Supplementary information

S1 Wind sector analysis

The HTDMA data was divided into wind sectors (WS) according to the criteria presented in Table S2. A nonparametric Kruskal-Wallis test was then applied to the data in order to see whether the sectors differed statistically significantly from each other. Finally, the sectional differences were identified by comparing the 95 % confidence intervals of the sectoral mean ranks. These tests were performed separately for each dry size (D_p = 80, 120 and 150 nm) and for three different parameters:

- GF_{avg} = Size-averaged growth factor
- $GF_{GF \geq 1.25}$ = Size-averaged GF of more hygroscopic particles
- $f_{GF < 1.25}$ = Number fraction of less hygroscopic particles

The Kruskal-Wallis test results are presented in Fig. S1 where the paired differences in mean ranks are plotted together with their 95 % confidence intervals. The bars are arranged in a way that the first three bars (from left to right) illustrate the variation within the polluted sector (wind sectors 1–3) and the last bar illustrates the difference between the two clean sectors (wind sectors 4–5). A simplified representation of the wind direction dependence is illustrated in Figs. S2–S4 where the wind sectors are colored according to the averaged HTDMA data using the map of Kuopio area as a background.

Generally, the polluted sector was characterized by significantly higher $f_{GF<1.25}$ than the clean one. Similarly, the average GFs of more hygroscopic particles were significantly higher for the polluted sector, with the only exception being the wind sector 1 at D_p = 150 nm. Consequently, no clear trends were seen in the average GFs.

Table S1. HTDMA configuration.

Part	Model/type	Additional information
Dryer	Silica gel diffusion dryer	Length 900 mm, inner diameter approximately 10 mm
Charger	^{85}Kr bipolar diffusion charger	
DMA1/DMA2	Custom-made Vienna type DMA	Length 280 mm, outer radius 33 mm, inner radius 25 mm
DMA HV suppliers	Fug HCE 7-12500	
Particle counter	TSI Model 3010 Condensation Particle Counter	Sample flow 1 lpm
Sample flow sensor	Vaisala HUMICAP® Humidity and Temperature Probe HMP110	Sample flow RH and temperature
Sheath flow sensor	EdgeTech DewMaster Chilled mirror hygrometer	DMA2 sheath flow RH and temperature
Humidifier	Custom-made Gore-tex humidifier	Length 150 mm
DMA Blowers	Ebm-papst RG100/1100–2012	Controlled sheath/excess flow circulation for DMA1 and DMA2 (closed loop; 6 lpm)
Flow meters	TSI Model 4143 Mass Flowmeter	Sheath/excess flow monitoring

Table S2. Wind sectors and their characteristics. Adapted from Portin et al. (2014).

Sector		Source	Direction and distance from the station
WS 1	0–45°	Paper mill Highway/Savilahti road	35°, 5 km 6–45°, > 1.4 km
WS 2	45–155°	City center Residential areas Highway/Savilahti road	120–155°, 1.6–3.2 km 45–120°, 1.2–4 km 45–155°, 1–1.4 km
WS 3	155–215°	Heating plant Residential areas Highway/Savilahti road	160°, 3.5 km 155–215°, 3.4–10 km 155–192°, > 1 km
WS 4	215–245°	Residential areas	215–245°, 3.4–4 km
WS 5	245–360°	Residential areas	245–360°, 1.5–3.5 km

Supplementary figure captions

Figure S1: Comparison between the five wind sectors (WS). Each row and column corresponds to different particle size and variable, respectively. The bar plots illustrate the paired differences in mean ranks and the whiskers correspond to their 95 % confidence intervals. Therefore, if the confidence interval doesn't include zero, the difference between wind sectors can be considered statistically significant (grey bars). Marked are also the test parameter (χ^2) and the level of significance (p) as obtained by Kruskal-Wallis.

Figure S2: Top left: Map of the Kuopio area. Numbered are the Puijo tower (1), paper mill (2), city center (3), heating plant (4) and the highway/Savilahti road (5). Other panels: Wind sectors colored according to the 80 nm HTDMA data. Shown are the average GFs (top right), the average GFs of more hygroscopic particles (bottom left) and the number fractions of less hygroscopic particles (bottom right). Background map by OpenStreetMap contributors.

Figure S3: Top left: Map of the Kuopio area. Numbered are the Puijo tower (1), paper mill (2), city center (3), heating plant (4) and the highway/Savilahti road (5). Other panels: Wind sectors colored according to the 120 nm HTDMA data. Shown are the average GFs (top right), the average GFs of more hygroscopic particles (bottom left) and the number fractions of less hygroscopic particles (bottom right). Background map by OpenStreetMap contributors.

Figure S4: Top left: Map of the Kuopio area. Numbered are the Puijo tower (1), paper mill (2), city center (3), heating plant (4) and the highway/Savilahti road (5). Other panels: Wind sectors colored according to the 150 nm HTDMA data. Shown are the average GFs (top right), the average GFs of more hygroscopic particles (bottom left) and the number fractions of less hygroscopic particles (bottom right). Background map by OpenStreetMap contributors.

Figure S5: Median GF distributions of total and interstitial aerosol during the twin inlet period. Here, the GF distributions were calculated by scaling the hourly averaged GF-PDFs with respective ambient particle concentrations. The whiskers represent the 25^{th} and 75^{th} percentiles.

Figure S6: Critical activation diameter (D50) vs. size-averaged hygroscopicity (κ) of 80 nm, 120 nm and 150 nm particles. The data points are colored according to the estimated effective peak supersaturations ($s_{c,eff}$), and the grey dashed lines represent the numerical solutions of κ-Köhler theory in the range of s_c = 0.1%–0.5%. The color scale from blue to yellow covers the supersaturation range from 0.15% to 0.30%, and the single data point with $s_{c,eff}$ = 0.44% is colored with black. Note that some of these data points were later removed from the analyses due to the discrepancies between HTDMA and DMPS derived activation properties. Therefore, some of the $s_{c,eff}$ values might be characterized by increased uncertainties.

Figure S7: Critical activation diameter (D50) vs. the (estimated) effective peak supersaturation ($s_{c,eff}$). The data points are colored according to the average hygroscopicity of 150 nm particles ($\kappa_{150\ nm}$), and the grey dashed lines represent the numerical solutions of κ-Köhler theory in the range of κ = 0.01–0.45. Note that some of these data points were later removed from the analyses due to the discrepancies between HTDMA and DMPS derived activation properties. Therefore, some of the $s_{c,eff}$ values might be characterized by increased uncertainties.

References

Portin, H., Leskinen, A., Hao, L., Kortelainen, A., Miettinen, P., Jaatinen, A., Laaksonen, A., Lehtinen, K. E. J., Romakkaniemi, S., and Komppula, M.: The effect of local sources on particle size and chemical composition and their role in aerosol-cloud interactions at Puijo measurement station, Atmos. Chem. Phys., 14, 6021-6034, 10.5194/acp-14-6021-2014, 2014.