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Contents

The First Flux Study Site at the International Rice Research Institute, Philippines

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IRRI, Rice and Climate Change

Rice is the staple food of almost 3 billion people, and rice farms cover around 150 million hectares - greater than any other crops. The rice production, much of which takes place in flooded paddies, has unique and profound implications for the environment and the livelihood of the people depending on it. Hence, the environmental sustainability is a key component of the sustainable rice ecosystem.

The International Rice Research Institute (IRRI) is the largest non-profit agricultural research center in Asia, with headquarters in the Philippines (see Fig. 1) and offices in 14 nations. IRRI was established in 1960 with the main goal to find sustainable ways to improve the well being of present and future generations of poor rice farmers and consumers while at the same time protecting the natural environment. The Institute's research headquarters consists of laboratories and a 252-hectare experimental farm in Los Baños, Laguna, about 60 kilometers south of the Philippine capital, Manila. IRRI has initiated its research on climate change in 1991.

Climate change will affect rice production in the future. While these climatic changes are a

Figure 1. International Rice Research Institute (IRRI)

Figure 2. The open-top CO_2 chambers (left side), the automatic closed chamber for CH_4 measurements (right side), and the IRRI research centers (at the back) which house the gene bank with 110,000 rice accessions

consequence of increased concentrations of carbon dioxide and other greenhouse gases in the atmosphere, rice production itself is a source of these so-called greenhouse gases. IRRI's research projects in the 1990's have focused on methane emissions through automatic closed chamber systems and impacts of increasing CO_2 through open top chambers (see Fig. 2).

In 2007, IRRI established the Rice and Climate Change Consortium (RCCC) as a platform to initiate research with other interested institutions. One of the major research goals of the RCCC is to improve the understanding of the impacts of diversifying rice ecosystems on the budgets of carbon, nitrogen, water and energy from local to global scale. This information is essential for assessing future trends in the global warming potential, resource use efficiency, net ecosystem exchange, and sustainability of the irrigated landscapes of Asia.

Studying the impact of water regimes

The water shortage is one of the growing concerns of global climate changes due to more frequent occurrence of extreme heat and drought (Bates *et al.*, 2008). The declining availability and increasing costs of irrigation water threaten the traditional way of growing rice under irrigated conditions (Fig. 3). Therefore, several water-saving techniques are currently developed to lower the water requirements of the rice crop (Bouman *et al.*, 2005). One of the promising water-saving technologies comprises of growing high-yielding lowland rice like an upland crop on a non-flooded aerobic soil condition (Fig. 4).

Initial field tests have shown that this approach has a great potential to save water, but it suffered from yield penalty and yield stability

Figure 3. Flooded rice

Figure 4. Aerobic rice

(Peng *et al.*, 2006). A new type of rice variety is needed to achieve high yields under aerobic conditions. Aerobic rice is a production system in which specially developed varieties are directly seeded in non-puddled and non-flooded soils. The water required for aerobic rice is about half of that for lowland rice. In China and Brazil, aerobic rice genotypes can produce high yields (up to 5 to 6 t ha^{-1}) with limited water supply (irrigation + rainfall = 500 to 600 mm), resulting in water productivity of about twice that of conventional lowland rice (Pinheiro *et al*., 2006; Bouman *et al*., 2005).

In the tropics, aerobic rice systems are still in the research and development phase. A thorough research is urgently needed to develop high-yielding aerobic rice varieties and to come up with sustainable crop-soil-water management recommendations (Bouman *et al*., 2006). However, this shift from continuously flooded to aerobic conditions will have profound effects on carbon and nitrogen budgets of rice fields (Bronson *et al*., 1997; Abao *et al*., 2000; and Wassmann *et al*., 2000). Apart from element cycles, the shift will also affect the water and energy exchanges in the rice production system leading to local effects in the microclimate of the rice canopy (Zhao *et al*., 2008; Sakai *et al*., 2004). Large uncertainties still exist in predicting the outcomes of these changes with regard to soil health, long-term sustainability and environmental impacts of rice production systems.

This study was therefore conducted to assess the environmental impact of shifting from lowland rice production to aerobic rice cultivation. One of the major objectives was to examine how this shift affects the fluxes of heat, water vapor and carbon dioxide (CO_2) using the eddy covariance method.

The first (roving) eddy covariance system in the Philippines

The International Rice Research Institute (IRRI) has set-up the first eddy covariance system in the Philippines in January 2008 (Fig. 5).

