DMA Train measurements of nanoparticle growth at a field site in Lewes, Delaware

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Knowledge of the mechanisms leading to atmospheric new particle formation and growth is of significant importance to the understanding of climate relevant aerosol radiative forcing. New particle formation (NPF) can be characterized by means of formation and growth rates (Kulmala, 2003). These parameters are usually determined using condensation particle counters (CPC) for measuring particle number concentration and scanning mobility particle sizers (SMPS) for measuring the size distribution.

At the moment, however, the main obstacles in aerosol research are related to detection limits and time-resolution of instrumentation for characterizing nanometer-sized particles (nanoparticles). Since nanoparticles may grow fast, high time-resolution instruments are required to precisely follow these processes.

A new measurement technique proposed by Winkler *et al.*, (2013), the DMA Train, provides precise and rapid measurements of the size distribution of growing nanoparticles. The DMA Train (Figure 1) consists of a set of differential mobility analysers (DMAs), each set to select particles of a specific mobility diameter. Size-selected particles from each DMA are subsequently counted by a dedicated CPC placed downstream. The DMA Train provides an alternative way of studying the dynamics of NPF by offering measurements of particle size distributions at high time-resolution (1 sec.).

In recent chamber experiments (Winkler *et al.*, 2013), the DMA Train was shown to provide definite growth rates even at low size-selected particle number concentrations. While the laboratory experiments describe measurements in well-defined and controlled conditions, it is important to confirm whether (1) the same behaviour can be observed in real atmospheric conditions and (2) the DMA Train measurement technique is suitable to be used in field studies. Thus, the DMA Train was deployed at a field site in Lewes, Delaware in August 2012 to perform size-resolved measurements of growth and formation rates for a particle size range between 3 and 10 nm.

The DMA Train at the Lewes Field Campaign measurement site utilized a parallel arrangement of four CPCs: a di-ethylene-glycol-based CPC (DEG-CPC; Iida *et al.*, 2009) and three butanol-based ultrafine CPCs (UCPCs, TSI 3025; Stolzenburg and McMurry, 1991) each coupled to a nano-DMA (TSI 3085) and a Po^{210} radioactive source (Figure 1). Further, each DMA was set at a fixed voltage and sample flow (1.5 L/min) for measuring ambient particle number concentration in a narrow range of mobility diameters. For this study the sampled mobility diameters were 3, 6, 8 and 10 nm.

Results from the Lewes field study, obtained using the DMA Train, will be presented and compared to data provided by the Particle Size Distribution (PSD) instrument.

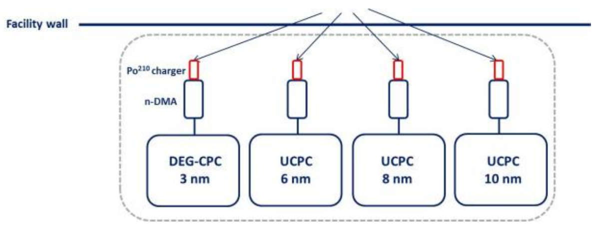

Figure 1. Schematic of experimental set-up includes DEG-CPC and three UCPC set to diameters of 3, 6, 8 and 10 nm respectively.

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