Seasonal variation of O_3 flux in red pine forest

Junpei Ito[1], *Ryuichi Wada[1], Satoru Takanashi[2], Takafumi Miyama[2], Michiaki Okano[2], Takashi Nakano[3], Tomoki Mochizuki[4], Akira Tani[4], Seiichiro Yonemura[5], Yutaka Matsumi[6], Kentaro Takagi[7], Masahito Ueyama[8], Yuzo Miyazaki[7]

1. Teikyo University of Science, 2. Forestry and Forest Products Research Institute, 3. Mount Fuji Research Institute, 4. University of Shizuoka, 5. National Agriculture and Food Research Organization , 6. Nagoya University, 7. Hokkaido University, 8. Osaka Prefecture University

The emission and absorption of trace gases at the biosphere affects to atmospheric chemistry, and thus it makes influence with potential indirect effects on carbon cycle and climate (Ollinger et al., 2002). We observed O_3 flux with the gradient method at a meteorological tower in red pine forest (Site Code: FJY) since 2016. We also measured CO_2 flux at the same meteorological tower for validation of the system by comparison with CO_2 flux determined by the eddy covariance method.The heights of the forest canopy and the meteorological tower were about 24 m and 32 m.Concentrations of O_3 and CO_2 were measured at two heights (26 m and 34 m) above the canopy by an ultraviolet absorption O_3 analyzer (Thermo: 49C), and an infrared absorption CO_2 analyzer (Licor:LI-820). The O_3 instrument was calibrated once a year and the CO_2 instruments were calibrated every three weeks at the observation site. The air was sampled every 300 seconds from each two vertical heights and supplied to the analytical instruments through PFA tube. Concentration of CO_2 was also measured by an infrared absorption CO_2 analyzer (Licor: LI-6262) at 26.5 m to determine CO_2 fluxes by the eddy covariance method. Wind speed and wind direction were measured at 26.5 m and they were used to obtain fluxes by the gradient and eddy covariance methods. The CO_2 fluxes in the day time (9:00-16:00) in 2017 were observed with the gradient and the eddy covariance method as -0.14±0.12 mol m^{-2} d^{-1} and -0.21±0.16 mol m^{-2} d^{-1}, respectively. The CO_2 flux obtained by the gradient method was slightly lower and more scattered than CO_2 flux obtained by the eddy covariance method; however these values reasonably agreed. We made sure the flux observation system with gradient method worked properly. The observed O_3 concentration showed a seasonal variation and was in a maximum in May. However the primary result showed that O_3 deposition in the red pine forest in daytime had a maximum between June and July. The peak of O_3 deposition delayed to the peak of O_3 concentration. A chemiluminescence O_3 analyser was developed and optimized the measurement condition using O_3 standard gas generated by O_3 generator. The developed analyser was tested in Uenohara for 4 days and the observed O_3 concentrations agreed with the concentrations observed by an ultraviolet absorption O_3 analyzer.

Keywords: Ozone, Forest, Flux

