

# Wintertime PM<sub>1</sub> sources in Nicosia (Cyprus): Major influence of biomass burning from domestic heating

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In ambient air the concentration of a pollutant results from the strength of local emission sources and the amount of that pollutant that is transported at a regional scale. As part of the ChArMEX (Chemistry-Aerosol Mediterranean Experiment, <http://charmex.lsce.ipsl.fr/>), and ENVI-Med "CyAr" (Cyprus Aerosols and gas precursors) programs, an intensive campaign dedicated to the characterization of the local/transported sources of submicron particles (PM<sub>1</sub>) was performed during wintertime at Nicosia (Cyprus); a medium-size representative city in the eastern Mediterranean with ~250 000 inhabitants.

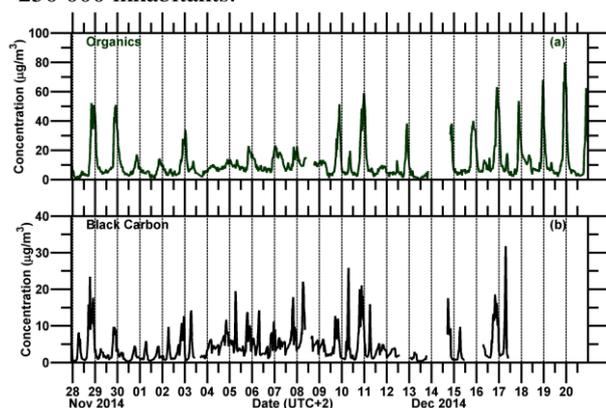


Figure 1. Time series of PM<sub>1</sub> OA (a) and black carbon (b) from 28 Nov. to 17 Dec. 2014 at Nicosia, Cyprus.

The mass and composition of PM<sub>1</sub> was monitored at the city's suburbs with a suite of real-time analyzers (TEOM 1400, Q-ACSM, Aethalometer AE31), during December 2014. This month was chosen based on a 3-yr long study using integrated (filter) measurements collected by the local air quality network (DLI), which showed elevated PM<sub>1</sub> concentrations during that month. Datasets of Q-ACSM (organic aerosol; OA, SO<sub>4</sub><sup>-</sup>, NH<sub>4</sub><sup>+</sup>, NO<sub>3</sub><sup>-</sup>) and Aethalometer (black carbon; BC) during the intensive campaign exhibited fair correlation ( $R^2 > 0.5$ ) against filter-based composition measurements collected at a different location revealing homogeneity across the urban area. Near real-time (30 min) chemical mass closure was also performed to ensure the overall quality of Q-ACSM and Aethalometer data.

High levels of BC (up to 20 µg m<sup>-3</sup>) and PM<sub>1</sub> OA (up to 80 µg m<sup>-3</sup>) were observed most nights, typically maximizing at 22:00 local time (Fig. 1). Concentrations

of levoglucosan up to 600 ng m<sup>-3</sup> (24-h integrated samples) emphasized the importance of biomass burning sources from domestic heating. Similar behaviour has been observed in other cities in the eastern Mediterranean (Pikridas et al., 2013) and has been partly attributed to the economic crisis (Vrekoussis et al., 2013). To identify the major organic sources, positive matrix factorization (PMF) was performed on 30-min Q-ACSM organic mass spectra using the SoFi software (Canonaco et al., 2013). Five factors were identified and apportioned (Fig. 2): a hydrocarbon organic aerosol (HOA) related to traffic, an oxygenated organic aerosol (OOA) related to regional secondary OA, two biomass burning related factors (BBOA; primary and secondary, respectively) and a cooking factor. Our results indicate that biomass combustion was the most significant local source accounting for one third of PM<sub>1</sub> OA.

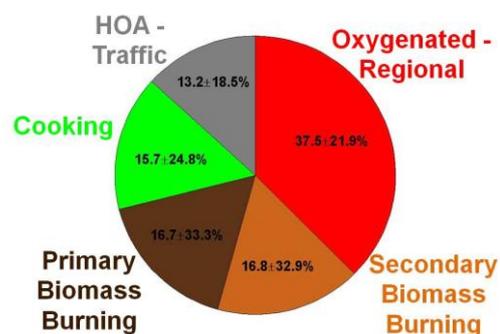


Figure 2. Average source contributions of PM<sub>1</sub> OA during December 2014 at Nicosia, Cyprus.

Canonaco, F., Crippa, M., Slowik, J., Baltensperger, U. and Prévôt, A. (2013) *SoFi, an IGOR-based interface for the efficient use of the generalized multilinear engine (ME-2) for the source apportionment: ME-2 application to aerosol mass spectrometer data*, Atmos. Meas. Tech., **6**(12), 3649–3661.

Pikridas, M., Tasoglou, A., Florou, K. and Pandis, S. (2013) *Characterization of the origin of fine particulate matter in a medium size urban area in the Mediterranean*, Atmos. Environ., **80**, 264 - 274.

Vrekoussis, M., A. Richter, A. Hilboll, J. P. Burrows, E. Gerasopoulos, J. Lelieveld, L. Barrie, C. Zerefos, and N. Mihalopoulos (2013), *Economic crisis detected from space: Air quality observations over Athens/Greece*, Geophys. Res. Lett., **40**, 458–463.