Urban aerosol: tendencies and challenges

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Approximately 47% of word population lives in urban areas, and this ratio is expected to grow further in time. In more developed countries, it is already 73%. Hence, the air quality in large urban zones affects the health and life of many people as well as the built environment and cultural heritage. Population growth, urbanisation, economic and industrial developments, road traffic and environmental management policies definitely influence the urban atmospheric environment. Temporal evolution of air pollution, however, shows tendencies or patterns which can be generalized to many large cities.

One of the most important criteria air pollutants in urban environments is atmospheric aerosol. Urban-type aerosol contains a mixture of particles which originate from a large variety of local (i.e. urban), regional (e.g. biogenic, geogenic or marine) emission sources and formation processes, and of particles that are advanced to cities by long-range transport. Combustion processes in homes and residential places, vehicular exhaust emissions of particulate matter and gaseous compounds and their interactions in the air usually contribute substantial to particulate matter. The complexity of particles makes it challenging to understand the role the urban aerosol and its production types play in many environmental and climate issues on different temporal and spatial scales, as well as to assess their relevance and consequences for human health. Are there dedicated or typical properties, behaviour and transformation processes for urban-type aerosol? What makes it different from the other aerosol types, and what are its peculiar environmental and health effects? Primary particles such as coarse particles with specific chemical composition, soot particles or some particulate organic compounds can be characteristic for urban activities. Some secondary organic components and the abundance of water-soluble organic carbon seem also to be linked to urban features. As far as the ultra-fine size fraction is concerned, its contribution to the total particle number is relatively large (above 75%) in cities. These particles likely also have different chemical composition with respect to the other aerosol types. There are feasible methods to distinguish between the two major production types of ultra-fine aerosol, i.e., between direct emissions and atmospheric nucleation as indicated in Figure 1.

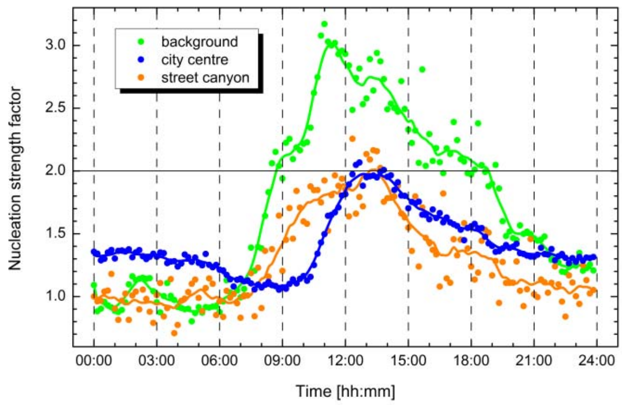

Figure 1. Diurnal variations of nucleation strength factor for the near-city background, city centre and street canyon environments in Budapest. The curves were obtained by one-hour smoothing. The horizontal line indicates the value at which atmospheric nucleation becomes the major production type for ultra-fine particles.

Micro-meteorology, geography and topology of urban agglomerations advance or restrict the transport and dispersion of particles. As a result, substantial differences in concentrations and other properties can occur among various urban environments within a city as far as both the particle number and mass are concerned.

In the lecture, the issues mentioned above will be discussed in more detail with selected examples for large European urban zones.

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