December 2004
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# AsiaFlux Newsletter

## Contents



## Message from the former Chairman of AsiaFlux

Susumu YAMAMOTO

National Institute of Advanced Industrial Science and Technology, Japan

Nearly three years have passed since I took over the chairmanship of AsiaFlux from Prof. Fukushima in April 2002 after the first joint meeting of AsiaFlux/KoFlux held in January of the same year at Jeju, Korea. During my tenure, AsiaFlux made steady progresses, despite the lack of secure funding, through variable activities and publications of quarterly AsiaFlux Newsletter and booklets with the leadership of both the steering and the executive committees and the support from the Center for Global Environmental Research / National Institute for Environmental Studies. During this period, ChinaFLUX was established under the leadership of the Chinese Ecosystem Research Network (CERN) and a joint meeting of ChinaFLUX/AsiaFlux was held at Beijing, China, in December 2003. The number of flux observation sites in FLUXNET has increased to over 200. The FLUXNET 2004 Open Workshop, which was held on December 13-15, 2004 in Firenze, Italy, with about 120 experts from six continents, was indeed a great success in promoting exchanges of ideas and technologies on flux measurement. I hope that AsiaFlux will contribute further to the development of global flux studies. With a remarkable increase in flux monitoring sites and expansion of the network on a global basis, the role of AsiaFlux has become much more significant than before. Under the circumstances that the importance of communicating information in the Asian region is increasing, I would

like to point out some challenges that AsiaFlux is facing as follows.

1) To exchange relevant information and knowledge in order to determine the dynamics of carbon cycling in terrestrial ecosystems and to share data obtained from flux observation studies in East and Southeast Asia.
2) To establish a scientific consortium based on AsiaFlux (Japan), KoFlux, and ChinaFLUX, and with the cooperation of OzFlux, in order to discuss important issues mentioned above.
3) To meet the demand for the growing interests in carbon cycle in Asian forests with more exchange on methods of flux measurement and training courses.
4) To compare results obtained from tower-based flux measurement during calm nights, satellite based-carbon balance analysis, and ecosystem-based model calculation, and scale up the results based on different methods in cooperation with FLUXNET.

These pending issues that I left are very complicated. I agree with Prof. Fukushima, the first chairman, who mentioned that the goal of AsiaFlux should be regarded not only as a community of distributing data but also as a productive network in creating new concepts, methodologies and knowledge for flux measurement, which IBP (International Biological Programme) has been doing.

I hope that AsiaFlux activities will progress considerably under the leadership of the new chairman, Dr. Ohtani, in cooperation with both young and senior researchers.

## Message from the Chairman of AsiaFlux

Yoshikazu OHTANI

Forestry and Forest Products Research Institute, Japan

Ever since AsiaFlux was established in 1999, the first and the second chairmen, Prof. Fukushima and Dr. Yamamoto respectively, provided an excellent leadership to advance the exchange of flux research information among researchers in Asian and other countries, through organizing AsiaFlux workshops in Japan, Korea and China, and publishing 11 issues of the AsiaFlux Newsletter and the manuals on flux measurement. A web site was also created (http://www-cger2.nies.go.jp/asiaflux/). During the past five years, the circumstances around AsiaFlux considerably changed: These include the establishment of Koflux (AsiaFlux Newsletter No.6), and ChinaFlux (as part of the "Research project on carbon budget in terrestrial/coastal ecosystems in China" by representative of CERN) in 2002 (AsiaFlux Newsletter No.4). The current issue of "How should AsiaFlux contribute to the flux community as a regional network of FLUXNET" was discussed by both the steering and the executive committees in order to formulate a new flux network in Asian countries. One idea was that AsiaFlux must be an umbrella to lead flux communities in Asia and a new domestic network in Japan be created under the umbrella of the AsiaFlux.

Under these circumstances, I undertook the chairmanship of AsiaFlux. I sincerely recognize my solemn duties and responsibilities for this challenging position. I would like to commend the former chairmen for their earnest efforts to develop the AsiaFlux activities and I look forward further to the cooperation of reappointed committees and the AsiaFlux members to achieve our goals.

The followings are the brief minutes of the 16th AsiaFlux Executive Committee Meeting, which was held in December, 2004.

**[New AsiaFlux Administrative system]**

**Members of the Steering Committee**

Chairman: OHTANI, Yoshikazu
(Forestry and Forest Products Research Institute, Japan)
Vice-chair: KIM, Joon (Yonsei University, Korea)
Committee members:
(Alphabetic order)
*FUJINUMA, Yasumi
(National Institute for Environmental Studies, Japan)
*FUKUSHIMA, Yoshihiro
(Research Institute for Humanity and Nature, Japan)
*HARAZONO, Yoshinobu
(University of Alaska Fairbanks, USA)
*HIRANO, Takashi
(Hokkaido University, Japan)
*INOUE, Gen
(National Institute for Environmental Studies, Japan)
*KIDA, Hideji
(Kyoto University, Japan)
*KOIZUMI, Hiroshi
(Gifu University, Japan)
*LEE, Byonglyol
(Meteorological Research Institute, Korea)
*LEE, Dongho
(Yonsei University, Korea)
*MIYATA, Akira
(National Institute for Agro-Environmental Sciences, Japan)
*MONJI, Nobutaka
(Osaka Prefecture University, Japan)
*OIKAWA, Takehisa
(University of Tsukuba, Japan)
*TANI, Makoto
(Kyoto University, Japan)
*YAMAMOTO, Susumu
(National Institute of Advanced Industrial Science and Technology, Japan)

