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Chemical characterization of ambient submicron aerosol during summer 2012 in Patras, Greece

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Ultrafine aerosol was measured at an urban background site in Patras, Greece, during summer 2012 (8–27 June) in an effort to better understand the sources and the characteristics of atmospheric aerosols in the eastern Mediterranean. An Aerodyne High Resolution Aerosol Mass Spectrometry (HR-AMS) was employed to measure the size-resolved chemical composition of the non-refractory PM_1.

The average total PM_1 concentration was 11 μg m^{-3}with organic aerosol (OA) contributing 44.3%, sulfate 38.9%, ammonium 11.1%, nitrate 1.2%, and black carbon (BC) 4.5%. Using the algorithm of Kostenidou et al. (2007) the collection efficiency (CE) and the organic density was estimated with a 2 hour resolution. The average CE was 0.75$\pm$0.13 and the average organic density was 1.27$\pm$0.21 g cm^{-3}. The overall organic to carbon (O:C) mass ratio was 0.64, and average fragments of m/z 44 and 57 represented 0.15 and 0.01 of the organic signal correspondingly.

Positive matrix factorization (PMF) analysis was performed on the high resolution (HR) organic mass spectra. 3 sources could be identified: LV-OOA (low volatility oxygenated OA) related to aged OA, SV-OOA (semi-volatile oxygenated OA) a less oxygenated OA and HOA (hydrocarbon-like OA) associated with traffic emissions. On average the organic matter consisted of 30% LV-OOA, 50% SV-OOA and 20% HOA. The LV-OOA correlated well with sulfate and ammonium (R^2=0.81 and 0.78). The SV-OOA had a good correlation with chlorobenzene and nopinone (R^2=0.62 and 0.58), measured by a Proton Transfer Reaction Mass Spectrometer (PTR-MS). The HOA factor correlated well with BC (R^2=0.51), nitrate (R^2=0.62), NO_2 (R^2=0.40), benzene (R^2=0.48) and toluene (R^2=0.45). The mass fraction of the HOA factor anti-correlated with the organic density indicating that the density of the fresher OA is lower than the density of the oxygenated OA.

During the campaign no nucleation event was observed, due to the fact that the aerosol was always acid (0.73$\pm$0.07 acidity).

References:

Kostenidou, E., Pathak, R. K., and Pandis, S. N.: An algorithm for the calculation of secondary organic aerosol density combining AMS and SMPS data, Aerosol Sci. Technol., 41, 1002–1010, 2007.