Long-term variability of elemental and organic carbon in aerosols over Athens, Greece.

D. Paraskevopoulou[1,2], E. Liakakou[2], E. Gerasopoulos[2] and N. Mihalopoulos[1]

[1]Environmental and Analytical Chemical Division, Department of Chemistry, University of Crete, P.O. Box 2208, 71003 Heraklion, Greece

[2]Institute for Environmental Research and Sustainable Development, National Observatory of Athens, I. Metaxa and Vas. Pavlou, 15236, P. Penteli, Athens, Greece

Presenting author email: dparask@meteo.noa.gr

Atmospheric aerosol particles have direct impact on the climate of the earth through scattering and absorption of radiation. The carbonaceous fraction of particulate matter, which consists of elemental carbon (or black carbon) and a variety of organic compounds (organic carbon), plays a significant role on this climatic change and on public health, as well. Organic carbon is considered one of the main elements of aerosols that scatter radiation thus; the main component of particulate matter that absorbs light is elemental carbon.

Long-term (5-year) measurements of Elemental Carbon (EC) and Organic Carbon (OC) in atmospheric aerosols are presented here for the first time in the area of Athens, Greece. Furthermore, the seasonal variability of carbonaceous content has been studied, reflecting the effects of the on-going recession on the quality of the air.

To calculate the concentration of OC and EC, a total of 1500 samples have been collected using Dichotomous Partisol and Partisol FRM samplers on a 24hour basis, at Penteli's premises (National Observatory of Athens station: 38°3'N, 23°5'E, 527 m a.s.l) covering a 5 year period. All chemical analyses presented in this research, were conducted on the $PM_{2.5}$ fraction, since fine fraction of aerosols constitutes the major carrier of the studied air pollutants. The applied method for OC and EC measurements was described in detail by Theodosi *et al* 2010.

The daily concentrations and the seasonal cycle of organic and elemental carbon for the studied period, is presented in Fig.1a, and 1b, respectively. The levels of OC and EC concentrations appear to decrease from 2008 to 2010 while, since 2010 an increase is observed during the colder periods of the year. This could probably be attributed to the reduction of sources of air pollutants from 2008 to 2010 due to the beginning of the crisis in the economy while, since 2010 biomass burning seems to dominate in domestic heating, resulting in augmented carbonaceous aerosol production.

It can be observed that OC and EC present similar covariance during the studied period and their maximum values appear mostly on fall to winter season, as it was expected, since during this period of the year there is fuel combustion and domestic heating that mainly leads to production of elemental and organic carbon.

The whole period average estimated concentration for OC was $2.32 \pm 1.29 \mu g/m^3$ and for EC was $0.54 \pm 0.39 \mu g/m^3$. The average OC/EC ratio of the aforementioned in situ measurements was 6.17 while, the concentrations of OC and EC appeared to be well correlated (R^2=0.48).

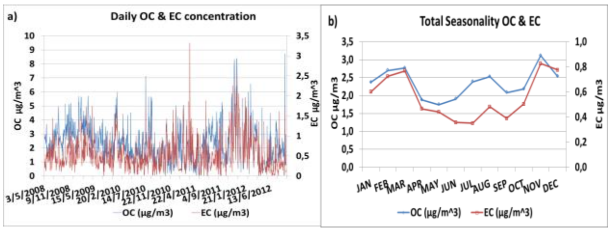

Figure 1 a. Daily OC and EC concentrations and b. Seasonal cycle of OC and EC concentrations at Penteli during the sampling period from 2008 until 2012.

The organic to elemental carbon ratio indicates that the organic carbon is mostly secondary. During colder period of the year additional sources like household heating contribute to the total carbon loadings. More importantly the type of domestic heating is considered a key parameter. As a consequence, it could be assumed that the deterioration of the air quality constitutes an additional side-effect of the years of recession in Greece.

Future studies will be focused on the correlation of OC and EC concentrations to ion concentration and optical properties of aerosols.

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