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Contents

Standing Together: Our Vision

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Dreaming and embracing a vision is the greatest motivator of humanity. It provides us with the power to hope beyond the majority and the present – an ability to believe in an unseen future. In a nutshell, vision is foresight with insight based on hindsight (Munroe, 2003). As the new chair, I am simply overwhelmed not only by the privilege and responsibility of the role to play but also with a grateful heart for our predecessors, particularly the former chairs – Profs. Y. Fukushima, S. Yamamoto, and Y. Ohtani. It is reassuring to witness these visionary leaders who not only know where they are going, but also invite us to pave the way with them. Because of their courage and foresight, we have now come to celebrate the 10th anniversary of AsiaFlux's science, service, and stewardship.

In many parts of the world, particularly including the Asian sectors facing unreliable food and energy supplies, the future pressure for people, plants and soil are being aggravated by an uncertain climate and its coupling with biogeochemical cycles of carbon and water. In recognition of the significant contribution and urgency, the 2007 Nobel Peace prize was awarded to science; Intergovernmental Panel for Climate Change (IPCC). Yet, claims are fuelling controversy that IPCC has seriously underestimated the challenge and costs of stabilizing greenhouse-gas emissions in the 21st century (Pielke *et al.*, 2008; Schiermeier, 2008). Global energy consumption continues to grow especially in Asia, producing more greenhouse gases, severely polluting our environment, and squeezing already scarce water resources. Truly we are standing at a turning point where the risks can be minimized by developing and transferring the right scientific knowledge to society. Maintaining a basic research program and interaction between science and policy are crucial for success (Patrinos and Bamzai, 2005)

The AsiaFlux is a science community with a mission to "bring Asia's key ecosystems under observation to develop and transfer scientific knowledge to ensure quality and sustainability of life on earth." What we have achieved for the last 10 years has been already summarized by the former chair, Dr. Y. Ohtani in the previous newsletter. Therefore, here we focus on the next 10 years by refining our vision, i.e., what the AsiaFlux should be and could be. Vision comes from purpose, and purpose is established before any production. The intent for which the AsiaFlux was created, in other words, the reason why we are standing together is to:

(1) Develop collaborative researches and data sets on the cycles of carbon, water and energy in key ecosystems in Asia;
(2) Organize workshops and training on current and related global climate change themes; and
(3) Cultivate the next generation of scientists with skills and perspectives to address global climate change in Asia as informed leaders and stewards.

Our vision is a glimpse of our future that the AsiaFlux has been purposed. Hence, vision generates hope in the midst of despair and provides perseverance in difficulty. It is the foundation of our courage and the fuel of persistence.

The long-term vision of the AsiaFlux is to serve as the "science frontier" in carbon, water and energy cycles, developing and transferring scientific knowledge characterized by

(1) "Consilience" (the synthesis of knowledge in a holistic, exploratory, pluralistic and perspectival ways) (Wilson, 1999),
(2) "Contextualization" (the reformulation of scientific knowledge in social and pedagogical context by embracing its implications as well as the applications) (Nowotny *et al*., 2001), and
(3) "Cultural diversity" (standing together for the truth despite different frameworks of thought, concern and perspective, i.e., *Weltanschauung*, on sustainability options in Asia).

The short-term vision of the AsiaFlux is to

(1) Develop infrastructure for "Asian Carbon Tracking System (ACTS)," a synthesized measurement and modeling system that keeps track of emissions and removal of atmospheric CO_2 in Asia, and
(2) Provide the first report on "The Asian Carbon Budget and Implications for the Global Carbon Cycle" by 2011.

During the 17th-19th of November 2008, we will celebrate our 10 years' science, service and stewardship, by hosting the 7th International AsiaFlux Workshop, entitled "Re-thinking Global Change Science: From Knowledge to Policy," at the Press Center in Seoul, Korea. In addition to our regular science sessions, various special sessions are being organized to set an example for capacity building such as CarboEastAsia, HydroKorea, and Asian Carbon Trackers' Society (ACTSociety). As indicated by the theme title, the workshop will provide a great opportunity for scientists, policy-makers, and the public to better understand the latest scientific achievements. Furthermore, it will help develop educational, technical, and socio-economic resolutions to prevent and mitigate the risk of human-induced climate change associated with carbon, water and energy cycle in Asia.

We, the AsiaFlux, have the potential to help make the shift to a sustainable global trajectory that will ensure the survival and quality of life of humans and other species that share the planet with us. May our vision become reality and impact our generation and the generations to come. Why don't you join us to make the difference?