**Members of the Executive Committee**

(Alphabetic order)
*FUJINUMA, Yasumi
(National Institute for Environmental Studies, Japan)
*INOUE, Gen
(National Institute for Environmental Studies, Japan)
*LIANG, Naishen
(National Institute for Environmental Studies, Japan)
*MIYATA, Akira
(National Institute for Agro-Environmental Sciences, Japan)
*OIKAWA, Takehisa
(University of Tsukuba, Japan)
*OHTANI, Yoshikazu
(Forestry and Forest Products Research Institute, Japan)
*SAIGUSA, Nobuko
(National Institute of Advanced Industrial Science and Technology, Japan)

**Secretariat**

INOUE, Gen (Secretary-General),
FUJINUMA, Yasumi
INUKAI, Ko
ARIHARA, Yoko

**[AsiaFlux Active Plan]**

1) The 4th AsiaFlux Workshop (Tentative title) in May 2005
2) Issue of AsiaFlux Newsletter No12 in January 2005

**[Future Activities]**

* Reorganize of AsiaFlux system
* Renewal of AsiaFlux web page

# Report on the 13th International Congress of Photosynthesis

Naishen LIANG

National Institute for Environmental Studies, Japan

Photosynthesis supplies most of the energy required for life on Earth and is the ultimate source of most of the energy used to power human civilization. Photosynthesis processes of leaves have a remarkable influence on our global atmosphere. A better understanding of leaf level gas exchange processes is therefore important in the context of global climate change. The International Congress of Photosynthesis offers special opportunities, once every three years, to meet with top international photosynthesis researchers from government, industry and academia with a vast range of interests and expertise. The 13th International Congress of Photosynthesis was held from August 29 to September 3, 2004 in Montreal, Canada with the theme of "A fundamental knowledge of photosynthesis leading to improved plant productivity and a balanced global climate." The main work of the conference was, of course, the understanding of photosynthesis at all levels of inquiry. Thus, the conference provided a forum for researchers investigating all aspects of photosynthesis and highlighted cutting-edge progress toward our understanding of the most critical energy conversion process on Earth. Research on the scale of single molecule and femtoseconds were discussed together with research encompassing the entire biosphere and millions of years, and everything in between.

About nine hundreds participants enjoyed the conference with thirty-two symposium sessions focusing on a number of specific topics within each of the following broad areas:

1. Antenna and Reaction Centres
2. Electron and Proton Transport, ATPase
3. Carbon Assimilation and Biosynthesis
4. Stress, Adaptation and Regulation
5. Agriculture and Biotechnology
6. Ecology, Environment and Global Perspectives

The new millennium has come with an acute international awareness of the effects of elevated $CO_2$ on global climate, and photosynthetic organisms have not been confronted with levels of $CO_2$ as high as present day for over 10 million years. Their individual responses to the continued increase in $CO_2$ are amazingly varied and just beginning to be understood. This issue is at the heart of photosynthesis research, and the ramifications are crucial to both the primary productivity of the biosphere and global climate. The 13th conference provided an opportunity for top international researchers to discuss photosynthesis and climate change solutions.

The opening morning session of the conference was focused on a global perspective of photosynthesis with two public plenary talks dedicated to this theme. Christopher B. FIELD of Stanford University highlighted the two controls on global scale photosynthesis. One is the amount of light that is harvested. The second is the efficiency of light utilization. Most of the past researches on global photosynthesis has focused on quantifying the former, especially using satellite data. Though the challenges of this research are still far from resolved, it is increasingly important to improve the techniques for quantifying large-scale efficiency of light utilization. The potential for increased understanding of the earth system from improved estimates of global photosynthesis is vast, with immediate relevance to climate and ecosystem dynamics. Moreover, ecologists increasingly understand enough about mechanisms to ask deep questions about photosynthesis and not only primary production, but also biodiversity. Susanne Von CAEMMERER of the Australian National University presented the environmental influences on C4 photosynthetic responses. C4 plants include some of the world's most important crops such as maize, sorghum and sugarcane, as well as many economically important weed species. Also, C4 grasslands form an important component of the global carbon cycle. The C4 photosynthetic

pathway, a recently evolved elaboration of the C3 photosynthetic pathway, allows $CO_2$ to be concentrated at the site of Rubisco carboxylation. She used molecular manipulation to improve the mathematical model for predicting and assessing the role that Rubisco plays in shaping C4 photosynthetic responses under different environmental conditions.

