RECENT RESEARCH ACTIVITIES

Exploring sub-daily to seasonal variations in methane exchange in a single-crop rice paddy in central Japan

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Methane (CH_4) is an important greenhouse gas, accounting for about 20% of the total direct radiative forcing from long-lived greenhouse gases since pre-industrial times. Rice paddy fields are known as a major source of CH_4 in the terrestrial atmosphere. Many studies have thus investigated the source strength and environmental controls on CH_4 exchange in rice paddies using the chamber technique and pot experiments. Despite these efforts, there is still large uncertainty regarding the global CH_4 emissions from rice paddies. It is important to understand the transport pathways from the anoxic soil where CH_4 is produced to the atmosphere, as well as the environmental controls on the transport processes. We applied the eddy covariance technique to observe ecosystem-scale CH_4 exchange in a rice paddy field in central Japan (Kanto Region) in both the growing and post-harvest seasons. Our objectives were: 1) to clarify the environmental controls on ecosystem-scale CH_4 exchange to infer the main transport pathways for the different stages of cultivation, and 2) to quantify the total annual CH_4 exchange in the rice paddy field.

Our observations showed that, before heading of rice plant, the CH_4 emission was dependent of soil temperature and wind speed. The soil temperature dependence can be due to an increase in CH_4 production, higher molecular diffusion, and higher conductance within rice plant at higher soil temperature. An occurrence of ebullitive emission was also indicated from the wind speed-dependent data. After heading was completed, relative humidity and water temperature influenced the CH_4 emission rates. Clear diurnal variations in the CH_4 emission were also observed, and their amplitudes were dependent of the stages of cultivation (0.03 μmol m^{-2} s^{-1} in the late pre-heading stage and 0.13 μmol m^{-2} s^{-1} in the post-heading stage). Induced convective throughflow within the rice aerenchyma after the change in plant structure was attributable to this variation in environmental controls after the heading.

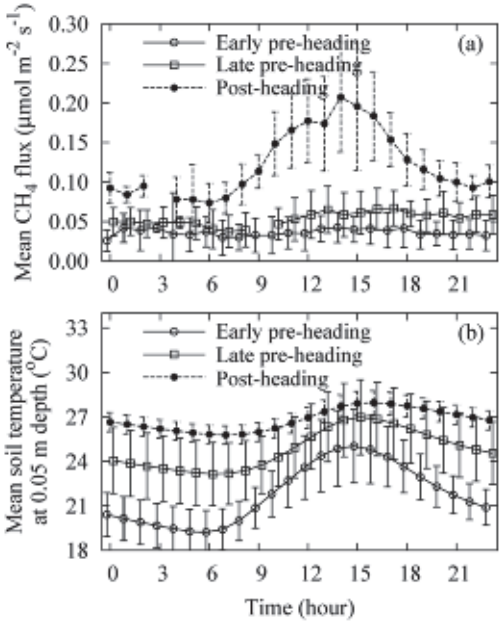

Figure 1. Mean diurnal variations in (a) CH_4 flux and (b) soil temperature at 0.05m depth for the early pre-heading period (May 23-June 23, 2012, open circle), the late pre-heading period (June 28-July 29, open square), and post-heading period (July 30-August 27, 2012, solid circle). The averaged data points are shown only when the number of original data points is more than five. The error bars represent standard deviation. For clarity, data points are slightly shifted in the x-axis direction.

References

Iwata, H., M. Mano, K. Ono, T. Tokida, T. Kawazoe, Y. Kosugi, A. Sakabe, K. Takahashi, and A. Mityata, "Exploring sub-daily to seasonal variations in methane exchange in a single-crop rice paddy in central Japan", *Atmospheric Environment*, 179, 156-165, doi: 10.1016/j.atmosenv.2018.02.015, 2018.