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Uptake and emission of VOCs near ground level below a mixed forest at Borden, Ontario

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Supplementary Information

The wind speed measurements were rotated following Wilczak et al. (2001) using 30-min averages, with the first rotation around the z-axis to give <*v*> = 0 and the second rotation around the y-axis to give <*w*> = 0, where *v* and *w* are the cross-wind and vertical velocities respectively (angular parentheses <> denote an average value). It was found that the second rotation resulted in unrealistic rotation angles due to low wind speeds in the understory. For this reason a fixed anemometer tilt of 2.0^{o} was determined based on the distribution of the second rotation angles as a function of the first rotation angle. VOC fluxes were calculated from the 1 to 6 m gradients using the diffusion equation,

$$< w'\rho' > = -K\frac{d\rho}{dz} \quad , \qquad \text{(S1)}$$

where ρ is the gas concentration, z is the height and K is the vertical diffusion coefficient, which is given (Garratt, 1994) as

$$K = \kappa u_* z / \varphi. \qquad \text{(S2)}$$

Here $\kappa = 0.4$ is the von Karman constant, u_* is the friction velocity calculated from the z = 1.8 m anemometer, and φ is the stability function, which is a function the Monin-Obukhov length, L, (Garratt, 1994) as,

$$\varphi = \begin{cases} (1-16z/L)^{-1/4}, & z/L < 0 \\ 1+5z/L, & z/L > 0 \end{cases} \qquad \text{(S3)}$$

Integrating between a reference height z_r and z gives

$$\rho(z) = \rho(z_r) - \frac{< w'\rho' >}{\kappa u_* / \varphi}\ln\left(\frac{z}{z_r}\right) \ . \qquad \text{(S4)}$$

Each 30-min concentration profile was least-squares fit to

$$\rho(z_i) = a + b\ln\left(\frac{z_i}{z_r}\right), \qquad \text{(S5)}$$

where a and b are the parameters of a least-squares fit, z_r = 1 m, and z_i = {1, 2, 3, 4, 5, 6} m. A comparison of Eqs. (S4) and (S5) gives the concentration flux as $< w'\rho' > = -\kappa u_* b / \varphi$.

References:

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