The system consists of a sonic anemometer (CSAT3), an open-path CO_2/H_2O infrared analyzer (LI-7500), and temperature & humidity probes (HMP45C). Hukseflux 4-component net

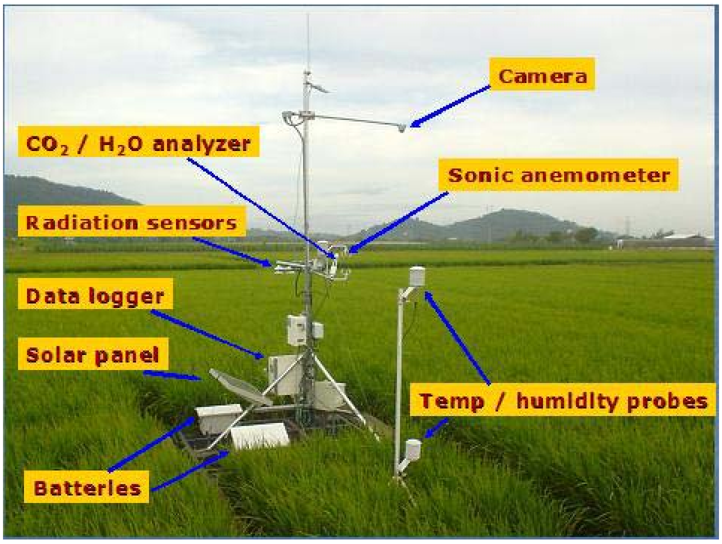

Fig. 5. Eddy covariance system at IRRI, Philippines

radiation sensor (NR01), pyranometer (LI-200X), and quantum sensor (LI-190SB) were added only this March 2009. All the sensors were installed at 2.25-m height on an aluminum tripod mast. Both CSAT3 and LI-7500 had a sensor separation of 20 cm. The LI-7500 was set back from CSAT3 to minimize flow distortions and the head was tilted about 15 degrees from the vertical to minimize the amount of precipitation that accumulated on the window.

The data were sampled at 10 Hz using a data logger (CR3000). The data logger program performed all the processing online and in real time. It applied cross-products (second moments) required for off-line coordinate rotation following Kaimal and Finnigan (1994) and Tanner and Thurtell (1969) as well as Webb *et al*. (1980) term for latent heat and CO_2 fluxes. The program also computed fluxes of CO_2, latent heat, sensible heat and momentum and friction velocity along with all the covariances, standard deviations, and means on a half-hourly basis.

Two temperature & relative humidity probes (HMP45C) were installed on a separate mounting tripod at 0.75, and 2.25 m above the soil surface to measure the air temperature and vapor pressure at canopy and ambient levels, respectively. The eddy covariance system was powered by a 65W solar panel and a 12V, 70A-hr deep-cycle marine battery. Another car battery powered the web camera to monitor the system continuously for security reasons.

Since we only had one eddy covariance system and we were monitoring two rice environments, we had to move the system from one location to the other every week with the help of tractor & trailer and 6-8 men (Fig. 6). The system was installed in the middle of the 4-ha rice field with about 100 m fetch distance on all sides.

Study sites

This study was conducted at the experimental farm of the International Rice Research Institute (IRRI) in Los Baños, Laguna, the Philippines (14°09'53" N, 120°15'14" E, 21 m a.s.l.), about 66 km south of Manila. The soil was a silty clay loam and classified as Aquandic Epiaquoll (Dobermann *et al*., 2000). Both flooded and aerobic rice fields were 4 ha each (200 m x 200 m) and they were about 1 km apart from each other. Table 1 shows some of the physical and chemical properties of the soils in the two study sites. According to records (1979-2006) from IRRI weather station, the mean annual precipitation was 1971 mm and the mean annual air temperature was 27°C. A north easterly wind prevailed during most of the study period of January – April 2008.

