Chemical profile of wood burning $PM_{2.5}$ and PM_1 in the two largest cities of Greece, Athens and Thessaloniki

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Particulate Matter (PM) is one of the most challenging environmental issues due to its well established impact on human health, air quality and global climate change. The current interest of scientific and regulatory communities is moving to finer PM fractions ($PM_{2.5}$ and PM_1), as a consequence of their relevant implications on the human health; they can remain in suspension much longer than coarse particles and they can penetrate more deeply into the human respiratory tract, elucidating early biological responses (Amodio et al. (2010)).

Wood combustion and various other forms of biomass burning have clearly been indicated as major contributors to ambient aerosol levels. Especially during periods of low vertical mixing due to stagnant weather conditions, the effects on both local air quality and human health can be considerable. In the industrialized world, including North America, Europe and the Far East, wood is burned in fireplaces and wood stoves for different purposes, including pleasure, heating, and cooking (Wang et al. (2005)). The increasing cost of oil and natural gas has been an important factor driving the increased usage of wood for heating and cooking purposes and resulting in increased PM burden of exposure.

In line with such scientific demands, the experimental set-up and the data analysis of the specific work allow the retrieval of information on the wood burning fine particles. The main objective of this study is the investigation of the influence of the residential wood-combustion emissions on the configuration of the PM profile, both mass and composition. Taking into consideration the complexity of the aerosols character, simultaneous measurements of both $PM_{2.5}$ and PM_1 fractions took place at different types of environment, in the two largest cities of Greece, Athens and Thessaloniki. The monitoring stations were selected carefully, representing urban background, suburban - industrialized and urban-traffic locations. Chemical characterization with respect to ionic and carbonaceous species was also carried out on the collected samples. The particle mass concentration determination was conducted gravimetrically according to EN 12341. The water-soluble ions (Cl^-, NO_3^-, SO_4^{2-}, NH_4^+, K^+, Mg^{2+}, Ca^{2+}) were detected using suppressed ion chromatography (IC), while the carbon elements (OC (organic carbon), EC (elemental carbon)) were determined with the use of a carbon analyser (Sunset Lab, USA). Beyond these, levoglucosan was used as a tracer of biomass burning (Belis et al. (2013)), using a GS-MS (Agilent, USA) analysis. The 2-months fieldwork took place during the winter period of 2013.

The acquired data will be evaluated in order to illustrate intra/inter-site differences accounting for the role of the type of the environment on the wood burning $PM_{2.5}$ and PM_1 profile. In an attempt to estimate the contribution of the emissions from the wood combustion, the obtained PM characteristics will be compared with those reported from previous works at the same locations. Focusing on the changes in the prevailing atmospheric circulation patterns (mesoscale/ synoptic), a possible link with the meteorology will be attempted. Finally, a mass closure study of the available chemical species in conjunction with the observed PM mass concentration will be also presented.

The first results at Thessaloniki showed that days with very low temperature (below 6-7 ^{0}C) and wind speed values were characterized by elevated PM concentrations, up to 98 and 92 μg/m^3 for $PM_{2.5}$ and PM_1 respectively. Furthermore, ambient levoglucosan reaching concentrations up to 4 mg/m^3 and being positively correlated (especially for the urban background station) to $PM_{2.5}$ and PM_1, verified the extensive use of biomass burning. During higher temperature days (above 11-12^{0}C) biomass burning was reduced, leading to lower values of the pollutants. Interestingly, the spatial PM differentiation between the traffic and the urban background atmosphere was not so prominent, owing to the prevalence of the residential heating emissions. Finally, daily $PM_{2.5}$ and PM_1 load is significantly increased (up to 50%), being compared to previous years. Since traffic volume is reduced and the related input to air pollution is lower, the respective contribution of residential heating (and more specifically biomass burning) is now dominant.

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