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AsiaFlux Newsletter

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Yoshihiro FUKUSHIMA (AsiaFlux Steering Committee Former Chairman,
Research Institute for Humanity and Nature)



AsiaFlux steering committee has held the 1st AsiaFlux workshop in Sapporo, Hokkaido, Japan, in Sep. 2000, and the 2nd AsiaFlux/KoFlux workshop in Jeju Island, Korea, in Jan. 2002. The efforts of the organizing committee members supported by the Center for Global Environmental Research/the National Institute for Environmental Studies have been rewarded with profound results. These workshops reveal that researchers from Europe, the United States, and Australia etc., are paying a great attention to AsiaFlux; that researchers in China and Korea recognize the importance and significance of distributing information

in Asia; and that Asian countries have great interests in the technology transfer and measurement training. Although I understand that it is difficult to meet the expectations from all countries, I would like to ask members involved in this mission to make further efforts. It is necessary for us to do our best to formulate strategic plans for strengthening the international exchange to develop the networking. As one of the members involved in the establishment of AsiaFlux as an Asia version of the FluxNet, I realize that more challenges are waiting for us.

EUROFLUX was established multi-nationally by research teams belonging to universities and institutes in Europe, aiming to examine relationship between carbon fixation and climate or tree species by the eddy correlation method to measure CO₂ flux. The research was originally spontaneous, however, the research scope has been extended to the global estimation of carbon cycle under the inter-governmental treaty to reduce carbon emission. Although the research was an unavoidable process, the development of research cannot be realized



without scientific interest. Studies on carbon dynamics in terrestrial biosphere started long before the development of the eddy correlation method and produced many significant results. From 1960's to 70's, the International Biological Program (IBP) intensively measured the gross primary production (GPP) and the net plant production (NPP) for various natural vegetation communities spreading from boreal to tropical zones. These measurements were conducted by research groups of vegetation and forest ecologists mainly consisted of university

staff. One of the important findings of IBP is that GPP can be expressed by a simple relation between leaf area index (LAI) and growth period irrespective of plant species.

I hope that our studies will enrich not only the flux database but also the flux measurement method and new findings. We are carrying out long-continuous monitoring by eddy correlation methods; meanwhile, I look forward to seeing ideas on how to re-use the IBP data.

**Susumu YAMAMOTO (AsiaFlux Steering Committee Chairman,
National Institute of Advanced Industrial Science and Technology)**

In the past three years since the establishment of AsiaFlux in September 1999, the AsiaFlux website was opened and AsiaFlux workshops were held twice to improve the exchange of information and to enhance the communication among researchers and laboratories in Asia. In the 7th AsiaFlux steering committee meeting held on 14 March 2002, the future prospects of flux research and the strengthening of global networking were discussed, and the following subject was reviewed based on achievements of our activities in the past.



[New Asiaflux administrative system]

* Change of the chairman: Dr. Fukushima wished to resign the chairmanship because of his tight schedule. Dr. Yamamoto (AIST) undertook chairman, Dr. Koizumi (Gifu Univ.) and Dr. Joon Kim (KoFlux), of vice-chairs.

* New members of steering committee are as follows:

Chairman: Susumu YAMAMOTO

Vice-chairs: Hiroshi KOIZUMI, Joon Kim

Committee members:

Yoshihiro FUKUSHIMA, Hideji KIDA, Takehisa OIKAWA, Nobutaka MONJI, Makoto TANI, Eiji OHTAKI, Yoshikazu OHTANI, Gen INOUE, Yasumi FUJINUMA, Akira MIYATA, Yoshinobu HARAZONO, Wonsik Kim, Byoung-Ryoul Lee, Takashi HIRANO, Two members from China (undecided)

Organizing meeting:

Susumu YAMAMOTO, Gen INOUE, Yasumi

FUJINUMA, Akira MIYATA, Yoshikazu OHTANI, Takehisa OIKAWA, Nobuko SAIGUSA

Secretariat:

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

* It was requested that an international committee be formed, having representatives from Korea, China, and Japan.

[AsiaFlux Active Plan]

* The second issue of the AsiaFlux Newsletter in July

* Publishing a flux measurement manual (scheduled on Sep.)

* Mini-WS on research exchange and methods for flux measurement at Sapporo in November 2002

* The third AsiaFlux WS in China, 2003

With the expansion and development of the AsiaFlux activities, such as the collaborative networking in Korea



and China, AsiaFlux is expected to have a better understanding on the carbon cycle in East Asia, to improve the construction and verification of the terrestrial ecosystem structure model, and to enhance the data collection on flux measurements in Asia.