The flooded rice field was uniformly planted with one lowland rice variety (*Oryza sativa L.*; cultivar NSIC Rc 122) and the area was surrounded by similarly flooded rice fields planted with the same variety (Fig. 7). Ten-day-old rice seedlings were transplanted on 15 January with

Fig. 6. Transporting the eddy covariance system

Table 1. Properties of the soil in the study sites

	Flooded rice field	Aerobic rice field
pH	6.44	5.53
Total C (%)	1.42	1.27
Total N (%)	0.13	0.12
Available P (mg/kg)	55.7	46.8
Available K (meq/100g)	1.42	1.50
% Clay	32	35
% Silt	45	47
% Sand	23	18

a plant spacing of 20 cm x 20 cm giving a plant density of 25 hills m^{-2}. To prevent damage from golden snails, the field was kept saturated but not flooded for two weeks after transplanting. Then the field was flooded with about 3 cm depth standing water throughout the growing season until two weeks before harvest (23 April). Three split doses of N fertilizer were applied. The mean grain yield was 5.58 t ha^{-1} and the mean total biomass (grain and straw) was 11.20 t ha^{-1}.

The non-flooded rice field was used for screening of aerobic rice varieties. The area was surrounded by similarly non-flooded fields (Fig. 7). In total, there were about 2604 aerobic rice entries tested. The rice seedlings were sown on 11-28 January and were harvested between 14 April and 15 May. Three split doses of N fertilizer were also applied during the entire growing period of the aerobic rice plants. The different aerobic rice entries were tested for their resistance to drought. The drought stress was imposed 4 weeks after sowing. There were two treatments of drought stress imposed: for mild stress, the soil water potential was allowed to reach -40 kPa at 20 cm depth while for severe stress, which was based on leaf rolling and an average soil water potential of about -75 kPa in all of the installed tensiometers in the same area with similar treatment. Re-irrigation of the soils followed immediately after these conditions were met.We also irrigate the same spot for 2 hours a day by sprinklers. The grain yield of the aerobic rice not subjected to stress ranged from 1.8 – 3.5 t ha^{-1} while that subjected to stress yielded only 0.6 – 2.5 t ha^{-1}.

Results

Results from 2008 dry season investigation showed that in the aerobic rice field, the mean air temperature in the canopy was higher while the relative humidity and vapor pressure were lower than in the flooded rice field. This resulted in higher vapor pressure deficit in the aerobic rice field over the entire growing season.

Fig.7. Eddy covariance system installed in aerobic and flooded rice fields.

Likewise, the aerobic rice fields had higher sensible heat flux (H) and lower latent heat flux (LE) compared to flooded fields. Consequently, the aerobic rice fields had significantly higher Bowen ratio than flooded fields, indicating that a larger proportion of the available net radiation was used for sensible heat transfer or for warming the surrounding air.

The total C budget integrated over the cropping period (21 January – 12 May 2008) showed that the net ecosystem exchange (NEE) in flooded rice fields was about three times higher than in aerobic fields while gross primary production (GPP) and ecosystem respiration (Re) were 1.5 and 1.2 times higher, respectively. The high GPP of flooded rice ecosystem was very evident because the photosynthetic capacity of lowland rice is naturally large and it is free from environmental stresses from dry air and soil. The Re of flooded rice fields was also relatively high because it was enhanced by the high photosynthetic activities of lowland rice as manifested by larger aboveground plant biomass. The ratio of Re/GPP in flooded fields was 0.67 while it was 0.83 for aerobic rice fields.

This study was intended to monitor the environmental impact of shifting from lowland rice production to aerobic rice cultivation in terms of C budget and heat exchange. Temperate aerobic rice cultivation has shown great promise in Brazil and China (Pinheiro *et al*., 2006; Bouman *et al*., 2006). In the tropics, the first-generation aerobic rice varieties are now being produced and initial management recommendations are being developed (IRRI, 2006). While relatively much work has been done on the development of technologies to maintain crop productivity under water scarcity, little attention has been paid to their long-term sustainability and global warming impacts.

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Continuous Flux Measurement at Barley-Rice Double Cropping Field in Japan

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Introduction

Rice paddy field is widespread and a characteristic cropland in Asia, where its cultivation pattern varies from single to dual and double cropping depending on climate conditions. We have conducted flux measurements at two paddy sites, single rice and barley-rice crops, which are close to each other (< 2 km). In this report, we introduce our measurement at the barley-rice site with some results.

Site Description

The study site (34°32'N, 135°54'E, 2 m a.s.l.) is located in the reclaimed land facing Kojima Bay in the southern part of Okayama Prefecture, Japan. The field was reclaimed from the middle 20th century as a development of new agricultural fields. The greater part of the land is used for rice paddy-based crops. According to the records from the Tamano automated meteorological data acquisition system (the Japanese Meteorological Agency; 6 km south of the study site) from 1986 to 2005, the annual precipitation is 1017.8 mm and the annual mean air temperature is 15.9 °C.