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The Chi-Lan Mountain (CLM) Site in Taiwan – A Long-term Ecosystem Research Site Impregnated with Fog

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The Chi-Lan Mountain long-term ecosystem research site (24°35′N, 121°25′E) was established in 2002 by the Institute of Natural Resources, National Dong Hwa University, Taiwan. This evergreen coniferous forest site is located in northeastern Taiwan at an altitude of 1400 to 1800 m a.s.l. (Figure 1). The dominant species, *Chamaecyparis obtusa* var. *formosana*, a variety of the Japanese Hinoki cypress, was one of the most valuable commercial tree species of the past decades in Taiwan due to its high wood quality. The Lithic Leptosol is poorly developed with about 90% of coarse material of metamorphic slate and quartzite. Due to the high precipitation, the soil is extremely acidic and contains little base cations below O horizon. Soil carbon stock sums up to 27.3 t C ha^{-1}, 32% of which is stored in O horizon and 48% in A horizon. The topography of this mountainous site is relative homogeneous, with an average slope of 14°.

1. Characteristics of the CLM site

The site was selected for long-term ecosystem research and for tower-based carbon budget measurement because of the relatively easy accessibility compared to most mountainous forested areas in Taiwan. The other reason for choosing this site is the particular environmental factors of the ecosystem, which might provide excellent opportunities for developing good scientific questions:

Figure 1. Location of the CLM site (indicated by * in left panel, image courtesy of MODIS Rapid Response Project at NASA/GSFC) and a photograph of the site indicating the main facilities (right panel).

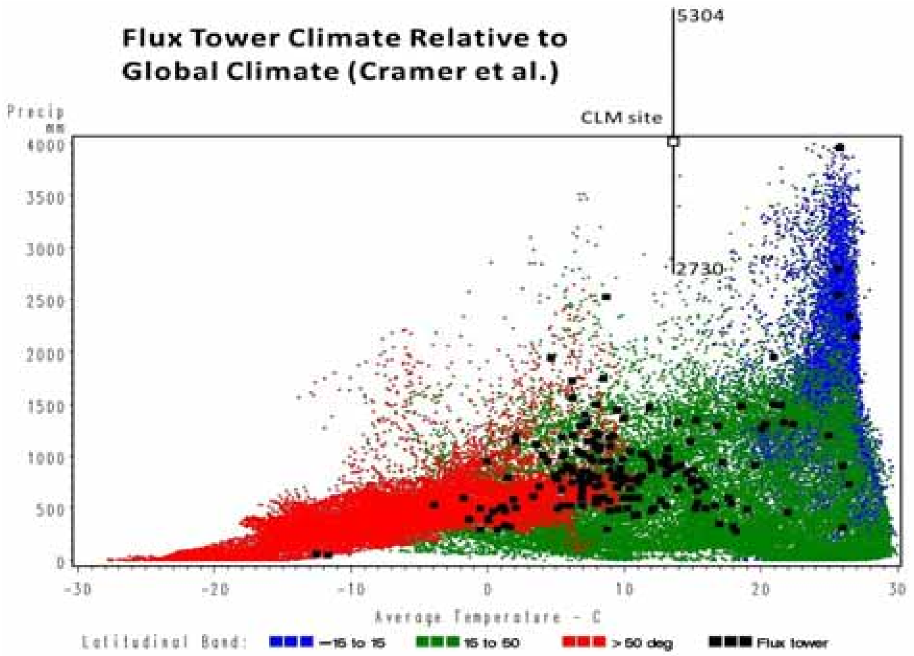

Figure 2. The annual precipitation and mean air temperature of the CLM site (2003 to 2006, indicated by the vertical line and the open square, respectively) in comparison with the other FluxNet tower sites (Modified from http://www.fluxnet.ornl.gov/fluxnet/images/Fluxnet_Climate_Sept2006.jpg).

- **Unique precipitation and temperature regime:** being situated in the subtropical mountains, the vegetation zone of the CLM site is classified as warm temperate. The annual mean air temperature is 13.5 °C, about 10 °C lower than that in the lowland area of northeastern Taiwan. On the other hand the site receives tremendous amount of precipitation. The annual precipitation from 2003 to 2006 ranges from 2730 to 5304 mm, mainly depending on the number and strength of typhoons that hit the area each year. The prevailing northeastern monsoon in winter and the summer storm also contribute to the high amount of rain. Compared with the most FluxNet sites, the CLM site is much wetter, especially in the temperature regime with annual mean temperature lower than 20 °C (Figure 2). Under such climatic condition, soil respiration is suppressed to a very low rate (Chang *et al*., 2008).