Followed were symposia and discussion sessions on global carbon and climate change solutions. Evan H. DELUCIA of Urbana University qualified the key role of forests in the global carbon cycle; due to the fact that forests contribute more than half of global net primary production and approximately 90% of terrestrial productivity. By using free-air $CO_2$ enrichment technology to expose plots within intact forests to the level of $CO_2$ anticipated in 2050, it was discovered that net ecosystem production (NEP) and net primary production (NPP) in loblolly pine and sweetgum forests were substantially increased. To partition net ecosystem exchange (NEE) into its component photosynthetic and respiratory fluxes, Russell K. MONSON of University of Colorado analyzed data obtained from several of the AmeriFlux sites by utilizing stable isotopes of $CO_2$ ($^{13}CO_2/^{12}CO_2$ ratio) in the air above the forest canopies as well as modeling approaches. They observed that differences among forests in their ability to assimilate $CO_2$ as a function of temperature were attributable to consistent differences in the partitioned temperature dependence of photosynthesis and respiration.

Naishen LIANG of the National Institute for Environmental Studies, Japan, impressed the conference attendees by presenting data obtained from the AsiaFlux sites, especially carbon flux components including foliage photosynthesis/respiration, wood $CO_2$ efflux and soil $CO_2$ efflux of forest ecosystem achieved using multichannel automated chamber systems.

The scientific program of the conference was delivered for five full days, and included many opportunities for interaction at different levels. Most of the presentations were concentrated on the basic studies, particularly photosynthetic systems and reaction centers. Research ideas and data were disseminated and discussed via plenary talks, symposia, discussion and poster sessions.

## Report on the Carbo/HydroKorea Internal Workshop on Nov. 5, 2004

Joon KIM and Dongho LEE

Yonsei University, Korea

**1. Introduction**

KoFlux is a regional Korean network of long-term micrometeorological flux measurement sites, launched in 2001 by networking individual research sites and the limited available resources in Korea to support AsiaFlux, the Asian arm of FLUXNET. During the phase I (2001 ~ 2004), the KoFlux team developed a regional network, managing overseas as well as domestic flux sites such that KoFlux data could be collected locally and shared anywhere. Upon successful completion of the phase I, the participating researchers and students realized a necessity of more in-depth and multidisciplinary approaches to water/carbon cycles for a typical - complex, mountainous - landscape of the country. CarboKorea and HydroKorea are the core research efforts thus created as an upgraded and expanded successor of KoFlux. Each project has its own funding source and uniquely pursues carbon (CarboKorea, from 2004 to 2008) and water (HydroKorea, from 2004 to 2007) cycles from tower to regional scales. CarboKorea and HydroKorea may progress independently but the outcome will eventually put together and serve to characterize terrestrial carbon/water cycles based on a unified logical framework. Carbo/HydroKorea ultimately aims to derive accurate assessments of carbon/water cycles on terrestrial ecosystems at diverse spatial/temporal scales. For this, researchers focus on linking flux footprint, ecohydrologic schemes and satellite images to bridge the gaps between different scales of carbon/water exchange processes in a complex landscape. Scaling

logic that incorporates a synergy of field measurements, remote sensing and numerical modeling will play a central role to achieve this goal and will be one of the practical deliverables.

A major difference between the 1st phase of KoFlux research and its successor is the establishment of the supersite where multi-disciplinary, coordinated research effort such as field measurements, numerical modeling and satellite image analysis are conducted. The Kwangneung flux site, where a flux observation tower has been operated since the beginning of KoFlux and ecological and hydrological information have been monitored for more than 10 years, is selected as a representative landscape of the country and becomes the center of the multi-disciplinary researches (Figure 1). For this, the Kwangneung supersite is re-defined as a 7 x 7 km (MODIS) unit that includes the flux towers. Within this MODIS unit, a 3 x 3 km intensive monitoring unit is designated. The unit is further subdivided into nine 1 x 1 km basic units, comparable to the scale of MODIS grid, that become the basic component of intensive field monitoring, modeling and image analysis studies. The results obtained from the supersite will form a primary database for quantitative assessments of carbon/water cycles at various scales.

On 5 November 2004, the first internal workshop of Carbo/HydroKorea was held at Yonsei University, Seoul, Korea to provide for the participating researchers an opportunity to better understand the logical framework of the project and to evaluate the current progress. Over 30 researchers joined the workshop to take full advantage of this opportunity to brainstorm their progresses and problems. The meeting started with an announcement by Joon KIM of Yonsei Univ. (the principal investigator of both projects) addressing the vision and objectives of both projects and the importance of coordinated efforts beyond the disciplinary boundaries. The subjects discussed in the workshop include most of the major components of the project such as field measurements, GIS and satellite image analysis, and data management and international cooperation. This report is a brief summary of the workshop to share information discussed in the meeting with researchers working on relevant areas in AsiaFlux community.

