Particle Pollution and Urban Forests: An Estimation of Particle Density on Leaves of Urban Plants Using Scanning Electron Microscopy

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Abstract - Leaves of sixteen urban plant species were examined for particle density in June and September 2016 using scanning electron microscopy (SEM). The particle density was estimated by particle size fraction and leaf sides. The total particle density for coarse and fine fraction on both the abaxial and the adaxial leaf side ranged between 202 to 10,981 particles mm^{-2} in June and 30 to 1,984 particles mm^{-2} in September. To determine the repeatability of the SEM methodology for particle density assessment, repeated measurements were performed at long time-intervals in different SEM sessions and on short time-intervals within the same SEM session. The within-session successive repeated measurements elucidated that features constructing the topography of a leaf surface frequently contributed towards the edge enhancement effect, resulting in exaggerated particle counts. Besides, the mechanical drift and charging effects contributed to the disparity in particle densities. The results from our study enable us to suggest that SEM will continue to be a useful approach for determining the particle shape, size, elemental composition, and density of the deposited particles. However, disparities in particle densities can occur due to inaccurate particle recognition. We recommend that within-session successive repeated measurements ($\sim$ n $\geq$ 5) need to be performed to remove measurement uncertainties and obtain reliable quantitative data of particle counts using SEM.

Keywords: Particulate matter, Leaf micro-morphology, Scanning Electron Microscopy (SEM), Particle recognition, Edge enhancement, Charging, Drifting