- **Fog:** Fog is the other decisive climatic factor that shapes the boundary conditions of this ecosystem. The occurrence of fog is an everyday life at the CLM site with annual number of foggy day greater than 350. During the daytime when the valley wind prevails, the advective fog forms and lasts for 4 hours in the summer months and for as high as 12 hours from late autumn to early spring. Annual fog deposition rate was estimated to be about 300 mm, which contributed about 10% of total atmospheric deposition of water (Chang *et al*., 2006) and plays a significant role in atmospheric nutrient inputs (BeiderwiedenSchmidt *et al*., 2007). Besides the "positive" effects of water and nutrient input to the ecosystem, the occurrence of fog strongly reduces solar radiation and results in a reduction of carbon assimilation (Beiderwieden, 2007).

The ecosystem studies at the site are aiming on the following goals:

- To clarify the energy, water, and nutrient cycling of the *C. obtusa* var. *formosana* forest ecosystem,
- To understand the role of fog in this subtropical montane cloud forest ecosystem, and
- To study the capacity of the cloud forest ecosystem in carbon sequestration.

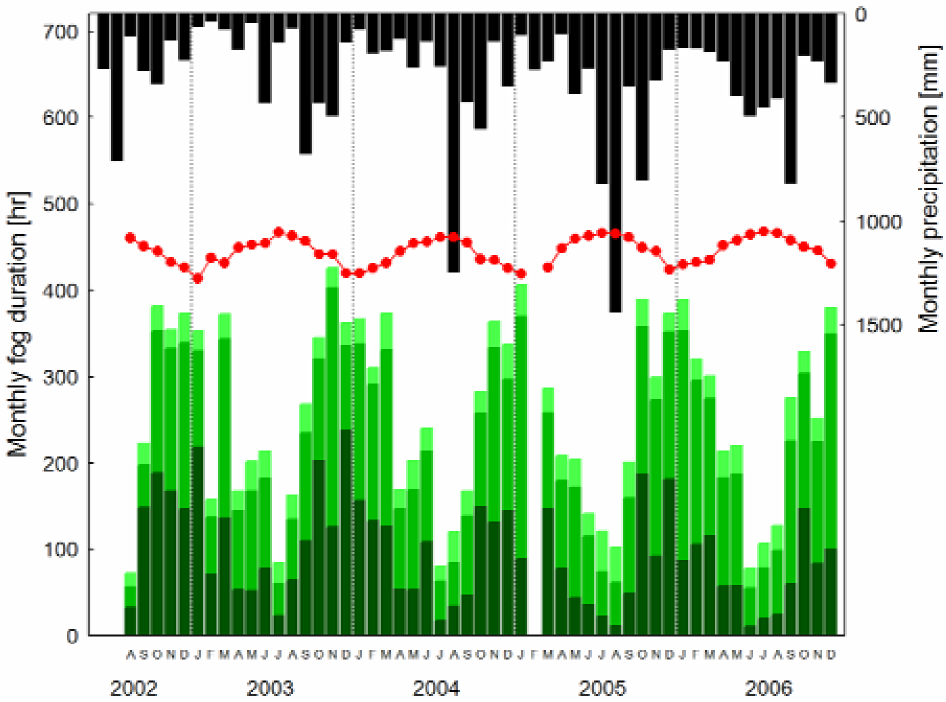

Figure 3. Monthly fog duration (dark green bar: visibility < 100 m; green bar: visibility between 100 and 500 m; light green bar: visibility between 500 and 1000 m), monthly mean air temperature (red point), and monthly precipitation (black bar) of the CLM site recorded from August 2002 to December 2006.

2. Research group

The study site is maintained by the Institute of Natural Resources, National Dong Hwa University. Besides the researchers and graduate students of this institute, several researchers from Taiwan Forestry Research Institute, Academia Sinica, and other universities are working at this site. International collaborations have been established since 2002 with two German universities.

3. Research program

3.1 Nutrient stocks

The major components of nutrient stocks in the forest were studied from 2002 to 2005, including:

- Aboveground (leaves, branches, stems) and belowground (fine and coarse root, in different depths) biomass of *C. obtusa* var. *formosana*,
- Organic and mineral layers of the soil in different depths, and
- Forest floor vegetation.

