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Depletion of gaseous polycyclic aromatic hydrocarbons by a forest canopy

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Abstract. Rapid uptake of gaseous polycyclic aromatic hydrocarbons (PAHs) by a forest canopy was observed at Borden in Southern Ontario, Canada during bud break in early spring 2003. High volume air samples were taken on 12 individual days at three different heights (44.4, 29.1, and 16.7 m) on a scaffolding tower and on the forest floor below the canopy (1.5 m). Concentrations of PAHs were positively correlated to ambient temperature, resulting from relatively warm and polluted air masses passing over the Eastern United States and Toronto prior to arriving at the sampling site. An analysis of vertical profiles and gas/particle partitioning of the PAHs showed that gaseous PAHs established a concentration gradient with height, whereas levels of particulate PAHs were relatively uniform, implying that only the uptake of gaseous PAHs by the forest canopy was sufficiently rapid to be observed. Specifically, the gaseous concentrations of intermediate PAHs, such as phenanthrene, anthracene, and pyrene, during budburst and leaf emergence were reduced within and above the canopy. When a gradient was observed, the percentage of PAHs on particles increased at the elevations experiencing a decrease in gas phase concentrations. The uptake of intermediate PAHs by the canopy also led to significant differences in gaseous PAH composition with height. These results are the most direct evidence yet of the filter effect of forest canopies for gaseous PAHs in early spring. PAH deposition fluxes and dry gaseous deposition velocities to the forest canopy were estimated from the concentration gradients.

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