diameters over nights.

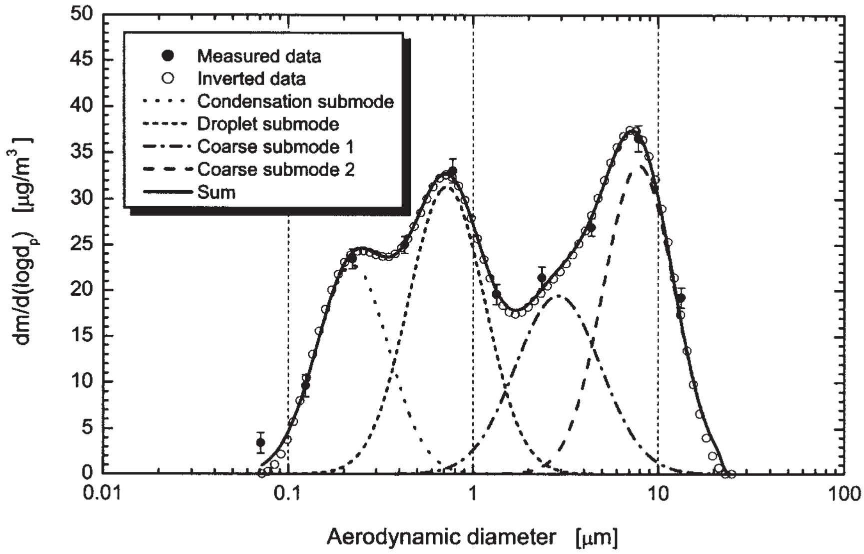


Figure 1. Mass size distribution of PM in downtown Budapest over the night of 26 April 2002.

Table 1. Average geometric mean aerodynamic diameters (GMAD) and standard deviations, and average geometric standard deviations (GSD) and standard deviations for urban aerosol over daylight times and nights in spring 2002. The units are μm.

| Sampling time<br>Parameter | Condensation mode | Droplet mode | Coarse mode 1 | Coarse mode 2 |
|---|---|---|---|---|
| For daylight periods | | | | |
| Mean GMAD ± st. dev. | 0.24±0.03 | 0.61±0.06 | 2.6±0.5 | 8.8±0.6 |
| Mean GSD ± st. dev. | 1.9±0.2 | 1.8±0.3 | 1.8±0.2 | 1.6±0.1 |
| For night periods | | | | |
| Mean GMAD ± st. dev. | 0.27±0.06 | 0.64±0.10 | 2.8±0.3 | 8.6±1.0 |
| Mean GSD ± st. dev. | 1.8±0.2 | 1.6±0.1 | 1.8±0.2 | 1.6±0.1 |

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