The nutrient concentrations were analyzed for C, N, Na, K, Ca, Mg, and P. In March 2008, the inventory of the site has been conducted and the increase in biomass from 2002 to 2008 will be used for the estimation of NPP.

Table 1. Long-term monitoring parameters of the CLM site.

	Monitoring parameters
Meteorology	Air temperature, relative humidity, visibility, wind speed, wind direction, wind profile, net radiation, shortwave radiation (downward, upward), long-wave radiation (downward, upward), sunshine, PAR, soil water content, soil temperature, soil heat flux, leaf wetness, CO_2 concentration profile, barometric pressure, sapflow
Nutrient fluxes	Precipitation deposition, fog deposition, throughfall, stemflow, forest floor leachate, mineral soil seepage, aboveground litterfall

3.2 Nutrient and energy fluxes

The CLM site started its monitoring program in meteorological parameters and nutrient fluxes in 2002 (Table 1). Meteorological parameters are recorded every 10 minutes and nutrient fluxes are sampled biweekly. Chemical composition of aqueous samples is analyzed for pH, electric conductivity, Na^+, K^+, NH_4^+, Ca^{2+}, Mg^{2+}, Cl^-, NO_3^-, SO_4^{2-}, DOC, and DON. Nutrient fluxes with litterfall were analyzed for C, N, Na, K, Ca, Mg, and P.

3.3 CO_2 fluxes

Two flux towers were set up for eddy covariance method including both closed-path and open-path systems. Open-path eddy covariance systems (Campbell CSAT3, LI-COR 7500) are operated on Tower 1 since 2005 and on Tower 2 since 2006. Due to the extremely humid weather condition that results in frequent malfunction of the open-path systems, a closed-path system (Campbell CSAT3, LI-COR 7000) was installed in July 2007. Objectives of the measurements are:

- Quantification of ecosystem-scale fluxes,
- Investigation of the effects of fog on ecosystem productivity, and
- Investigation of topographic effects on flux measurements.

CO_2 fluxes within the ecosystem are investigated using chamber methods. An automatic multi-chamber system (LI-COR 8100) is used for the measurement of soil respiration at high temporal resolution. Autotrophic and heterotrophic contributions to soil respiration are separated using the same system by the trench method. The photosynthesis of the *C. obtusa* var. *formosana* leaves at different canopy locations is studied using a portable photosynthesis measurement system (LI-COR 6400) on Tower 3, which was constructed in January 2007 and enables the reach of canopies of about ten *C. obtusa* var. *formosana* trees.

4. Recent publication

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Further information:

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Report on the 1st Young Scientists Meeting during AsiaFlux Workshop 2007

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AsiaFlux is the regional research network to understand carbon, water vapor and energy exchanges between the atmosphere and the biosphere in Asia. Since AsiaFlux organization has been established in September, 1999, there have been a number of activities such as AsiaFlux Training Course and AsiaFlux Workshop to share and exchange the ongoing activities and significant research findings among the related scientific communities from prospective students, early career post doctorial fellows and experienced senior scientists. However, there was no official activity to promote friendship among young scientists even though the number of the young scientists participating in the regional network is quite large. Several young scientists initiated a young scientist meeting for the purpose of active scientific exchanges and promotions of fraternity among young scientists in AsiaFlux. In an effort to encourage a strong cooperation among young scientists with a personal vision and mission to contribute to the mandated activities of AsiaFlux, Dr. Kentaro Takagi (Hokkaido University, Japan), Dr. Ming-Hsu Li (Institute of Hydrological Science, National Central University, Taiwan), Dr. Ryuichi Hirata, Mr. Keisuke Ono (Tsukuba University, Japan), Dr. Masayoshi Mano and Dr. Satoru Takanashi (Forestry and Forest Products Research Institute, Japan) organized the first young scientists meeting during AsiaFlux Workshop 2007, Taoyuan, Taiwan (http://www.asiaflux.net/youth/).

The 1st Young Scientists Meeting of AsiaFlux in Taiwan

The 1st Young Scientists Meeting of AsiaFlux was kicked off during AsiaFlux Workshop in October, 2007 in Taoyuan, Taiwan. Around 30 young scientists from 10 countries, including graduate students and post-doctorial fellows, talked about theme and objective of their ongoing studies, and shared their vision for diverse long term activities among young researchers. The meeting was supported by local secretaries for AsiaFlux Workshop 2007. We would like to give a special thanks to Dr. Yue-Joe Hsia, National Donghwa University, Taiwan and the members of Institute of Hydrological Science, National Central University, Taiwan for their support and hospitality for the successful meeting.

