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Hygroscopic properties of ultrafine particles at an urban site in northern Japan during the summer of 2011

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To investigate the hygroscopic property of ultrafine particles, hygroscopic growth factors [g(RH)] of size-segregated atmospheric particles were measured at an urban site in Sapporo, northern Japan, during the summer of 2011. Hygroscopic growth factors at 85% RH [g(85%)] of freshly formed nucleation mode particles ranged from 1.11 to 1.28 with an average of 1.16 $\pm$ 0.06. These values are similar to those of secondary organic aerosols, suggesting that low volatile organic vapors are important to the growth of nucleated clusters into quasi-stable aerosol particles larger than 3 nm. Higher g(85%) values (range: 1.21-1.31, AVG: 1.27 $\pm$ 0.04) were obtained for grown Aitken mode nucleated particles. This result may indicate that the growth of freshly formed nucleation mode particles to the Aitken mode particles at the urban site can be attributed to condensation not only of low volatility organic vapors but also of highly water-soluble inorganic compounds like sulfuric acid. Diel variations in the number concentrations of less-hygroscopic particles [g(85%) <1.05] were similar to those in NO concentrations, suggesting that less-hygroscopic particles are mainly produced by local anthropogenic emissions such as traffic. Higher g(85%) values (1.27 $\pm$ 0.05) were obtained at a dry particle diameter of 120 nm when the air masses originated from downwind areas of the Asian continent, whereas lower g(85%) values (1.19 $\pm$ 0.06) were obtained when clean marine air masses arrived in the urban site. These results indicate that the hygroscopic property of large Aitken and small accumulation mode particles (80-165 nm) are highly influenced by the long-range transport of atmospheric particles.