

Residential heating in Greece and the Greater Athens Area (GAA): changes in the aerosols emissions profiles due to the economical crisis.

K.M. Fameli, and V.D. Assimakopoulos

Institute for Environmental Research and Sustainable Development, National Observatory of Athens, Penteli, 152 36, Greece

Keywords: residential heating, PM₁₀ emissions, Athens, Greece.

Presenting author email: kmfameli@noa.gr

The economic recession in Greece led citizens to seek alternative cheaper solutions in order to reduce space heating expenses. According to a survey by Santamouris *et al* (2013), residents consumed much smaller amounts of energy during the winter 2011-12 compared with that of 2010-11 although the former was much more severe, mainly due to the rapid deterioration of the economic situation. Indeed, the energy consumption was 37% lower than expected. The percentage of households using biomass (wood and pellets) instead of oil as fuel for heating increased dramatically. Especially in northern Greece, the retail sales of wood and pellets increased by approximately 600% since the beginning of the recession in 2009 (Slini *et al*, 2014). As a consequence severe smog events were reported in urban areas of Greece.

The present work aims to present the effect from biomass burning for heating purposes on the PM₁₀ and PM_{2.5} emissions in Greece and the GAA. The annual emissions were calculated for the period 2006-2012 based on the methodology proposed by the EMEP/EEA Emission Inventory Guidebook 2013. Annual energy consumption data for Greece provided by the Odyssee-Mure project (www.odyssee-mure.eu) (fig.1) revealed that oil consumption prevails among other fuels. In 2008 before the rapid increase in heating oil prices, the energy consumption for space heating by fuel type was 68.3% for oil, 5.0% for gas, 18.7% for wood and 6.6% for electricity. In 2012, after the economic crisis set in, an increase in wood consumption of 10.2PJ (36.6%) was observed while the oil consumption decreased by 24.9PJ (24.5%).

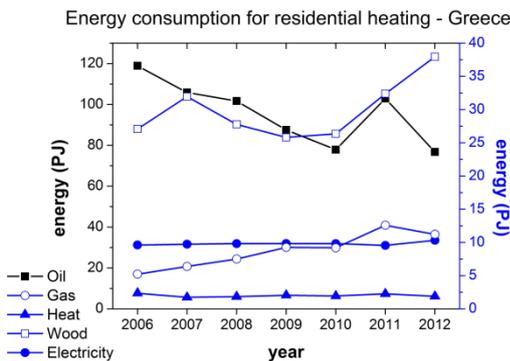


Figure 1. Annual variation of energy consumption for residential heating.

The consequent PM₁₀ emissions for Greece amounted to 28.03ktn in 2008 and 31.32ktn in 2011. The further study of annual emissions by source category (fireplaces, stoves and boilers) confirmed that PM₁₀ emissions are highly related to fireplaces and

consequently to the biomass burning – 19ktn of the national PM₁₀ emissions for the year 2008 were attributed to fireplaces while in 2011 the relevant contribution was 21.28ktn. The annual total emissions were then spatially allocated on a 2km resolution grid over the GAA (fig.2) based on updated population data in order to quantify the aerosol (PM₁₀ and PM_{2.5}) emissions changes as a result of biomass burning. Preliminary results for PM₁₀ indicate that cells representing high population densities (city centre and southeastern suburbs) are associated with higher values of PM₁₀. Significant values of PM₁₀ emissions were also observed at the urban areas of the Mesogaia Plain (fig.2).

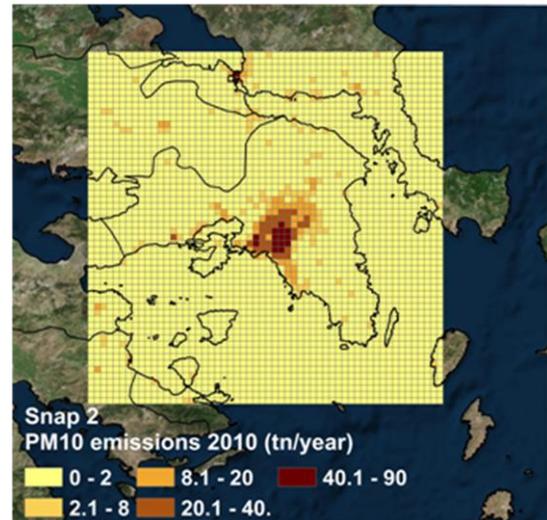


Figure 2. Gridded PM₁₀ emissions from residential heating for the year 2010.

This research has been financed by the "Development Proposals of Research Entities - KRIPIS" framework which is funded by N.P. "Competitiveness and Entrepreneurship", Action: "THESPIA - Development of synergistic and integrated methods and tools for monitoring, management and forecasting of Environmental parameters and pressures".

Santamouris, M., Paravantis, J.A., Founda, D., Kolokotsa, D., Michalakakou, P., Papadopoulos, A.M., Kontoulis, N., Tzavali, A., Stigka, E.K., Z., Ioannidis, Mehili, A., Matthiessen, A., Servou, E. (2013) Financial crisis and energy consumption: A household survey in Greece. *Energ Buildings*, **65**, 477–487.

Slini, T., E. Giama & A.M. Papadopoulos (2014) The impact of economic recession on domestic energy consumption. *Int J Sustainable Energy*.