The meeting consisted of two sessions: in session I, the participants had a seminar with the two young invited speakers in AsiaFlux Workshop 2007, and in session II, the participants had free time to promote friendship and cultural exchanges among participants.

Session I: Firstly, participants introduced themselves one another. Continuously, two invited speakers of the AsiaFlux Workshop 2007, Dr. Chun-Ta Lai from San Diego State University, USA, and Dr. Dario Papale from University of Tuscia, Italy, participated in the meeting and presented their research activities as well as their thoughts on a researcher's life as senior scientists. They also suggested the young researchers with their exiting ideas for the young researchers for leading a successful research and peaceful life. Dr. Lai suggested how to structure life with 3 keywords: long-term view, intermediate plan and short-term management. Dr. Papale briefed about his career research and personal life and answered several questions such as what motivates him to begin the present study and how he managed when ever he thought to quit his career. After their short speeches, the participants had time to ask them questions on various issues on their research lives and research trends relating to their research topics. Especially, Dr. Papale suggested them to practice programming languages as analyzing tool and advised that without computational programming skill, it is very difficult to excel as a successful scientist in the field of flux research.

Session II: During the Session II, which was informal and face-to-face talk, the young participants shared their research interests, career opportunities, and worldviews and visions as an aspiring young scientist. They also shared the difficulties they experienced while studying and conducting the flux measurements and evaluation. The topic of their conversation covered not only scientific concerns but also the young scientists' personal life. Some of the participants mentioned the communication difficulty because of cultural tradition of hierarchy in Asian Countries, partly, has prevented young scientists from freehearted debates in the community. It led to raise the need to continue Young Scientists Meeting in AsiaFlux.

Beyond the first meeting

A current keyword in a research field is "interdisciplinary." There's no good example but AsiaFlux network which can be well-matched to the term, "interdisciplinary". Scientists with different academic background such as geophysics, geochemistry, biology, ecology, physiology and mathematics etc., with different methodologies to approach research targets, and different nationality bring together for the ubiquitous goal of understanding the exchanges of carbon dioxide, water vapor and energy between the atmosphere and the terrestrial ecosystem. Hence, sharing and exchanging ideas and scientific guidance through effective communication shall be important and desirable. However, there is difficulty for the young scientists to communicate with one another from various countries, partly, due to the tradition that modesty is regarded as the best virtue in Asian. And it is also hard for the young scientists to get a chance to participate in international conferences or workshops frequently due to cost factor, relatively compared to senior scientists. So the first Young Scientist Meeting provided the opportunity to make a suitable strategy to fill the gap among young scientists and made way to share their ideas and goals among young scientists in flux research. In regard with this, the first Young Scientist Meeting could be a start point driving young researchers to make a profound contribute to AsiaFlux.

Future plan

International collaboration is vital to reaching the goal of CO_2-flux research. AsiaFlux Workshop is one of efforts to promote international collaboration in understanding carbon and water cycle, and energy balance and in sharing existing scientific knowledge. However, such collaboration cannot be built in a day. It can be possible only through continuous efforts to build trust and friendship among the young scientists. We hope that the activity of Youth AsiaFlux shall contribute to build and enhance friendship in the context of AsiaFlux research objectives.

In a continued effort after the conclusion of the 1st Young Scientists Meeting, the Youth AsiaFlux was established under the umbrella of AsiaFlux on January 2008(Y. Ohtani, AsiaFlux Newsletter No. 24). And Youth AsiaFlux is waiting for approval of committee members of AsiaFlux. For the next two years, the authors will serve as secretaries in Young Scientists Meeting in AsiaFlux. The objective of Youth AsiaFlux is to promote friendship among Asian young flux researchers. Under this pursuing goal, specific activities will include (1) a regular meeting in regular AsiaFlux Workshop, (2) exchanging information using mailing list (youth-ml@asiaflux.net), which contains all participants' e-mail addresses in the first Young Scientists Meeting held in Taiwan, and (3) running webpage for Youth AsiaFlux to provide forum. We are planning the next Young Scientists Meeting during upcoming AsiaFlux Workshop 2008 in Seoul, Korea. We hope that many young scientists from various Asian countries will join the next meeting in Seoul. That will be a good opportunity for young researchers who have common interest in flux observation studies in Asia to build close relationship across the border.

