한국 활엽수림의 이산화탄소 농도의 연직구조와 저류항

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Vertical Profiles of CO_2 Concentrations and CO_2 Storage in Temperate Forest in Korea

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Abstract

Micrometeorological fluxes measured over a tall forest in a complex terrain are difficult to interpret. CO_2 storage often makes significant contributions to net ecosystem exchange of CO_2 (NEE) in early morning and during nighttime due to calm and stable conditions. We measured the above-canopy CO_2 flux along with its concentration profiles at eight levels within and above the canopy to evaluate CO_2 storage term. Our question is whether or not the CO_2 storage term can be estimated accurately from a single level measurement of CO_2 concentration in a complex terrain. Our objectives are (1) to document vertical profiles of CO_2 concentration and (2) to compare the diurnal and seasonal variations of CO_2 storages estimated from single and multi-level CO_2 concentration data.

Seasonally averaged Diurnal variations of CO_2 concentration ranged from 398 to 455 ppm near the forest floor at 0.1 m whereas they ranged from 364 to 395 ppm at 40 m in the atmosphere. The diurnal variation of vertical profiles of CO_2 concentration shows very interesting features with season. At all eight levels, diurnal variation of CO_2 concentration showed little change in winter. In spring, the diurnal variations of CO_2 concentration at 8 levels showed three distinct groups of layers with height: the first layer: 0.1m (near

surface), second layer: 1.0 m and 4.0m (below canopy) and the third layer: 7.4m to 40.7 m (near canopy and above). In summer, these three groups of layers were further separated with larger variations whereas such distinction became smaller in fall. The diurnal variation of CO_2 concentration in the first three layers near surface always showed higher concentration with larger variability. Typically, CO_2 concentration showed peaks in early morning and in the evening. After the evening peak, CO_2 concentration gradually increased except for those near the surface (i.e., 0.1, 1.0 and 4.0 m) where the concentrations actually decreased. We suspect that this could be attributed to the drainage flow of CO_2 along the hill slope from the headwater to downstream, which is not taken into account for net ecosystem CO_2 exchange. In comparison to the results of other studies, the distinct and different vertical structures of CO_2 concentrations observed at our site may be due to complex terrain and weak turbulent mixing under calm conditions at the site. The annual mean of diurnal variation of CO_2 storage flux from single level ranged from -0.6 to 0.9 μmol $m^{-2}s^{-1}$ and from multi-level from -1.2 to 1.0 μ μmol $m^{-2}s^{-1}$. When compared against the results from the multi-level concentrations, the storage flux estimated from a single-level concentration was generally adequate except for specific hours near sunrise and sunset. Further details and their implication will be discussed in the presentation.

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