Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)
©2015. Japan Geoscience Union. All Rights Reserved.

ACG30-P02 Room:Convention Hall Time:May 25 18:15-19:30

Methane dynamics in a temperate forest revealed by plot-scale and ecosystem-scale flux measurements

SAKABE, Ayaka[1*] ; KOSUGI, Yoshiko[1] ; TAKAHASHI, Kenshi[2] ; ITOH, Masayuki[3] ; UEYAMA, Masahito[4] ; IWATA, Hiroki[5] ; ATAKA, Mioko[1]

[1]Graduate School of Agriculture, Kyoto University, [2]Research Institute for Sustainable Humanosphere, Kyoto University, [3]Center for Southeast Asian Studies, Kyoto University, [4]Graduate School of Life and Environmental Sciences, Osaka Prefecture University, [5]Faculty of Science, Shinshu University

Soils play important roles as CH_4 sources and sinks. CH_4 is produced in anoxic environments, including submerged soils, by methanogenic bacteria. On the contrary, CH_4 is oxidized by methanotrophic bacteria in upland soils. In general, forest soils are recognized as the efficient sinks for atmospheric CH_4, because of their CH_4 oxidation capacity in water-unsaturated soil (Le Mer and Roger, 2001). However, we hypothesized that forest ecosystems, especially in wet warm climates such as Asian monsoon climate, are not always CH_4 sink. In this study, we examined the CH_4 dynamics in a temperate Asian monsoon forest (Kiryu Experimental Watershed: 35^{o}N, 136^{o}E), which included wet areas along riparian zones within the watershed. In order to reveal the spatio-temporal variations of CH_4 fluxes, we combined multi-point plot-scale CH_4 flux measurements using chamber methods and ecosystem-scale CH_4 flux measurements using a micrometeorological method, relaxed eddy accumulation (REA) method (Businger and Oncley, 1990; Hamotani et al., 1996, 2001).

Intensive manual chamber measurements of CH_4 fluxes at 60 points in the wet areas and within the water-unsaturated forest floor, respectively, showed that the wet areas had a greater spatial and temporal variability of CH_4 fluxes than the forest floor. This indicates that accurate consideration of CH_4 fluxes from any wet areas is important in order to evaluate the CH_4 budget within the forests. From biweekly continuous manual chamber measurements of CH_4 fluxes at 9 points in the wet areas and the forest floor, respectively, hotspots of CH_4 emissions were observed during summer and fall immediately after intensive precipitation in the wet areas. On the other hand, in the forest floor, seasonal variations of CH_4 fluxes were not simply associated with temperature variations. In contrast, CH_4 absorption increased at some measurement plots in spring before intensive summer rainfall. In addition to the manual chamber measurements, we observed the environmental responses of CH_4 fluxes at a half-hourly time resolution, by using automated chamber measurements at three plots on the water-unsaturated forest floor. We found that the CH_4 absorption flux was greatly weakened by summer intensive rainfall, but recovered and peaked after rainfall as the soil water content decreased. The responses of CH_4 fluxes to rainfall were different for each plot. In a dry soil plot with a thick humus layer, CH_4 fluxes decreased abruptly at the peak of rainfall intensity, and it increased gradually after rainfall. In a wet soil plot and a dry soil plot with a thinner humus layer, such abrupt decreases in CH_4 fluxes were not observed, and CH_4 fluxes gradually switched from a sink to neutral following rainfall. Simultaneous measurements of CO_2 fluxes provided useful information when considering the controlling factors affecting complex CH_4 fluxes in terms of gas diffusivity and microbial activity.

The ecosystem-scale CH_4 flux measurements revealed that the Japanese cypress forest switched seasonally between being a sink and source of CH_4, and the pattern differed year by year. CH_4 fluxes tended to be a source during summer and fall, and switched to a sink during dry period. At hourly to daily timescales, the CH_4 fluxes were sensitive to rainfall; rain events increased CH_4 emission, decreased CH_4 absorption, or shifted CH_4 absorption to CH_4 emission. The results show that the temperate forest containing riparian zone acted as a CH_4 source seasonally, through the increased CH_4 emission in the wet areas and/or the decreased CH_4 absorption on the water-unsaturated forest floor in response to changing soil temperatures and/or the soil water status. The Asian monsoon rainfall was found to strongly influence temporal variations in CH_4 fluxes at both plot-scale and ecosystem-scales.