I became the new chairman in this April under these

circumstances. I fully realize the heavy responsibility of this challenging position. I would like to commend Dr. Fukushima, former chairman of the AsiaFlux, for his efforts that have made the AsiaFlux a success. I look forward to further cooperation from new committee members and members of the AsiaFlux to achieve our goals.

Global Carbon Project

Gen INOUE (Center for Global Environmental Research,
National Institute for Environmental Studies)

The rapid increase of "Greenhouse gases", especially carbon dioxide, is challenging the scientific community, policy makers and the public. The long-run experiments of climate change model to predict the future climate change are based on the scenarios of greenhouse gases increase under different development patterns of the society. In order to predict the future climate change accurately and to find the way to avoid a serious risk, it is essential to understand the feedback mechanism of climate change to the carbon cycle based on the studies of the present patterns and variability of carbon cycle, and the mechanism of them.

The International Geosphere-Biosphere Programme (IGBP), the World Climate Research Programme (WCRP), and the International Human Dimensions Programme on Global Environmental Change (IHDP), decided to start the Global Carbon Project jointly. The task of this project is to answer the following questions in coming ten years;

- 1. What are the geographical and temporal patterns of carbon sources and sinks?**
- 2. What are the control and feedback mechanisms--both anthropogenic and non-anthropogenic---that determine the dynamics of the carbon cycle on scale of years to millennia?**
- 3. What are the likely dynamics of the global carbon cycle into the future?**

Much research on the global carbon cycle is already under way or planned, and the Global Carbon Project is to coordinate national and disciplinary efforts to answer the above questions.

The international network of carbon-dioxide flux observation, such as AsiaFlux, together with the carbon cycle mechanism study and the scale-up efforts is one of the most important key international frameworks of this project. The office of Global Carbon Project is under the preparation, and this project move to the implementation stage in a few months.





Results of Japan-U.S. Inter-Comparison Measurements

Yuichiro NAKAI (Forestry and Forest Products Research Institute)
Nobuko SAIGUSA (National Institute of Advanced Industrial Science and Technology)
Takashi HIRANO (Graduate School of Agriculture, Hokkaido University)

Here we report the results of the inter-comparison measurements carried out above the forests of Tomakomai and Sapporo in Northern Japan. At present, for an accurate estimate of the amount of CO₂ absorbed and emitted between the terrestrial ecosystem and the atmosphere, towers measuring fluxes more than in 150 sites that represent the different ecosystems in the world have been established. From these measurements, the CO₂ cycle in different ecosystems can be understood. For this purpose useful data is continuously collected. The premise of the analysis of these data is that it is necessary to quantify the differences in measurements among various measurement systems of the tower sites. For that reason, the FLUXNET relocatable standard system has been taken around different sites in the world to carry out inter-comparison of CO₂ and energy fluxes measurements and thus the relative differences among flux sites are determined.

In August 2001, inter-comparison as those explained above took in Asiaflux. Dr. Bob Evans from the Ameriflux (USDA Forest Service) was in charge of the comparisons in two forests sites in Hokkaido. The institutions that participated, were the National Institute of Advanced Industrial Science and Technology (Deputy Director, Dr. Yamamoto, and Senior Research Scientist, Dr. Saigusa); Graduate School of Agriculture, Hokkaido University (Associate Professor, Dr. Hirano); Forestry and Forest Products Research Institute (Head of Meteorol. Lab., Dr. Ohtani, Group Leader, Dr. Nakai, Researchers, Mr. Kitamura, and Dr. Suzuki); and National Institute for Environmental Studies (NIES fellow, Dr. Toriyama).

The inter-comparison measurements in two sites were carried as follows: One site was the Tomakomai Flux Research site in the national forest of east Iburi region in the city of Tomakomai (<http://www-cger2.nies.go.jp/moni-e/warm/flux/flux01.html>). This is managed as a

Flux Monitoring station of the Center for Global Environmental Research of the National Institute for Environmental Studies. Mainly artificial deciduous coniferous Larch trees compose the forest population. The average height is 15 m. In this site the comparison measurements were done from August 10 to 16, for a total of six days. Flux measurements were carried out at 42 m (27 m above the tree canopy, at the top of the tower) above the ground.

