# Hygroscopic Properties and Mixing state of Ultrafine Aerosol Particles over two Urban Background Sites

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Keywords: Aerosol Measurement, Particle size, Particle growth, H-TDMA, Mediterranean
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Ultrafine aerosol particles in the atmosphere affect the global climate by absorbing and scattering radiation and by acting as Cloud Condensation Nuclei (CCN). Due to the high variability of their physical and chemical properties, however, quantifying the contribution of airborne particles on climate is a challenging task. Particle properties may change depending on the activity of their sources and the meteorological conditions. In addition their mixing state can vary with time and location. Having information about the variation of the properties and the mixing state is therefore very important for understanding the contribution of atmospheric particles on climate.

In this work we report in situ measurements of the hygroscopicity and the mixing state of the particles observed in the atmosphere over two urban background sites in Greece: one in Patras and one in Athens. Measurements were conducted from 8 to 27 June in Patras and from 4 to 25 July 2012 at the NCSR Demokritos Global Atmosphere Watch (GAW) in Athens using a Hygroscopic Tandem Differential Mobility Analyzer (HTDMA; Rader & McMurry, 1986). In brief, dried aerosol particles having mobility diameter of 40, 60, 80, 100, and 120 nm were selected by the first DMA of the system. The monodisperse particles downstream of DMA-1 were conditioned at a relative humidity (RH) of 87±2% and measured by the second DMA and the CPC. A curve-fitting algorithm was used to fit up to three lognormal distributions depending on the spread of the selected monodisperse size distributions, revealing the aerosol's mixing state.

Figure 1 shows the HTDMA measurements of particles having dry diameter of 120 nm in Patras and in Athens. Particles observed over the Athens GAW station were more hygroscopic and more frequently externally mixed. The measured hygroscopic growth factors ranged from 1.01 to 1.63 with an average value of 1.26 and from 1.01 to 2.0 with an average value of 1.37, over the urban background sites of Patras and Athens respectively.

Table 1 provides a summary of all the HTDMA measurements recorded during the campaign.

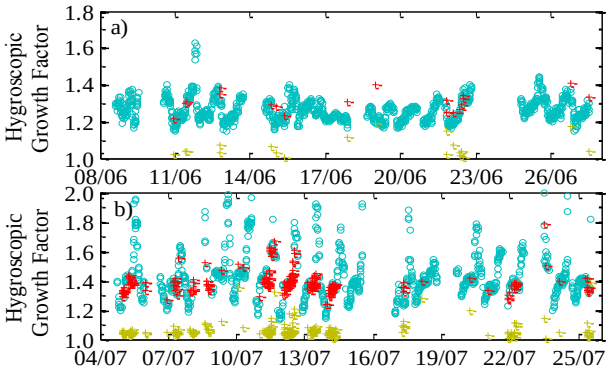


Figure 1. Particle hygroscopic growth factors in (a) Patras and (b) Athens. The growth factors correspond to particles having dry mobility diameter of 120 nm when exposed to 87±2% RH. Circles indicate internally mixed particles and crosses externally mixed particles (bimodal).

Table 1: Summary of the HTDMA measurements. Key: $d_{dry}$ is the mobility diameter selected by DMA-1; $P_u$ and $P_b$ are the relative frequencies of occurrence for unimodal and bimodal distributions, respectively; $g_1$, $g_{21}$, and $g_{22}$ are the average growth factors ± one standard deviation for the measurements showing unimodal and two bimodal distributions, respectively.

| | $D_0$ | Gf 1 | $P_u$ (%) | Gf 21 | Gf 22 | $P_b$ (%) |
|---|---|---|---|---|---|---|
| Patras Background Urban Station | 40 | 1.21 ±0.07 | 74.2 | 1.11 ±0.04 | 1.34 ±0.06 | 25.4 |
| | 80 | 1.25 ±0.06 | 87.3 | 1.06 ±0.03 | 1.30 ±0.05 | 12.7 |
| | 120 | 1.26 ±0.06 | 96.8 | 1.06 ±0.05 | 1.31 ±0.05 | 3.2 |
| Athens Background Urban Station | 40 | 1.27 ±0.17 | 42.9 | 1.08 ±0.05 | 1.37 ±0.10 | 54.8 |
| | 80 | 1.41 ±0.17 | 65.1 | 1.06 ±0.03 | 1.37 ±0.08 | 34.6 |
| | 120 | 1.43 ±0.17 | 72.4 | 1.06 ±0.05 | 1.39 ±0.09 | 27.6 |

Acknowledgement:
This research has been co-financed by the European Union (European Social Fund – ESF) and Greek national funds through the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF) - Research Funding Program: **THALES**. Investing in knowledge society through the European Social Fund.

## References

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