We are always open to you. If you have any suggestions or opinions on Youth AsiaFlux, please don't hesitate to send e-mail to youth@asiaflux.net.

A Dry-battery-powered Closed-chamber System for Measuring CO_2 Efflux from Numerous Stems

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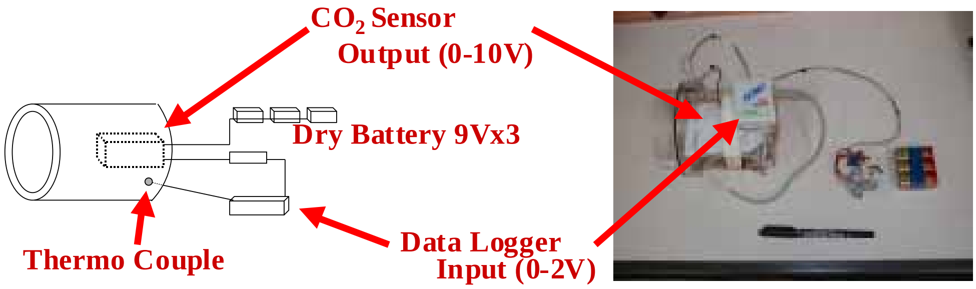

Figure 1. Overview of the dry battery-powered chamber system for measuring CO_2 efflux.

1. INTRODUCTION

Several field-based studies about CO_2 efflux from stems has been recently reported, but while many researchers use the LI-6400 or LI-820 as CO_2 sensors, these sensors are very expensive and their measurement systems have large-scale in physical structure and likely lack portability. Therefore, it has been labor-intensive to take measurements at numerous locations in wide-spread area. Thus, we developed a very light, simple, and inexpensive closed-chamber system powered by dry batteries for achieving CO_2 efflux measurements at multiple locations more easily. In this report, we validate this new system by comparing it to the calculated efflux and verify its application in conducting multi-point moving observations.

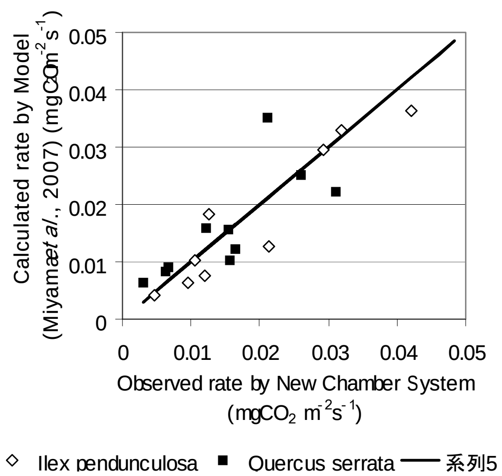

Figure 2. Validation of the new chamber system with the standard dynamic closed chamber system(Tamai *et al.*, 2008).

2. THE SYSTEM

The new system is outlined in Fig. 1. A non-dispersive infrared CO_2 sensor (eSENSE; Baron Denshi, Tokyo, Japan) is installed in an acrylic chamber with a cross-sectional area of $75 cm^2$. The sensor is powered by three 006P (9 V) dry batteries and can operate for 30 h. The output data (0–10 V) are linearly attenuated to 1/5 of its original voltage (i.e. 0-2V) and recorded with a data logger (HOBO Data Logger, Onset Computer Corp., Pocasset, MA, USA). The air temperature in the chamber can be measured and recorded. Each unit costs around $1,000 US and weighs about 800 g.

3. VALIDATION

1) Comparison to calculated efflux

Performance of the new system in making long-term measurements was tested from September 2006 to August 2007 in Yamashiro Experimental Forest (Tamai *et al.*, 2008). In other studies by Miyama *et al*. (2007), the CO_2 efflux from stems of *Ilex pendunculosa* and *Quercus serrata* was measured using a dynamic chamber system with a LI-820, and then modeled. The calculated root mean square error (RMSE) between the observed efflux with the new system and the calculated efflux based on

