Development of a High-accuracy CH_4 and Total Hydrocarbon Flux Monitoring System for a Broadleaved Deciduous Forest in Japan

Principal Investigator: Takafumi MIYAMA
Institution: Forest and Forest Products Research Institute (FFPRI)

[Abstract]

Keywords: Methane flux, BVOC flux, Micrometrological technique, Chamber technique, Global warming

Methane (CH_4) is a well-known greenhouse gas and non-methane hydrocarbons are thought to be a precursor of secondary organic aerosols (SOA) and to form ozone. Thus, a continuous monitoring system needs to be developed and time series and spatial variations in hydrocarbon flux need to be monitored in order to predict and control global warming. In this study, we developed a field flux observation system using the multi-automated closed chamber method, relaxed eddy accumulation (REA) method, Fast Methane Analyzer (FMA, Los Gatos Research, U.S.A.) and Proton Transfer Reaction - Mass Spectrometry (PTR-MS, Ionicon Analytik, Austria). For field measurement, the Yamashiro Experimental Forest (YEF) in southern Kyoto prefecture was used. To evaluate the characteristics of variations in hydrocarbon concentrations and flux in a warm-temperate mixed forest in Japan, we measured the vertical profiles and flux of hydrocarbons. An almost constant uptake of CH_4 was observed at the upland forest floor throughout the year. In the profile measurements, the CH_4 concentration was slightly higher at the canopy height than the mean value when the friction velocity (u^*) was lower than 0.3 m s^{-1}. These phenomena were observed on the same day at micrometeorological towers in ridge and valley positions. An investigation plot was set in the riparian zone of YEF. A high rate of CH_4 emission was observed on the soil chamber around the shoreline which contained large amounts of root and leaf litter. These results suggest that root and leaf litter are important potential sources of CH_4 in the forest and certain large-scale factors govern variations in CH_4 concentration at ground level. However, the wet area of the riparian zone accounts for less than 0.6% of YEF and forest-level CH_4 emission and daily variations in CH_4 flux were not observed by the micrometeorological method (REA). In isoprene flux measurement, the ratio between leaf emission rate and canopy flux decreased around noon. It is possible that an abundant supply of isoprene from leaves might accelerate to form SOA and deposition. The newly developed monitoring system will be an effective tool to understand the overall role of the forest in the circulation of hydrocarbons in the ecosystem.