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Smog events over Athens during winter 2013-2014: Pollution measurements and chemical characterization

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Smog due to wood burning has evolved to a major pollution problem affecting the most populated Greek cities during winter time. The economic crisis and the subsequent increase in the price of heating oil, has led people to look for alternative ways for domestic heating. Wood burning appeared to be the most common option, resulting to a rapid increase of pollution levels during nighttime, with emphasis on particulate matter. Taking into account the fact that highly populated cities such as Athens are also overloaded with traffic pollution, the need for specialized air quality measurements for the evaluation of the newly emerged problem was an imperative.

Measurements of smog related pollution components in Athens took place during winter 2013-2014, at the premises of the National Observatory of Athens in Thissio (city center). The site was selected as representative of the average situation in Athens, while most of wood burning activities take place in Athens' suburban areas. For the chemical characterization of the smog particles, on line chemistry monitoring was performed by an Aerosol Chemical Speciation Monitor (ACSM, with 30 minutes resolution for the determination of organics, ammonium, sulfate, nitrate and chloride) and a Particle Into Liquid Sampler coupled with an Ionic Chromatograph (PILS, with 15 minutes resolution for the determination of ammonium and potassium). Additionally, aerosol samples were collected on 12-hour basis using a sequential dichotomous sampler for the sampling of $PM_{2.5}$, $PM_{2.5-10}$and PM_{10} fractions of aerosols on quartz filters, for further analyses, while a beta attenuation PM monitor was also deployed. Gas analyzers were installed for continuous NO_x (NO, NO_2), SO_2, CO and O_3 monitoring on 1-minute resolution. Finally, black carbon (BC) measurements were conducted with: a Particle Soot Absorption Photometer, a portable Aethalometer and two Multi Angle Absorption Photometers. The meteorological conditions were recorded during the whole period of the campaign and additional information about the vertical distribution of aerosols and the mixing height was provided by means of a ceilometer.

The first measurements and analyses have demonstrated that the daily limit of 50 μg/m^{3}is exceeded quite often. An increase on the frequency of smog events was detected mainly during weekends depending also on the meteorological conditions (low temperatures and wind). A strong daily variation was observed with a 5-6 hours window (20:00-2:00 LT) of peak values in the order of 150-200 ug/m^3. Parallel measurements from the National Network revealed much higher values in the areas of peak smog presence, sometimes exceeding 120-150 ug/m^3(daily values). With the use of specific wood burning indices like potassium, levoglucosan and wood burning related BC, the effect of wood burning was isolated and evaluated compared to other sources of pollution (e.g. traffic, central heating).