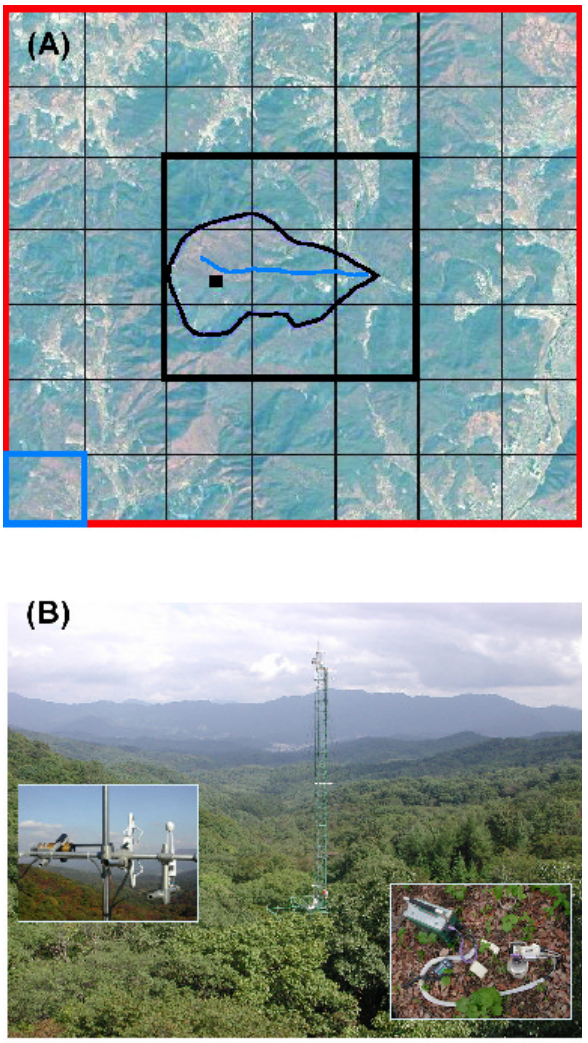


**Fig. 1 Images of the Kwangneung supersite showing (A) the location of the flux tower (solid square), 1 x 1 km basic unit, catchment boundary, and the 3 x 3 km intensive monitoring unit, (B) the landscape with the flux tower. Insets are the eddy covariance system and the measurement of soil $CO_2$ with a portable dynamic closed path chamber.**

## 2. Field Measurements

Carbo/HydroKorea supports a large group of researchers working on field-based measurements such as soil $CO_2$, hydrology, tower fluxes, stable isotopes and ecological measurements. Researchers working on these areas constitute a major component of Carbo/HydroKorea project, producing quality data to be used for input parameters of various ecohydrological models and for validation of model results and satellite-derived data.

The tower flux measurement, conducted by the group led by Joon KIM (Yonsei Univ.), is by far the most fundamental part of Carbo/HydroKorea project. At Kwangneung supersite, a 40 m tower equipped with two eddy covariance systems (at 19 and 40 m height) is operational and collects 10 Hz and 30-minute flux data from dominantly broadleaf, deciduous forest. Additionally, slow response meteorological data are also being collected. The Kwangneung site is currently undergoing a major augmentation which includes (1) setting up a new flux tower at evergreen needleleaf forest, (2) adding an 8-level sampling system to each tower for better assessment of storage term and footprint. One of the persistent problems pointed out with increasing field measurements is the lack of consolidated quality control and data processing protocols, which will have to be accomplished in the near future.

Soil $CO_2$ teams are co-led by Yowhan SON (Korea Univ.) and Jae-Suk LEE (KonKuk Univ.). The main interests encompass continuous measurement of soil $CO_2$ efflux with automated chambers (i.e., automatic opening and closing chamber, AOCC), mechanistic understanding of soil $CO_2$ production and microbial activities, and spatial measurement of soil $CO_2$ with a portable dynamic closed path chamber. Some of the highlights in the findings of soil $CO_2$ group are: (1) the AOCC has proved to be a reliable system producing soil $CO_2$ efflux with least disturbance, (2) long-term measurements by AOCC enable evaluations of temperature and precipitation dependency of soil respiration which can provide an important gap-filling technique, (3) inter-comparison between AOCC and dynamic closed path chamber data (LI-6400) shows a good agreement in the range of 600 ~ 800 mg $CO_2$ $m^{-2}$ $h^{-1}$, and (4) soil $CO_2$ data measured during monsoon seasons led to an important finding on the role of precipitation on annual carbon emission. Soil respiration appears to be affected more to the charateristics of rainfall events such as intensity and duration than to the absolute amount.

Hydrological observation at the supersite is a new and challeging task led by Nam-Chil WOO and Sankey MOOM (Yonsei Univ.) in collaboration with Jong-Whan LIM and Kyung-Ha KIM (Korea Forest Research Institute). The main focus is to confirm the closure of water budget at catchment and plot scales. For this, monitoring of hydrologic components is being conducted such as precipitation, interception, discharge, evapotranspiration and groundwater recharge. A plot level water balance is also investigated by characterizing a vertical movement of water fluxes such as throughfall, infiltration, soil moisture change and groundwater recharge. A thorough investigation of catchment geology is prerequisite to characterize subsurface hydrological processes. Such results will provide important gap filling information.