The second site was located in Sapporo city, in the Sapporo Forest Meteorology Research Site of the Forestry and Forest Products Research Institute (FFPRI). This site is managed by FFPRI FluxNet (<http://www.ffpri.affrc.go.jp/labs/flux/>). Deciduous broad-leaf natural white-Birch and Mizunara-oak trees mainly compose this forest. The average height of trees is 21 m. Comparison measurements were continued from August 16 to 20 and took place at 29 m (8 m above the tree canopy, in the 41 m tower) above the ground.

In this opportunity, the Ameriflux relocatable standard system (more detailed information can be found in this web page: http://public.ornl.gov/ameriflux/Standards/roving-system/roving_update_12-26-2000.cfm) is called "System-A" for the benefit of explanation. On the other hand, the systems used for continuous measurements in the two sites mentioned above are called "System-T" for the Tomakomai Flux Research site and "System-F" for the Sapporo Forest Meteorology Research Site respectively. This later is also used in six sites of FFPRI FluxNet. In each of the systems, measurements and calculation methods were then mutually compared and described.

In the systems, the Eddy Covariance Technique (Eddy correlation method) for the measurement of fluxes is used. The basis of this method, the ultrasonic anemometer, Kaijo DA-600 (Systems-T and -F) and ATI Kaimal-



probe (System-A) were used by these systems. Closed-path infrared gas analyzers (LICOR, Li-6262, hereafter CIRGA) were used to measure CO₂ and water vapor concentrations. System-T also used the open-path infrared gas analyzer (LICOR, Li-7500, hereafter OIRGA). The air sample of the CIRGA in System-F was dried and only the CO₂ concentration was measured. Water vapor concentration was measured with an aspirated HUMICAP hygrometer (Vaisala HMP45A), installed next to the ultrasonic anemometer and by applying the band-pass covariance method, water vapor flux was calculated. Data for the System-F was sampled at 5 Hz, but on the other two systems, it was at 10 Hz.

Data were stored on digital recorders (Systems-T and -F) and hard disk of a laptop (System-A). From these data, fluxes were then calculated. In every system 3-dimensional coordinate rotation, detrending and WPL correction were applied to the 30-minute averaged flux. In regard to trend detrending, linear trends were eliminated from

Systems-T and -F; furthermore for the flux calculations from the OIRGA in system T, second-order polynomial equations were used. In System-A, 10-minute running average was detrended. For flux calculations obtained from the CIRGA measurement, a sensor-separation correction and a sensor-span correction were applied. For the flux calculations obtained from the CIRGA measurements, the high frequency attenuation correction was applied due to the long tubing of Systems-F and -A (40 and 60 m respectively). Net radiation above the forest canopy, as well as downward- and upward- long and short wave components were measured independently and calculated for Systems-T and -F. On the other hand, for System-A, a net radiometer (REBS Q*7.1) was used. The same sensor type measured photosynthetical-

ly active radiation in all systems (LiCor, Li-190SA). Temperature and pressure at the eddy measurement levels, necessary for the calculation of CO₂ and water vapor density, were measured with platinum resistance thermometers and air pressure gauges respectively. The radiation shield of the platinum resistance thermometer for temperature measurements was set carefully, especially in System-A. A sunshade with a diameter of more than 30 cm covered the aspirated cylinder in which the thermometer is located.

In both sites, the weather conditions were optimal during the measurement periods. On these days enough data were taken for inter-comparison. Measurements of



At Sapporo Forest Meteorology Research Site, Dr. Bob Evans and the other participants (in turn from the left side, Nakai, Bob, Toriyama, Saigusa, Kitamura, and Suzuki, titles are omitted), photographed by Ohtani.

net radiation, photosynthetically active radiation, CO₂/H₂O/sensible heat and momentum fluxes were compared to those in the Ameriflux relocatable standard System-A at each site. Additionally information related to each of the instruments, techniques of measurements and accuracy maintenance were exchanged among the participating groups.

The results in Tomakomai (T and A comparison) are described as follows: approximately 90 hours of comparison measurement results, including days with rain, were collected. CO₂ and water vapor fluxes were obtained with the three measurement systems as following: System-A(CIRGA); CIRGA of System-T and OIRGA of System-T. Analyzing them using linear regression, data that contained too many spikes were eliminated, derived the correlation coefficients, $R^2 > 0.9$, and differences in the slopes of the regressions were smaller than $\pm 10\%$, showing a good agreement. The sensible heat flux between Systems-A and -T had the same characteristics. However friction velocity was systematically lower in the System-T than in System-A ($R^2 > 0.9$, with a difference in the slope approximately



was 20%).