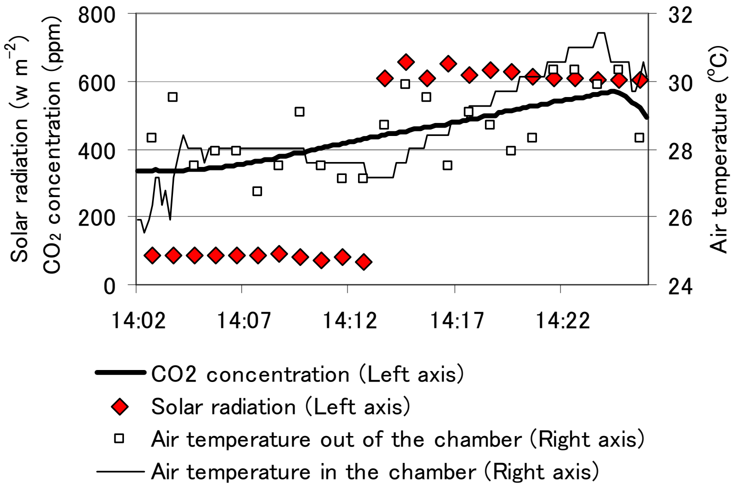

Figure. 3. The sunbeam effect on CO_2 efflux measurement with regard to stem efflux (Tamai *et al.*, 2008).

Miyama *et al.*'s (2007) model was only 0.004 $mgCO_2\ m^{-2}s^{-1}$ (Fig. 2); we conclude that the new system attain sufficient performance in precise long-term field measurements.

2) Sunbeam effect on efflux measurement

The sunbeam effect caused by air temperature increases in the chamber is known to produce experimental artifacts in the measured values. Its effect on measurements was assessed using experimental measurements performed on stem efflux from *Podocarpus macrophyllus* at Kyushu Research Center, Forestry and Forest Products Research Institute on 11 October 2007. Air temperature and CO_2 concentration in the chamber was measured in every 10 s for 24 min (Fig. 3). The chamber was shaded during the first 12 min and then exposed to sunlight during the second 12 min. During the first 12 min, solar radiation on the chamber was around 100 Wm^{-2} and an increase in air temperature was not evident. During the second 12 min, the air temperature increased about 4°C with about 600 Wm^{-2} radiation. However, the increasing rate of CO_2 concentration was almost the same between the first and the second 12 min, indicating that the sunbeam effect on the stem CO_2 efflux was

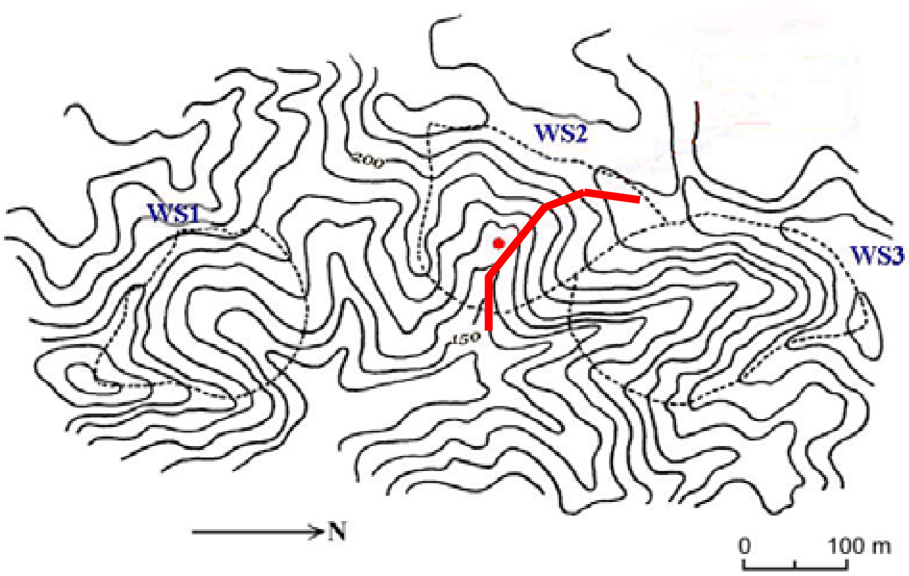

Figure 4. Topographic map of Kahoku Experimental Forest showing a 200-m transect from a valley to a ridge for stem CO_2 efflux measurements.

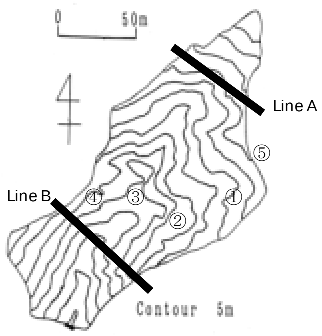

Figure 5. Topographic map showing the observation sites and transect lines for CO_2 efflux measurements on the forest floor (Tamai, 2006).

negligible.

