Concentration levels and chemical composition of $PM_{2.5}$ in the urban area of Thessaloniki

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Abtsract

The urban atmosphere contains high concentrations of suspended particulate matter (PM) of complex chemical composition depending on its origin (vehicular traffic, residential heating, industrial activities, soil dust, secondary aerosol formation, etc). Suspended particulate matter (PM) is a major environmental problem in several countries in the E.U., while new evidence regarding its detrimental impact on human health has emerged.

The aim of this work is to review the concentration and chemical composition data for $PM_{2.5}$ in the city of Thessaloniki.

The paper presents the ambient concentrations of $PM_{2.5}$ measured by the TEOM and the beta-radiation methods over a 5-year period (2005-2009) at a traffic-impacted site in the commercial city centre, and over a 3-year period (2007-2009) at an urban background site. The annual mean concentrations of $PM_{2.5}$ in the commercial city centre ranged between 36 and 45 $\mu g/m^3$, exceeding the EU annual limit (25 $\mu g/m^3$ according to 2008/50/EC). On the contrary, at the urban background site, the annual mean concentrations of $PM_{2.5}$ ranged between 18 and 22 $\mu g/m^3$. In general, concentrations were higher in winter and lower in summer as a combined effect of intense traffic and residential heating with meteorological conditions that do not favor pollutant dispersion in the cold season. The hourly $PM_{2.5}$ concentrations exhibited different diurnal pattern at the two sites; at the traffic-impacted site, a first high maximum was observed in the morning (around 9:00), and a second lower peak in the afternoon (around 17:00). At the urban background site, no significant diurnal variation could be observed.

Data concerning the chemical composition of $PM_{2.5}$ in Thessaloniki are, so far, very limited. Only the elemental content of $PM_{2.5}$ (fine) and the $PM_{2.5-10}$ (coarse) particle fractions was investigated by XRF analysis of teflon filter samples collected by a Dichotomous Sampler at another site in central Thessaloniki, during the cold and the warm period of 2007. The most abundant elements in the $PM_{2.5}$ fraction was found to be S (6.3%), K (2.2%), Ca (1.9%), Si (0.7%), while the sum elemental content accounted 14% of the $PM_{2.5}$ mass. Prevailing elements in the $PM_{2.5-10}$ fraction were Ca (23%), Si (3.7%), K (2.3%), Fe (2.0%), Al (1.6%), S (1.4%), and Cl (0.8%), while the sum elemental content accounted for 37% of the mass of this fraction. The anthropogenic trace elements Pb, Sb, As, Cd, Br, Zn, V, were distributed mainly in the fine particle fraction.

This work was supported by the European Commission LIFE + Environment Policy and Governance programme.