In normal year, two-rowed barley was sowed between late-November and late-

Figure. 1. Photograph showing the study site and rice.

Figure 2. Photograph showing the field after post-harvest biomass burning.

December depending on weather conditions and budded about three weeks later. The barley grew slowly because of the low temperature until late-March. The barley headed around middle-April and the leaves turned yellow from middle-May. The barley was harvested between late-May and early-June by combine. The panicles were taken out from the field, but leaves, stems and roots were left. A few days after the harvesting, leaves and stems were burned to make the field management easier and plowed. Following the land preparation, the field was flooded by irrigation, and then rice was transplanted late-June. Intermittent drainage was practiced with four days of flooding and three days of drainage, that was repeated until about two weeks before the harvest. The depth of standing water is about 7 cm. The rice was headed in middle-August and turned yellow gradually (Fig. 1). The rice was harvested between late-October and early-November. The residues were treated in a similar manner to barley (Fig. 2).

Field Observations

The flux of CO_2, water vapor, heat and momentum were measured at 1.9 m above the ground using the eddy covariance method with a sonic anemometer (DA-600, Kaijo) and an open-path gas analyzer (LI-7500, Li-Cor). The data were recorded at 10 Hz and calculated every 30 minutes. CO_2 and CH_4 concentrations were measured at four heights by a NDIR CO_2 gas analyzer (LI-840, Li-Cor) and a FID CH_4 gas analyzer (APHA370, HORIBA), respectively. Micrometeorological variables, such as wind speed profile, air temperature, humidity, four-component radiation etc are also measured.

In the crop growing period, plant biomass was sampled every three weeks. The sampled plants were divided into roots, stems, leaves and panicles. Each organ was dried, and weighted, and its carbon content was measured.

Results

Daily Gross Primary Production (GPP), Total Ecosystem Respiration (TER) and Net Ecosystem Exchange (NEE) at the field from 28 November 2007 to 15 December 2008 (from barley sowed to next sowed) are shown in Fig. 3. In the barley period, small GPP lasted for more than three months until March. GPP increased rapidly in March with barley development. The maximum GPP appeared five months after sowing. In contrast with barley, GPP during the rice period increased and showed its maximum one month after transplanting, and then decreased gradually. TER during the rice period showed the serrated seasonal variation because of intermittent drainage practice. Observed TER was the sum of autotrophic and heterotrophic respirations under the drainage condition, but the latter could be restricted under the flooded condition and TER was smaller than drained condition. This effect was reflected in NEE. Cumulative NEE over

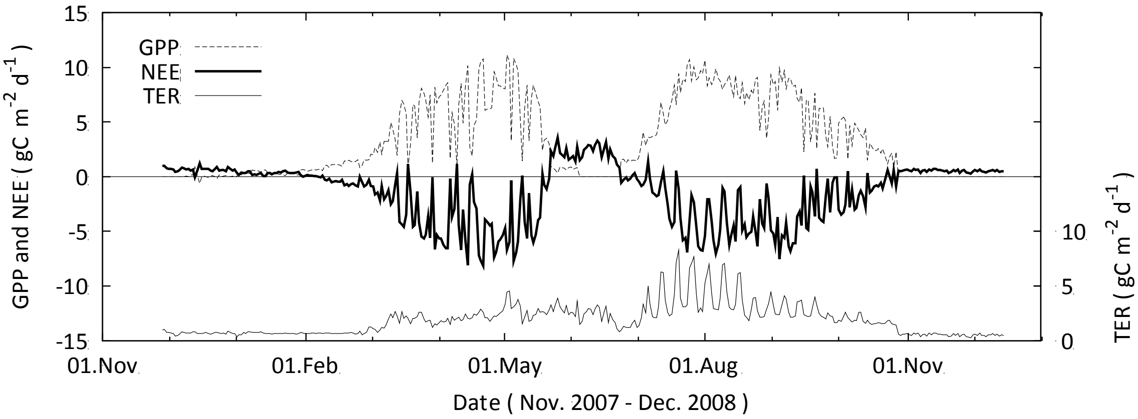

Figure 3. Seasonal variations of GPP, TER and NEE.

the two crops was –544 gC m^{-2}. Considering other terms in the carbon budget, CH_4 emission (8 g C m^{-2}), dissolved carbon in flooded water from the soil (7 g C m^{-2}), harvest (375 g C m^{-2}), and CO_2 emission by residue burning (212 g C m^{-2}), Net Biome Production (NBP) at the field was –65 gC m^{-2} as a carbon source. Biomass burning was the most important among the terms. If residues were incorporated into the soil before burned and not decomposed as much, NBP would be less negative or slightly positive.