Stable isotope study is another new component of Carbo/HydroKorea project, led by Dongho LEE (Yonsei Univ.). The study ultimately aims to partition carbon/water fluxes and produce gross primary production (GPP), ecosystem respiration (ER) and evaporation (E) for validation of eco-hydrological models. The stable isotope study consists of (1) tower (footprint) scale water/carbon cycling such as constraining GPP, ER and E, and (2) watershed scale water/carbon flux partitioning such as long-term evaporation and transpiration fluxes. Developing new techniques of sampling and isotope analysis, and improving equations for GPP, ER and E are major challenges we are facing with.

**3. GIS/Satellite Image Analyses**

Site characterization is a necessary component of Carbo/HydroKorea research as the spatial extent (source area) of measured fluxes needs to be quantified. The spatial structures of potential flux indices (e.g., NDVI, crown closure) are being characterized by geo-statistical techniques such as semivariogram and window size analysis. Sankey MOON (Yonsei Univ.) is in charge of analyzing the supersite in terms of spatial distribution of important ecological and geographical components. GIS and high resolution satellite images such as IKONOS and Landsat TM are being used to produce spatial variables to be used for eco-hydrological models and for validation of MODIS products.

The regional scale carbon/water cycles that

Carbo/HydroKorea aims to describe practically depends on a reliable interpretation of low resolution satellite images (MODIS). This part of research is led by Sinkyu KANG (Kangwon Univ.). MODIS 15 (LAI, FPAR), 16 (ET) and 17 (GPP) images provide regional scale eco-hydrological data that can be used to predict and describe carbon/water cycles. Improving MODIS algorithm through validation by field-based and model-derived data is one of the key parts of Carbo/HydroKorea project.

Two other main components of Carbo/HydroKorea project remained to be discussed (not presented at the workshop) are eco-hydrological modeling and flux scaling (footprint analysis). Biome-BGC and RHESSys are being used to quantitatively predict water/carbon cycling in the study area primarily led by Sinkyu KANG (Kangwon Univ.) and Dowon LEE (Seoul National Univ.). The results of eco-hydrological models should be validated by the field data and the improved algorithm of the models subsequently used to validate GPP, ET data produced from low resolution satellite images. Likewise, various footprint models are being tested for their applicability to the complex landscape of Kwangneung supersite by Jinkyu HONG (Yonsei Univ.).

**4. Data Information System and International Cooperation**

As Carbo/HydroKorea plans to be a research cluster serving for domestic and international needs, a data information system (DIS) needs to be devised. Byonglyol LEE (Korea Meteorological Administration) currently works on developing an IT framework based on GRID technology. Through this protocol, valuable data and technologies developed from Carbo/HydroKorea can be shared and transferred to others. International cooperations led by Joon KIM (AsiaFlux, FLUXNET, CEOP, GTOS), Nam-Chil WOO (CUAHSI, Consortium of Universities for the Advancement of Hydrologic Science, Inc., "http://www.cuahsi.org") and other members are another important part that Carbo/HydroKorea serves for scientific advances and public demands.

**5. Concluding Remarks**

In summary, Carbo/HydroKorea serves as a 'pathfinder' that will lead us to the development of new methodologies to assess carbon/water cycles at diverse temporal/spatial scales. Qualified researchers from widely varying disciplines such as micrometeorology, forestry, ecohydrology, biogeochemistry, plant physiology, remote sensing, biophysical modeling have joined this project to achieve the goal. Ultimately, Carbo/HydroKorea will contribute significantly to our understanding of carbon sources and sinks in terrestrial and marine ecosystems, improve our ability to predict the adaptability of ecosystems to current global changes, and aid decisions of the global community in the context of the Kyoto protocol. Carbo/HydroKorea will pave the way to the practical application of the technologies to answer the pending scientific and socio-economic questions in relation to current global changes. Phase III of the program (will be designated as Carbo/HydroAsia) will use the 'scaling logic' methodologies developed during Phase II (Carbo/HydroKorea) to apply and to monitor accurately the carbon and water cycles from local to regional scales, thereby proactively providing options needed to minimize damage and to allow and encourage sustainable use of our biosphere. Through stronger partnerships and collaborations with flux communities in Asia and other continents, we plan to thrive in the years ahead, continuing to make powerful and useful contributions to the global scientific community.

**Acknowledgment:** CarboKorea is supported by "The Eco-Technopia 21 Project" from the Ministry of Environment, Korea and HydroKorea is supported by a grant (code: 1-8-2) from Sustainable Water Resources Research Center of 21st Century Frontier Research Program.

