

Carbon cycle studies based on CO₂ flux measurements at tropical forest ecosystems in Southeast Asia

Nobuko Saigusa[1]; Hiroaki Kondo[1]; Minoru Gamo[1]; Takahisa Maeda[1]

[1] AIST

The region referred to as monsoon Asia is covered by a range of ecosystems from tropical forests in Southeast Asia to boreal forests in the northern Asia. Exchange processes of carbon dioxide (CO₂) between the ecosystems and the atmosphere plays an important role on the seasonal and inter-annual changes in the atmospheric CO₂ growth rate. There are many discussions on the CO₂ growth rates how regional CO₂ flux anomalies in various biome in different climatic zone have affected the atmospheric CO₂.

Climatic conditions in tropical forests in Southeast Asia have been highly influenced by El Nino/Southern Oscillation events and also by year-to-year changes in the Asian monsoon circulation. Recent studies suggested that the carbon budgets of tropical forests in Southeast Asia are quite sensitive to the inter-annual changes in the environmental variables such as photosynthetic photon flux density, soil moisture, atmospheric humidity, and also to the biological responses such as photosynthetic efficiency and phenological changes in individual plants. The results have been obtained by long-term flux measurements, inverse model analyses, and also satellite data analyses.

To make clear the physical and biological responses in the tropical ecosystems to climatic variations, long-term observations of energy, water vapor, and CO₂ fluxes have been increased in Southeast Asia since the latter half of 1990's with expansion of the FLUXNET activity (Gamo *et al.*, 2005; Kosugi *et al.*, 2008). Few studies, however, have been reported in Asia to generalize our understanding of the temporal and spatial variability of energy, water, and CO₂ exchange from a dataset consisting of multiple sites over several years.

During recent few years, a synthetic study was conducted under a framework of Global Environmental Research Fund of the Ministry of the Environment of Japan, and JapanFlux/AsiaFlux network, which attempted to compare the carbon uptake by various forest ecosystems in Asia. The results showed that the annual CO₂ uptake depended highly on the environmental variables and biological factors such as the annual air temperature and history of disturbance. Results also suggested that the gross primary productivity in the tropical forests was two to three times higher than those in the temperate forests and had a clear seasonal change in tropical seasonal forests (Hirata *et al.*, 2008; Saigusa *et al.*, 2008). The studies also stated that we still had problems lying in the eddy covariance methods, especially in the nighttime. The underestimation of nighttime total ecosystem respiration caused observational errors on the carbon budget estimation even though we followed the 'standardized method' by FLUXNET. Further studies are clearly necessary to solve the problem and find out better technique.

We face to many difficulties to continue long-term flux observations especially in Southeast Asia, since our activities include not only maintaining field measurement with the overseas affiliated members but also improving the quality of data, constructing the database, and conducting synthetic analyses. However, it is obviously necessary and indispensable to evaluate carbon, water, and the energy budgets in regional scale in different climatic zones in Asia, in order to find new results and interpretations for spatial and temporal variability concerning the relation between climatic change and the feedback of terrestrial ecosystems.

References

- Gamo *et al.*, 2005: In Proc. Int. Workshop on Advanced Flux Network and Flux Evaluation, p. 86.
- Hirata *et al.*, 2008: Agric. For. Meteorol. (in press)
- Kosugi *et al.*, 2008: Agric. For. Meteorol. (in press)
- Saigusa *et al.*, 2008: Agric. For. Meteorol. (in press)