Diurnal variation of CO_2 concentration, $\Delta^{14}C$ and $\delta^{13}C$ in an urban forest: Estimate of the anthropogenic and biogenic CO_2 contributions

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In urban areas, anthropogenic CO_2 emissions mixes with the background and biogenic CO_2 components. The carbon isotope of atmospheric CO_2 provide information about carbon pathways and the contribution of anthropogenic CO_2.

In the present study, diurnal variation of concentration, carbon isotopic compositions in the atmospheric CO_2 are presented in order to estimate the proportions of CO_2 derived from anthropogenic and biogenic sources at an urban forest in Nagoya City. Observation was conducted in winter (9 February 1999), when photosynthetic activity is quite low, so that the CO_2 sink or source related with biogenic activity is mainly the efflux from the soil surface. To compare contributions of anthropogenic and biogenic CO_2 just above the canopy of an urban forest and with that further above the canopy, air was sampled at two levels to measure CO_2 concentration, $\Delta^{14}C$, and $\delta^{13}C$. Within the forest, CO_2 concentration and $\delta^{13}C$ were measured at 6 different heights in order to clarify the behavior of CO_2 within the forest.

The anthropogenic (fossil fuel) and biogenic (soil respiration) to the total atmospheric CO_2 ranged from 0.4 to 15.5% (2 to 70ppm) and 2.4 to 8.2% (13 to 32ppm) at 23.75m (just above the forest canopy) and from 0.2 to 9.5% (1 to 41ppm) and 1.9 to 3.7% (7 to 16ppm) at 85m. The diurnal variation in the atmospheric CO_2 concentration, which is low during the daytime and high at night, was controlled mainly by wind velocity, and was influenced by the amount of CO_2 emitted from fossil fuel burning. At the forest, however, the diurnal variation of soil respiration component below the forest canopy is not affected by wind velocity at the canopy height. CO_2 from soil respiration at the forest site has accumulated just on the soil surface until the breeze starts at the bottom of the forest.

Although the total CO_2 concentration of the forest atmosphere was constant vertically, the CO_2 concentration for the soil respiration component had a vertical gradient within the forest. The CO_2 concentration was higher nearer the ground, especially at midnight. During the night, the gradient of the soil respiration component is larger than that of the fossil fuel component.