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# Regional Carbon Budgets: from Methodologies to Quantification

Pep CANADELL* and Penelope CANAN**

*Global Carbon Project, Canberra International Office, Australia

**Global Carbon Project, Tsukuba International Office, Japan

There exist multiple efforts to develop approaches for national, regional, and sectoral carbon budgets. They constitute fundamental tools assisting reporting obligations and policy development under the broad mandate of the United Nations Framework Convention on Climate Change (UNFCCC). However, the use of these budgets as bottom-up constraints for estimating carbon sources and sinks, and their comparability are limited because elements and assumptions differ substantially among budgets. Some terrestrial budgets include land-use change and fossil fuel emissions, while others focus only on natural ecosystems, ignoring direct human activities; some are based mainly on primary data (such as a forest inventory) while others depend on process-scale model simulations constrained by measurements of stocks and fluxes. The underlying socio-economic drivers of important carbon fluxes are rarely coupled to regional carbon budgets, and their use for policy applications varies enormously depending on their spatial and temporal resolutions.

The Global Carbon Project, a joint project of the Earth System Science Partnership (IGBP, IHDP, WCRP, and DIVERSITAS) organized a workshop on "Regional Carbon Budgets: From Methodologies to Quantification," 15-18 November 2004 in Beijing, China. The meeting was the first international gathering (25 countries) of this nature to discuss the state of development of regional and national dynamic carbon budgets. The main goal of the workshop was to foster harmonization of existing approaches with the purpose of:

- comparing regional budgets and their components in order to gain insights on global patterns and variability of carbon fluxes and stocks;
- using regional carbon balance estimates to constrain global estimates (multiple constrain approaches with bottom-up and top-down measurements);
- promoting coordinated development of robust carbon budgeting systems for a number of space and time scales;
- moving towards the development of a capability to manage the coupled carbon-climate-human system with comprehensive, quantitative, and multi-disciplinary approaches.

The workshop identified a number of key components required for scientifically robust approaches to dynamic regional carbon budgets. Some of these elements are:

- Comprehensiveness, that is, all sectors should be included in the analyses with both vertical and lateral transport of carbon (e.g., forest, grasslands, agriculture, fossil fuel, riverine transport);
- Dynamic in time, a) retrospectively to build robustness by using the methods based on past data, and b) forward modelling to explore future scenarios;
- Spatially explicit at scales which are relevant a) to policy needs and b) that allow the use of top-down measurements (e.g., atmospheric $CO_2$ inverse fluxes) to constrain quantities. It is likely that no single approach can deliver all requirements, but flexible scaling up and down tools are encouraged;
- Integration of uncertainty analyses of data used for parameter estimation;
- System boundaries. The ultimate goal is to fully integrate both anthropogenic (e.g., fossil fuel emissions) and biospheric carbon sources and sinks in one single dynamic system.
- The system requires enough process level understanding of the controls of various fluxes to enable identification and quantification of control points for the purpose of climate mitigation.

One of the major outcomes of the workshop was the realization that regions around the world are still very far from a carbon accounting system such as the one described above. Twelve regions presented the current state of development which showed clearly the need for major research development over this coming decade, a research agenda that the GCP is committed to pursuing. More encouraging were some of the developments in coupling biogeochemistry modelling, management practices, and economics in order to design portfolios for carbon mitigation with principles of sustainable development.

The workshop in Beijing was also the venue for the announcement by the Chinese scientific community of their commitment to contribute to international efforts in studying the carbon cycle and to establish a formal contribution to the GCP. For this, the Chinese Academy of Science and the Institute of Geographical Sciences and Natural Resources Research will establish an affiliate office of the GCP in Beijing with the mandate to coordinate national carbon research in China and play a role in the Asia region by promoting coordination, data management, and capacity building.

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# Report on the FLUXNET 2004 Open Workshop; Celebration 10 years since La Thuile and Planning for the Future

Susumu YAMAMOTO*, Akihiko ITO**, and Akira MIYATA***

*National Institute of Advanced Industrial Science and Technology, Japan
**Frontier Research Center for Global Change, Japan
***National Institute for Agro-Environmental Sciences, Japan

The FLUXNET 2004 open workshop was held on 13-15 December 2004, in Firenze, Italy, for Celebrating 10 years since La Thuile and Planning for the Future. FLUXNET is a "network of regional networks" for coordinating regional and global analysis of observations from micrometeorological tower sites. The first FLUXNET workshop was kicked off in 1995 at Lathuile, Italy, followed by the second workshop in 1998 at Polson, Montana, USA, the third in 2000 at Marconi, CA, USA, and the forth in 2002 at Orvieto, Italy.

The workshop was organized by the local organizing committee and the steering committee, and the conveners were D. Baldocchi and R. Valentini. The goals of the workshop are to:

1. Convene an open meeting of FLUXNET participants to facilitate communication and interaction among active scientists,
2. Produce an overview of recent findings,
3. Form a bridge for linking FLUXNET with new and emerging activities in bioscience,
4. Organize and strategize for the present and future operation of FLUXNET,
5. Position us as a system for being integrated into regional and global studies of the terrestrial carbon cycle, and
6. Produce a special Issue of *Global Change Biology* based on thematic overview lectures.

