Air mass history on 1-year long new aerosol particle formation dataset in Budapest

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As part of an urban aerosol research project, number size distributions of particles were measured at Lágymányos Campus of the Eötvös University, located in central Budapest, Hungary continuously between November 2008 and November 2009. The measurements were performed by a flow-switching type differential mobility particle sizer (DMPS) in the electric mobility diameter range of 6–1000 nm in 30 channels with a time resolution of ca. 10 min. Meteorological data were obtained from the Urban Climatological Station of the Hungarian Meteorological Service operated within the university campus.

The measurement days were classified on the basis of Dal Maso et al. (2005). For the 1-year period, there were 31 days that belonged to the nucleation event, class 1A (Salma et al., 2011). The start (t1) and end (t2) times of the beginning of the nucleation, and the end times of the condensational particle growth were determined from the contour plots by examining the changes in the channel contents and meteorological data (Kristensson et al., 2008). The times t1 and t2 were shifted by an interval that was needed for the particles to grow from 2 to 6 nm utilizing the actual growth rate between 2.0 and 13.3 nm/h.

Wind roses were constructed by taking the wind speed and wind direction data into consideration from t1−1 h to t1+6 h for the nucleation events, and for 0–24 h for the non-nucleation days. Wind speed varied from 0.15 to 13.2 m/s with a median of 2.7 m/s for the nucleation events. The prevailing wind direction was SE as shown in Figure 1.

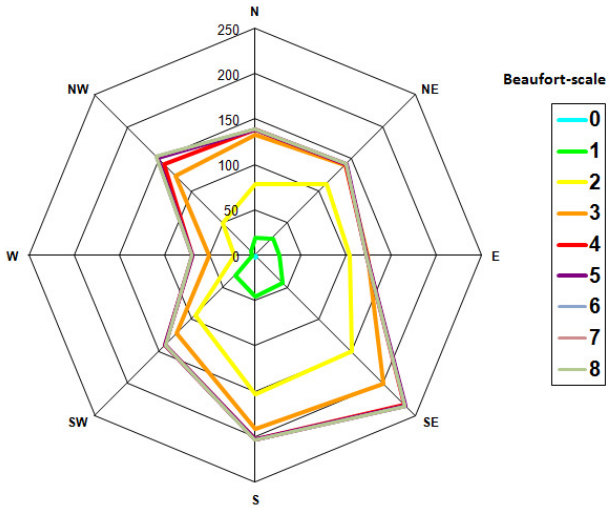

Figure 1. Wind rose for class 1A nucleation events.

For the non-nucleation days, the wind speed changed from 0.10 to 15.8 m/s with a median of 2.4 m/s, and the prevailing wind direction was NE. For the nucleation events, the range of the wind speed was smaller while the mean wind speed was somewhat larger than the non-nucleation days.

Air mass history was also investigated for class 1A nucleation events. Backward trajectories were calculated by the HYSPLIT code of the National Oceanic and Atmospheric Administration Air Resources Laboratory using meteorological data from the GDAS database (Draxler and Rolph, 2013). The trajectories arriving at the receptor site (47.474° N, 19.062° E) in a height of 200, 500, 2300 m above ground level were derived. The most distant (starting) point of the trajectories corresponded to the times when the particle growth was finished or by which the nucleation mode could be separated from the Aitken mode. The trajectories were calculated for every individual event with a resolution of 1 h to the ending time. The coordinates from the trajectories were plotted on a single geographical map. The plot revealed that the estimated horizontal dimension of the nucleating air mass extends far beyond the city, and that there are several distinct directions within the Carpathian basin where the nucleating air mass originates from. These directions were similar to the prevailing wind direction of the wind rose generated for the nucleation events.

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