Future Works

As shown above, the field acted as carbon source during one cycle cultivation period. Considering a longer-term carbon budget, we have to also monitor soil carbon dynamics to reveal the field to be carbon sink or source. In addition, we will understand the historical soil organic matter turnover by using the modified RothC model. We are developing a scheme to scale-up the eddy covariance dataset to wide-area GPP using MODIS data.

Advanced use of flux data by ecosystem models: a report of the Asilomar Workshop

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An unique workshop focusing on FLUXNET data-model fusion was held in Asilomar, California, February 12-14, 2009. In spite of unstable weather and off-season desolation, about 30 participants, including Dr. Joon Kim and I, had fruitful time to discuss a wide range of topics, thanks to administration and encouragement by Dr. Dennis D. Baldocchi, University of California, Barkley.

Describing all discussions made in this workshop is beyond the scope of this short report. Alternatively, I would like to report a few examples and recent trend for advanced use of flux data by ecosystem models. From the beginning, I was surprised that the main discussion theme, flux data-model fusion, was not a new topic at all. In the introduction by Dr. Steve Running (University of Montana), he mentioned that he had strongly encouraged Dr. Baldocchi to establish the FLUXNET activities during the early phase. Indeed, about 10 years ago, Running *et al.* (1999) foretold how tower flux, satellite, and modeling studies should be integrated for depicting terrestrial structure and functions at broad scales. Also, flux observers started their research bearing in mind that observed flux data should be used for model development (Baldocchi *et al.*, 1996).

Flux data utilization by modelers started from a

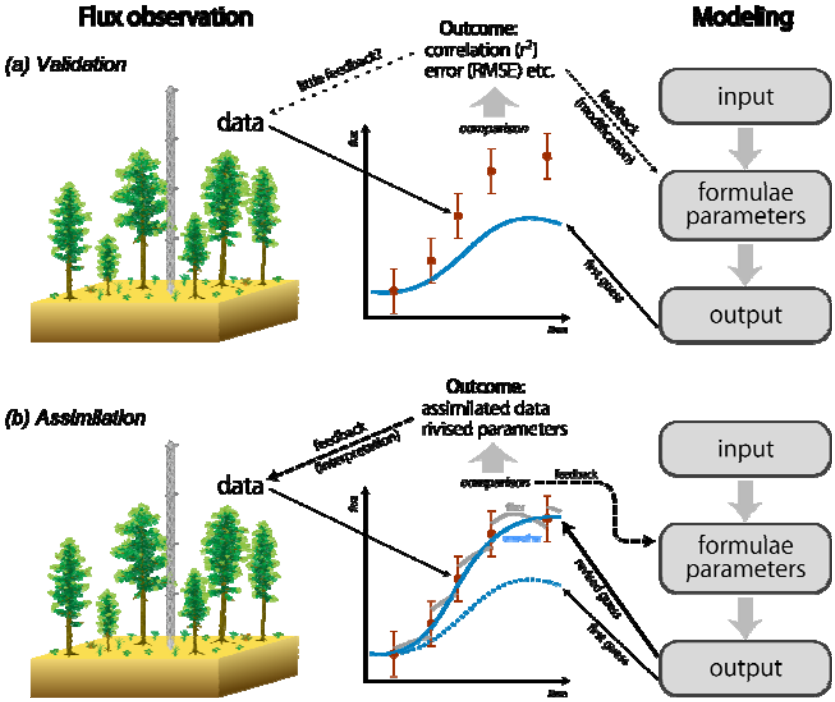

Figure 1. Conceptual diagram of flux data utilization by ecosystem models. (a) Validation and (b) data assimilation