Next, the results in Sapporo (System-F and -A comparison) are described as follows: approximately 76 hours of comparison measurements during clear days were collected. The Root Mean Square Error (RMSE) of the measured values between System-F and System-A were: CO₂ flux, 1 μmolm⁻²s⁻¹, Sensible heat flux, 9 Wm⁻², Latent heat flux, 18 Wm⁻², Net Radiation, 15 Wm⁻². In general there was a good agreement between System-F and -A. The Latent heat flux during daylight on clear days was larger for System-F than for System-A. The momentum flux was lower for System-F than for System-A and a systematical error existed (with a maximum of 0.1 kg m⁻¹ s⁻²). The friction velocity in System-F was larger than in System-A for Sapporo site, but it was lower in System-T than in System-A for the Tomakomai site. The error in the horizontality of the ultrasonic anemometer is thought to be the cause the difference in the friction velocity.

As explained above, Systems-T and -F were in agreement with the measurement results of System-A. The measurement results obtained here can be useful for comparison analysis of measurement results from other sites around the world.

Dr. Bob Evans brought all the equipment to Japan by

himself due to the mobility and compact packing of it. In order to obtain as much data as possible for the comparison, he worked all day long to set the moving measurement system. Even though he was older than us he was incredibly energetic. His hard work and eagerness gained our admiration. He has performed this kind of work in eight countries in thirty different sites. He is a specialist in calibrations and calibrates completely the relocatable system by himself.

By the way, Dr. Bob Evans lives in the North East part of the USA, where the landscape is similar to those in Hokkaido. Before coming to Japan he expected to find a more Asian looking but he found very similar forests and no old Shrines nor old Temples.



The netradiometer on the left side and the sensors for reflective solar radiation and PPF on the right side, above the canopy of Sapporo Forest Meteorology Research Site.

Publishing a Flux Measurement Manual

Nobutaka MONJI (Osaka Prefecture University)

The Asiaflux steering committee is planning to issue a flux measurement manual. At present, flux data have been collected in many sites over the world and the number of sites is increasing very rapidly in Asia. Therefore, it is necessary to provide guidelines on measurement methods and data formats for exchange through networking. The manual will be helpful for researchers or investigators who are carrying out a long-term measurement of fluxes of carbon dioxide, water vapor, and other quantities. We hope that the manual will be also useful for researchers and students who are trying to start measuring the fluxes. The manual will include as many technical contents and examples as possible to

give practical and precise information. An English version as well as Japanese version will be prepared to present AsiaFlux standard to other organizations. The contents are as follows:

1. Introduction

2. Flux measurement and survey of forest ecosystem

Measurements of various fluxes and relevant parameters such as turbulent flow, radiation, precipitation, wind speed and direction, air temperature, humidity, and CO₂ profile.

Measurements of photosynthesis, respiration, soil moisture, and soil respiration for studying carbon cycle at the



sites.

3. Practical flux measurement by eddy correlation method

Instrument and principle for measuring turbulent flow, response and calibration of instrument, and notes on installation and data recording.

4. Practical analysis of flux measurement by eddy correlation method

Requisite data elements, removal of noise and trend in data analysis, calibrations of a sonic anemometer, and

statistical analysis of spectrum.

5. Case studies

Factorial analysis of error, energy balance, correction of night time flux, annual carbon budget and seasonal variation, and parameterization of GPP and NEE.

6. Data management and database construction

Data format for archiving, data quality control, complement of missing data, and data dissemination system.

7. Final remarks

AsiaFlux Logo



We decided to use this logo for AsiaFlux.

The outline circle and the yellow horizontal bar imply an Albedo meter. The map in the logo shows the wide geographical distribution of monitoring sites. The blue part of the circle is the symbol of the sky; the green part, the forest; and the brown part, the earth.



- - KoFlux monitoring sites - -

Information of five additional monitoring sites registered in KoFlux will be appeared on the AsiaFlux webpage.



Editor's Note



I went on a visit to a flux research site at the Northeast Forestry University in China on this May.

Colleagues in Harbin and Beijing, thank you for your help!

The editor of AsiaFlux Newsletter No.2:
Nobuko SAIGUSA
(National Institute of Advanced Industrial Science and Technology)

The editor of AsiaFlux Newsletter No.3 will be Kentaro TAKAGI (Hokkaido University).



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