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Atmos. Chem. Phys., 4, 1047-1062, 2004

www.atmos-chem-phys.net/4/1047/2004/

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Aerosol particle size distributions in the lower Fraser Valley: evidence for particle nucleation and growth

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Abstract. Particle size distributions from 9 to 640nm diameter were measured at Eagle Ridge in the lower Fraser Valley from 13 August to 1 September 2001 as part of the Pacific 2001 Air Quality Study. The site was on top of a ridge, about 300m above the valley floor, in a predominantly agricultural area about 70km ESE of Vancouver. To further characterize the particles, their hygroscopic properties (affinity for water) were measured. The maximum of the number distributions was generally between 40 and 100nm diameter, but the number distribution was sometimes dominated by ultrafine particles with diameters below 40nm. These ultrafine particles, which appeared to some extent on all days, were frequently associated with elevated levels of CO and NO_x, as expected for fresh vehicular emissions. The appearance of these fresh emissions was most pronounced when the growing mixed layer reached the altitude of the site. In contrast, pronounced nucleation events occurred on the five cleanest days; these resulted in particle number concentrations as high as 5x10⁴ particles cm⁻³ and growth rates of 5 to 10nmhr⁻¹. Nucleation appears to have been triggered when the UV flux reached about 25Wm⁻². The growth of these newly formed particles was probably driven by the photochemical oxidation of biogenic organic compounds. Dramatic growth events were also observed on the afternoons of the more polluted days; these produced an extremely narrow mode ($\sigma < 0.3$) at a diameter of about 40nm. Rainy days showed low number concentrations with the size distributions shifted to small sizes. On one of these days there was evidence of nucleation not far from the site; this may have been occurring in the vicinity of the clouds.

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Citation: Mozurkewich, M., Chan, T.-W., Aklilu, Y.-A., and Verheggen, B.: Aerosol particle size distributions in the lower Fraser Valley: evidence for particle nucleation and growth, Atmos. Chem. Phys., 4, 1047-1062, 2004. ▣ [Bibtex](#) ▣ [EndNote](#) ▣ [Reference Manager](#)

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