More than 100 participants attended the workshop from around 20 countries including 7 flux researchers from Japan. At the beginning, R. Valentini delivered the opening greeting and introduction.

In the following session titled as "Science of FLUXNET", D. Baldocchi made a speech entitled "Fluxnet Overview, Successes, Failures, New Surprises", and several lectures were made by B. Cook on "Fluxnet Data Archive", A. Dunn on "Fluxnet and Interannual Variability", S. Running on "Fluxnet and Remote Sensing", P. Ciais on "Fluxnet and regional carbon flux modeling", A. Friend on "Fluxnet and Global Carbon Modeling", M. Falk on "Scaling Carbon and Water Fluxes with Remote Sensing Indices", Y. Malhi on "Fluxnet and Biogeography", J. Grace on "Fluxnet and Ecosystem Dynamics", and H. Dolman on "Fluxnet and Ecohydrology".

In the second session titled as "Present Status: Operation of Fluxnet, Status of Regional Networks", presentations were made by B. Law from "AmeriFlux", R. Valentini from "CarboEuroflux", M. Cao from "ChinaFlux", S. Yamamoto from "AsiaFlux", C. Coursolle from "Fluxnet-Canada", J. Beringer from "OzFlux", and N. Hanan from "AfriFlux", C. Ranbow from "Latin America". At present, over 266 tower sites are being operated by the regional networks on a long-term and continuous basis.

In the third session entitled as "The Future, FLUXNET and new Technologies", exciting reports were made by T. Dawson on "Isotopes and networks of wireless sensors", F. Miglietta on "Aircraft, flux transects and pbl budgets", and N. Liang (from AsiaFlux) on "New sensors for soil respiration".

During the later half of the workshop, breakout sessions were held for syntheses of the results obtained from various biomes such as Savanna, Tropical forests, Temperate forests, Conifers, Grasslands/Crops, Urban/Suburban and Wetlands/Tundra. Furthermore, another breakout sessions were presented for new issues in the future: Fluxnet and Biogeography, Fluxnet and Ecohydrology, Fluxnet and Global Carbon Modeling, Fluxnet and New Technology. After these sessions, integrated discussions were made in a plenary session earnestly based on the reports of breakout sessions.

**Photo. 1 The plenary session (provided by Y. Ohtani)**

Throughout the meeting period, many contributed posters were presented and frank discussions were carried out by authors and participants.

The meeting closed in the late afternoon on Dec 15, after concluding discussion on the syntheses papers and remaining issues for the future studies. After this exciting workshop, some participants visited and enjoyed the beauty of historical places in Firentze.

At the end of this report, we'd like to introduce impressions of the authors on each interesting issue.

From the viewpoint of carbon modeling, it was impressive that many researchers focus on the importance of "data assimilation", in which flux and remote

sensing data are integrated into a single model-system sequentially through time. Such data assimilation systems will be necessary for evaluating and forecasting regional carbon budget, as emphasized also in the Global Carbon Project. Several keynote speakers (e.g., S. Running, P. Ciais, and A. Friend) discussed about the efficiency of flux data for global carbon researches. However, in the working group of global carbon modeling, members confronted a problem that more than half of the flux observation data have not been reported yet (even less data have been reported from Asia). It was also a matter of problem that there is a large discrepancy of spatial scales between flux measurement and global modeling. It is apparent that further collaboration between modeling and flux observation is required. For example, the comparison of interannual variability in NEE between observation and model estimation will be an interesting starting point. It was especially interesting to find out the effect of European heat wave in summer, 2003 on both vegetation and soil processes. Moreover, we should address other complicated problems concerning the impact of disturbances, carbon-water linkage, carbon-nitrogen interaction, and so on.

We were very impressed by the FLUXNET, especially CarboEuroflux, paying considerable attention to grassland ecosystem. It was shown that grazing grasslands act as sources of greenhouse gases (GHGs) if fluxes of nitrous oxide ($N_2O$) and methane ($CH_4$) are taken into account. However, it is difficult to discuss $N_2O$ and $CH_4$ fluxes at the same level as $CO_2$ flux because the former are measured with chambers. Improvement of flux measurement techniques of these gases is desired. In the synthesis report from the wetland/tundra group, the presenter emphasized the importance of $CH_4$ flux monitoring. It is well known that $CH_4$ exchange is crucial when we discuss budgets of carbon and GHGs in wetlands. However, long-term studies of $CH_4$ flux at wetlands are very rare, except for chamber-based studies, because of limited electric power and the difficulty in transporting novel instruments. New devises for $CH_4$ flux measurement with low power consumption are highly required. There are a few poster presentations on the use of $^{13}CO_2$ in FLUXNET. One of them is isoflux measurement by use of relaxed eddy accumulation method, and another is partitioning of daytime NEE into respiratory and photosynthetic fluxes by the procedure proposed by Bowling et al. (2003). As is pointed out in the workshop, this field of study is highly promising, and will advance much if analysis of $^{13}C$ in the field is realized.

