On-line measurements and air flow modelling at/near BpART facility

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Budapest platform for Aerosol Research and Training (BpART) was created for advancing long-term on-line atmospheric measurements and intensive aerosol sample collection campaigns in Budapest through complex surface based and satellite born measurements. The facility has been in continuous operation since November 2013. The aerosol instruments available include an FDMS-TEOM 1400a, RT-OC/EC analyser, DMPS, SFU sampler, MOUDI and nano-MOUDI samplers and HiVol virtual impactor. Meteorological data are available from a regular Urban Climatological Station operated within the university campus, and from a simpler on-site meteorological station. Aerosol optical thickness data can be retrieved via satellite receivers from the MODIS on the Terra satellite.

Air flow and dispersion of aerosol particles in the surroundings of the BpART facility were investigated by using a three-dimensional CFD model of the neighbouring territory for both summer (vegetation with leaves) and winter (no vegetation) canopy conditions. Flow structure around the platform for the prevailing wind direction of N is shown in Fig. 1. The studies confirmed that the BpART facility represents a well-mixed, average atmospheric environment for the city centre.

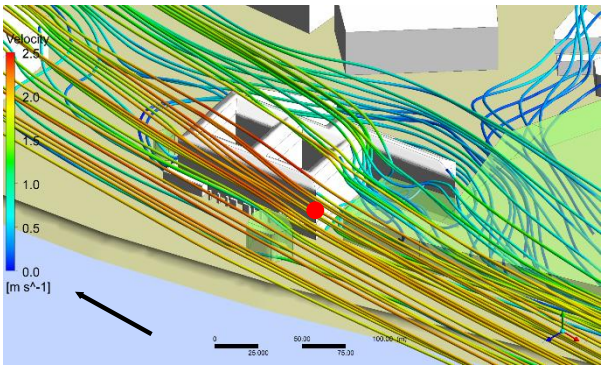

Figure 1. Path lines and speeds around the BpART facility for the prevailing wind direction of N in summer in a perspective view. The wind direction is marked by an arrow, and the location of the platform is indicated by red dot.

Arch-type size distribution surface plots consisting of an obvious and uninterrupted particle growth which was followed by a continuous decrease in nucleation-mode median diameter were observed in 4.5% of quantifiable nucleation events (Fig. 2). In some cases, the newly formed particles shrank back to the smallest measurable diameter limit of 6 nm. The shrinkage phase took 1:34 h in general, and the shrinkage rate varied from –4.8 to –2.3 nm h^{-1} with a mean and standard deviation of (–3.8±1.0) nm h^{-1}. Concentrations $N_{6–25}$, $N_{6–100}$ and N increased substantially (by approximately 45–70%) during the particle growth as expected, and they decreased by about 30–50% during the particle shrinkage. Variation in $N_{100–1000}$ over these time intervals were negligible. Changes of O_3, GRad, gas-phase H_2SO_4 proxy, RH, T and partially WS are biased by their ordinary diurnal cycling, while the atmospheric concentrations are also influenced by planetary boundary layer dynamics and mixing intensity. The largest relative changes expressed by the mean growth/shrinkage ratios were associated with GRad, T and gas-phase H_2SO_4 proxy. They substantially differed from 1, which indicates that there can be further relationships – in addition to the diurnal bias – between these variables and the physicochemical processes undergoing within the particles during the shrinkage phase. Some alternative explanations are also possible.

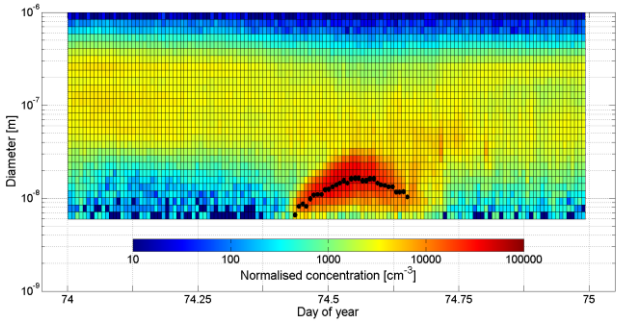

Figure 2. Arch-type size distribution surface plots at the BpART facility.

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