Seasonality of the chemical composition of PM_1 over Cyprus using near real-time measurements. Sources and geographic origins.

I. Stavroulas[1], M. Pikridas[1], C. Savvides[3], M.Vrekoussis[1,4,5], N. Mihalopoulos[1,2,6], V. Gros[7] and J. Sciare[1,7]

[1]EEWRC, The Cyprus Institute, Aglantzia, Nicosia, 2121, Cyprus
[2] Department of Labour Inspection (DLI), Ministry of Labour and Social Insurance, Nicosia, Cyprus
[3] Environmental Chemical Processes Laboratory, University of Crete, Heraklion, Crete, 71003, Greece
[4] University of Bremen, Institute of Environmental Physics, Bremen, Germany
[5] Center of Marine Environmental Sciences - MARUM, Bremen, Germany
[6] IERSD, National Observatory of Athens, P. Penteli, Athens, 15236, Greece
[7] Laboratoire des Sciences du Climat et de l'Environnement (CNRS-CEA-UVSQ), Gif/Yvette, 91191, France

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Presenting author email: i.stavroulas@cyi.ac.cy

Chemical composition of the PM_1 aerosol was investigated throughout 2015 over the island of Cyprus, located in the Levantine Sea, the easternmost part of the Mediterranean. The island, lies at the crossroads of diverse air masses, both natural and anthropogenic. Approximately 69% of these air masses originate from the polluted north (Turkey, Europe), 10% are of "clean" marine origin and 18% from Africa and the Middle East. The remaining 3% corresponds to stagnant weather.

An Aerodyne quadrupole Aerosol Chemical Speciation Monitor (ACSM) was deployed at the Cyprus Institute Atmospheric Observatory at the remote area of Agia Marina Xyliatou (35.04N–33.06E, 532 m a.s.l) in mainland Cyprus for an entire year (05/01/2015 - 05/01/2016). The ACSM, was set to deliver mass spectra and thus chemical composition of non-refractory atmospheric aerosol at temporal resolution of 30 minutes. These measurements were complemented with those of black carbon (BC) by means of a Magee Scientific 7-wavelength Aethalometer (AE-31) at temporal resolution of 5 minutes. Quality control of the measurements was conducted by comparison with chemical analysis of concurrent 24h sampling on filters as well as comparison with 1-h $PM_{2.5}$ derived by a Thermo Scientific TEOM Monitor (Series 1400). Origin of the air masses arriving at Agia Marina was also investigated. Back trajectories were calculated at four distinct times for each day of the entire measuring period using the Lagrangian dispersion model Flexpart. Source apportionment analysis of the organic aerosol (OA) mass spectra acquired was also performed, using the SoFi toolkit (Canonaco et al., 2013). A three factor solution was determined that included an equal contribution of low volatility oxygenated OA (LV-OOA) and semi-volatile oxygenated OA (SV-OOA), additional to approximately 10% of hydrocarbon-like OA (HOA) to the PM_1 organic fraction. The combination of retroplume analysis and PMF, will allow us to pinpoint the pollution regions that affected Cyprus and apportion their contribution, focusing on the organic fraction.

The dominant PM_1 component, shown in Fig. 1, was OA, accounting for 43% which corresponds to an annual average concentration of 4.41 $\mu g \cdot m^{-3}$. Sulfate contributed in average 2.64 $\mu g \cdot m^{-3}$ at 26% and ammonium 2.41 $\mu g \cdot m^{-3}$ at 24%. Finally nitrates contributed 0.3 $\mu g \cdot m^{-3}$ and Black Carbon 0.36 $\mu g \cdot m^{-3}$, a 3% and 4% respectively. Chloride was found to contribute a negligible amount.

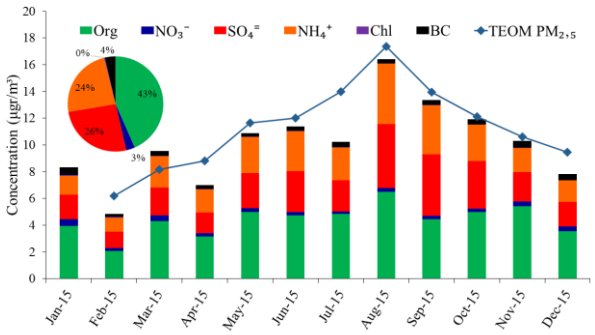

Figure 1. Monthly average PM_1 mass loadings and chemical composition over Agia Marina Xyliatou

The observed annual cycle exhibits a maximum, in August with respect to total mass. The minimum was observed in February. This behavior can be related to long range transport during summertime from the wider Northern sector, and pronounced removal mechanisms affecting air masses during wintertime coinciding with the wet season in Cyprus. This assumption is further supported by the annual variation of sulfate and ammonium which seem to follow closely this trend exhibiting maxima in August and minima in January and February. The winter maximum observed for January is mainly driven by OA along with BC, while ammonium and sulfate remain close to their minimum values.

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Canonaco, F., et al. *Atmospheric Measurement Techniques* 6.12 (2013): 3649-3661.