Equivalent Refractive Index of the urban background aerosol in Athens

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The international experimental campaign Hygroscopic Aerosols to Cloud Droplets (HygrA-CD), organized in the Greater Athens Area (GAA), Greece, 15 May – 22 June 2014, provided an extended record of data on aerosols, clouds, and meteorology.

The campaign's major sampling site was DEM station (37.995°N 23.816°E, at 270 m a.s.l., GAW/ACTRIS), which is situated on the foot of Mount Hymettus in Aghia Paraskevi and covers an area of 600 acres in a forest of pine trees. At about 7 km to the north from downtown Athens, the National Centre of Scientific Research "Demokritos" monitoring site is representative of the atmospheric suburban background of Athens.

Aerosol inlet flows are dried to Relative Humidity below 40%. The instruments that are in operation include a Scanning Mobility Particle Size Spectrometer to acquire the particle size distribution of atmospheric aerosol in the size range from 10 to 500 nm (electrical mobility diameter) and an Optical Particle Counter (Grimm 1.107@630 nm laser light wavelength) to acquire the particle size distribution in the size range of 250 nm to 2.5 μm optical diameter (Wiedensohler *et al.*, 2012), (Heim *et al.*, 2008). Time resolution for both instruments is 5 minutes.

The size distributions obtained by the two instruments were compared in order to acquire an aerosol Equivalent Refractive Index – ERI (Hand *et al.*, 2002). The method used to acquire ERI has the following assumptions:

Absorption is negligible and particles are spherical. The aerosol is internally mixed and only one constant value for each size distribution could represent the equivalent refractive index. OPC size distribution measured represents particles with a real part of refractive index equal to 1.6 (Polystyrene latex spheres).

For each size distribution, an iterative process (Nelder-Mead algorithm) was used with the following steps:

An equivalent refractive index was assumed. For this refractive index the new diameter for each OPC size bin was calculated. The resulting OPC size distribution is compared to the SMPS size distribution in the overlapping range (dN/dlogdp).

Figure 1 indicates that during daytime a stable value of ~1.58 is observed. During night time (01:00-05:00) and afternoon hours (16:00-20:00), ERI increases to values above 1.6.

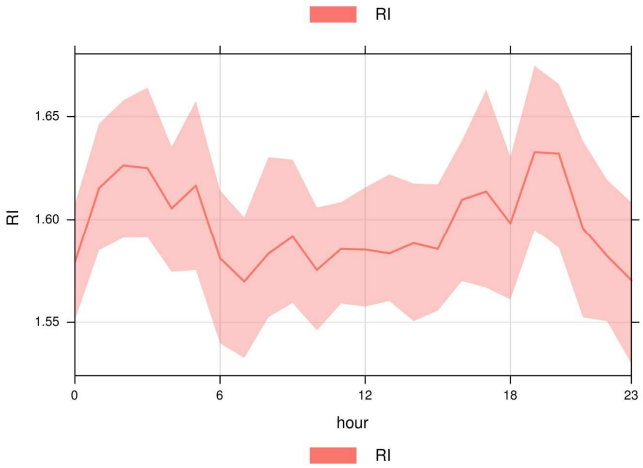

Figure 1: Equivalent refractive index (ERI) diurnal variation for the period 15 May 2014 – 22 June 2014. Time is GMT+2 (local time is GMT+3).

Nevertheless, 24h variability is influenced by local circulation patterns bringing air from different emission sources in the Greater Athens Area (GAA) and beyond. Photochemistry and transport are playing an important role in the area. Nitrates, sulphates, and organics are the main constituents of aerosol mass at the site, while Sahara dust events are also frequent (Eleftheriadis *et al.*, 2014).

Table 1. ERI and Volume up to 1 μm mobility diameter statistics during the campaign at DEM-GAW station

	ERI	Volume, $\mu m^3/cm^3$
Average	1.59	6.19
Median	1.59	5.53
Std dev.	0.11	3.02

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