During the meeting, S. Yamamoto reported the plan of 4th AsiaFlux Workshop (Tentative title) to be held in May, 2005 in Japan, new action plan of AsiaFlux and introduced the new Chairman of the AsiaFlux Steering Committee, Yoshikazu Ohtani of Forestry and Forest Products Research Institute, Japan. We think that the activities of AsiaFlux should be more organized one with own funding, and synthetic analysis of the results obtained in AsiaFlux will be needed to clear the remaining issues and the breakthroughs with collaboration of young and senior researchers. We felt strongly that we share common issues and goals with FLUXNET groups through this meeting. We were very happy to attend the meeting and to share the atmosphere with the FLUXNET colleagues. We would like to express our gratitude to R. Vallentini and other staff for their excellent contribution to the workshop.


**Photo. 2 Y. Ohtani(left), the chairman of AsiaFlux, and S. Yamamoto(right), the former chairman of AsiaFlux**

# Damage by Typhoon 200418 at Sapporo-site, FFPRI Flux Net

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A tropical storm "Typhoon 200418 (SONGDA)" overpassed on September 8, 2004 the western seaside of Hokkaido which is Japan's northernmost main island. And the strong wind attacked the southwestern district of Hokkaido. The maximum instantaneous wind speed of over 50 $ms^{-1}$ was observed in the Sapporo local meteorological observatory. The strong wind widely damaged forests in this area. Similar to this tragic event, just 50 years ago, Hokkaido island had been attacked by a strong typhoon.

The Sapporo-Hitsujigaoka Experimental Forest managed by Hokkaido Research Center, Forestry and Forest Products Research Institute (FFPRI) was largely affected by the wind. The 41-m high flux towers (42° 59' N, 141° 23' E, 180m ASL) operated by FFPRI FluxNet (Ohtani et al., 2001) also collapsed during the storm (Photo 1). The instantaneous wind velocity exceeded horizontally 30 $ms^{-1}$ and vertically 10 $ms^{-1}$, which were the final records from the 3-D sonic anemometer.

**Photo. 1 The main tower folded down.**

The experimental forest is a mixture of various broadleaf species with an area of 1.5 $km^2$, regenerated after a fire. The forest is just at the transitional stage from mature birch (*Betula platyphylla*) to subclimax species consisting of Mizunara oak (*Quercus mongolica*), Painted maple (*Acer mono*), Caster aralia (*Kalopanax pictus*), and etc., (Nakai et al., 2003). Thus, we aim to integrate the ecological and the meteorological researches and to model the carbon cycles and exchange including the forest dynamic transition (Watanabe et al., submitted).

A large part of the forest was visibly damaged by the typhoon. Many white birch, Mizunara oak, and other broadleaf trees around the towers were uprooted or snapped off (Photo 2). An area-based ratio of broken crown was estimated from the difference in canopy-surface height between pre- and post-typhoon Lidar data (Takao, unpublished). Before the typhoon, the canopy was almost closed with the dominant tree species. According to the estimation, the severely damaged area where the broken crown is 50% or more, occupies 10 or 20 % of the whole experimental forest. The total broken area of tree crown reaches roughly 15-20 % of the forest. However, the broken trees were not uniformly distributed throughout the forest. The broken-crown area exceeded 30% of the ground area to the southeastern direction within 300 m from the main tower. This area is a main-footprint for the flux measurements.

**Photo. 2 Severely damaged area by wind**

The tower flux observations currently are impossible. FFPRI had started investigating immediately for an early restoration, however the resumption of observations seems to be difficult within the year of 2004. We are preparing to reconstruct towers and restart the flux measurements in the spring of 2005 at the site to detect the change of the carbon balances after the wind-thrown disturbance. At the same time, we are checking the current

research state but getting insufficient parameters in the remained forest.

Our research is funded partly by Forestry Agency, Ministry of Agriculture, Forestry and Fishery, and Ministry of Education, Culture, Sports, Science and Technology (the Project for Sustainable Coexistence of Human, Nature and the Earth).

We thank the colleagues in our institute and also thank the Agro-Meteorology Laboratory, National Agricultural Research Center for Hokkaido Region for providing the available weather data.

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## Announcement for the 4th AsiaFlux Workshop (Tentative title)

**Date**: May 11-12, 2005

**Venue**: Tokyo, Japan

Up-to-Date Information: http://www-cger2.nies.go.jp/asiaflux/

＊We will send the details to AsiaFllux members via our mailing list.

Related: International joint symposium organized by the Meteorological Society of Korea, China, and Japan to be held on 13-14 May 2005, in Tokyo, Japan.

### Editor's Note

With a delightful privilege to write the editor's note, I'd like to express my gratitude to authors, committee members and secretariats of AsiaFlux, for their effort in improving our Newsletter, and to all members, for their incessant interest and support.

The editor of AsiaFlux Newsletter No.12:
**Dongho LEE**
(Yonsei University, Korea)

The editor of AsiaFlux Newsletter No.13 will be Satoru SUZUKI (Hokkaido Research Center, Forestry and Forest Products Research Institute ).

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