4. APPLICATION OF THE NEW SYSTEM

1) Spatial variation of stem CO_2 efflux on a steep slope

The CO_2 efflux was measured for 126 collars at 61 stems along a 200-m transect from a valley to a ridge in Kahoku Experimental Forest, western Japan (Fig. 4). The height difference was around 60 m. The dominant species were *Cryptomeria japonica*, *Chamaecyparis obtusa*, and *Quercus glauca*. Each measurement required at least 12 min, with a waiting time of at least 5 min between measurements of different colors. The 126 measurements took about 8 h with six chambers. Measurements were made once a month between February 2006 and December 2007.

2) Spatial variation of the forest floor CO_2 efflux at the watershed scale

Forest floor CO_2 efflux was measured for 96 soil collars at sites 1–4 in Yamashiro Experimental Forest (Fig. 5) (Tamai, 2006). The relationships among the soil temperature, the soil moisture content ratio, and measured soil CO_2 efflux were expressed by single unified function despite the fact that the measured places were located in different topographical areas. To verify this function, the soil CO_2 efflux was measured for 264 other soil collars on lines A and B in the same catchment. The relative difference between the calculated and the measured soil CO_2 efflux was 24%. The time series data of daily soil CO_2 efflux were estimated by this function with the monitoring data of soil temperature and soil moisture content ratio at five locations in this catchment. These daily soil CO_2 efflux fluctuated in a similar pattern and their relative variation ranged between 50 and 140% in 1 year. The chamber used in this study was almost identical except that it was powered by AC 100 V.

3) Verification of the spatial pattern measured by the automated chamber

Environmental factors of forest floor is highly heterogeneous, and thus it is difficult to estimate representative soil CO_2 efflux value for an entire ecosystem from small number of measurements. Combination of different type of chambers is effective to investigate spatio-temporal variations in soil CO_2 efflux in heterogeneous forest floor. An automated chamber system monitored the temporal variations in the forest floor CO_2 efflux in a fixed point at site 5 in Yamashiro Experimental Forest (Tamai, 2006). The manual chamber also monitored the forest floor CO_2 efflux from the eight soil collars around the automated chamber at adequate intervals (Fig. 6). The averaged soil CO_2 efflux measured at eight soil collars was almost equal to that measured with the

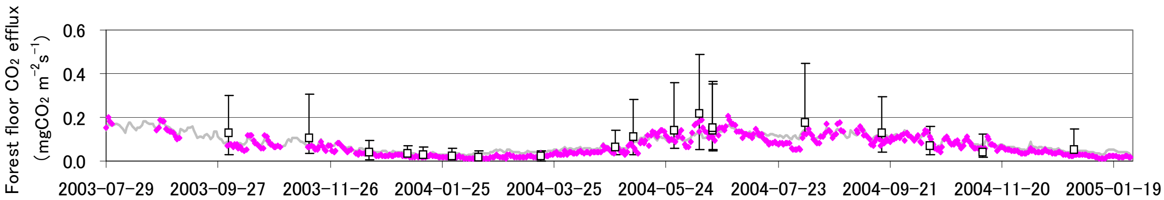

Figure 6. The monitoring of forest floor CO_2 efflux with an automated chamber (pink diamonds) and a manual chamber (white squares) (Tamai *et al*., 2008). Bars indicate the range of measured rates with the manual chamber using eight colors. Thin lines denote the calculated rates based on soil moisture and soil temperature.

automated chamber. The multi-point moving measurements taken with the manual chamber was helpful to assess the spatial variation in soil CO_2 efflux around the automated chamber. The chamber used in this study was nearly identical to that used in the stem CO_2 efflux measurements except that it was powered by AC 100 V.

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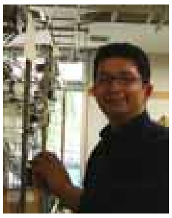
Editor's Note



AsiaFlux network now became 10 years old. But, I have a feeling that the atmosphere surrounding this network has become youthful year after year. I realized that many Asian young researchers built a strong bridge of friendship through AsiaFlux training course and “Young Scientist Meeting”. We are now at starting point. I hope that many collaborative studies will be taken up based on the friendship.

The editor of AsiaFlux Newsletter No.25:
Yoshiyuki TAKAHASHI
(National Institute for Environmental Studies, Japan)

The editor of AsiaFlux Newsletter No.26 will be Hyojung KWON (Yonsei University, Korea).