primitive stage: i.e., simple comparison for validation (Fig. 1a). Nevertheless, it was revolutionarily effective because ecosystem-scale data such as NEE (net ecosystem exchange) was the very information that modelers were looking for. In the 1990s, broad-scale terrestrial ecosystem models were validated through comparison with some dataset of *in situ* net primary production (NPP) measurements. It was virtually impossible to determine whether certain ecosystem is working as a net CO_2 sink or a source, because of the lack of information on soil budget. Additionally, the NPP data were usually obtained once a year, making it difficult to examine temporal variability and representativeness. Continuous flux measurement allows modelers to check model performance at hourly to interannual (now even decadal) time scales. Increasing number of towers and increasing amount of data enable modelers to validate their model with higher reliability (e.g., Ruimy *et al*., 1996; Ito, 2008; Stöckli *et al*., 2008). In many cases, the flux data are used as a constraint of model behavior, in combination with other field survey and remote sensing data. Although there remain problems of methodological biases (e.g., for nighttime and steep topography) and spatial representativeness, nowadays, every modeler cannot represent model validity without showing that his model appropriately captures diurnal or seasonal patterns similar to flux data. In the workshop, Dr. Gab Abramowitz (Univeristy of New South Wales) presented his results on the intercomparison or benchmarking study among models on the basis of flux measurement data, in a more sophisticated manner. This kind of data utilization has mostly been a one-way traffic (i.e., asymmetry; Williams *et al*., 2008); observers did not receive much effective or scientific feedback from modelers, except for demand for more data.

A more advanced use of flux data by ecosystem model is directed toward data-model fusion, or data assimilation (Fig. 1b). The idea of objective model calibration (parameter tuning or optimization) by the use of observational data is not novel, but has been advanced in various areas of Earth Science to the level of practical use (Mathieu and O'Neill, 2008). For example, data assimilation is routinely conducted by weather forecast models to obtain a better initial condition from scattered observational data. In meteorology, operational products of data assimilation are widely used for researches, because these data cover the whole globe and long time-series with high physical integrity. Many algorithms have been developed for higher precision and at less computational cost: e.g., nudging, optimal interpolation, adjoint equation method, and Ensemble Kalman Filter (EnKF). In the carbon cycle study, data assimilation was firstly adopted for calibrating global models on the basis of atmospheric

CO_2 concentration data: e.g., CCDAS (Carbon Cycle Data Assimilation System: Rayner *et al*., 2005). Because these algorithms were developed for physical or statistical models, it was not easy to apply them to ecological process-based models, which are usually non-linear and include numerous undetermined parameters. Nevertheless, several studies have started applying data assimilation algorithms to ecosystem models. For example, Mo *et al*. (2008) applied the EnKF method to calibrate parameters of a boreal forest model (BEPS) with eddy covariance flux data. Similarly, Williams et al. (2005) and Quaife *et al*. (2008) applied the EnKF method to calibrate parameters in DALEC model, which is a simplified data assimilation-oriented model. Most advanced researchers have started comparison between model calibration and data assimilation algorithms applicable for terrestrial ecosystem models (e.g., OptIC by Trudinger *et al*., 2007; Raupach *et al*., 2005). More computational algorithms, such as the Markov Chain Monte Carlo (MCMC) method and Bayesian estimation, have also been tested by ecosystem carbon cycle models. For example, Xu *et al*. (2006) applied the MCMC technique to a terrestrial carbon cycle model (TECOS) for obtaining plausible probability distribution of parameter values. This kind of task, i.e., objective parameter calibration and data assimilation, can effectively save time and labor for seeking a more plausible (sometimes optimum) set of parameters, in comparison with the traditional, manual trial-and-error method. This is also a new mutual way of collaboration between flux observers and modelers, because this task may revise flux data that help analysis of spatial-temporal variability. Also, the requirement of data-model fusion effectively justifies long-term flux measurement at multiple sites, because quality of the assimilated dataset is critically dependent on basal observation data availability.

Improvement of data availability through data sharing is a common problem for both flux researchers and modelers. Since data management is also an issue of informatics, a couple of engineering technologists participated in this workshop. Now the FLUXNET is composed of many regional sub-networks (e.g., AmeriFlux, AsiaFlux, and CarbonEurope) and sub-sub-networks (e.g., ChinaFlux , JapanFlux, and KoFlux), which have different data management policies and database servers. Clearly, there is no standard rule of data publication authorized by worldwide tower sites, for some unavoidable administrative reasons. Model researchers should moderately and persistently make a request to improve flux data availability. In the workshop, Dr. Dario Papale (Univeristy of Tuscia) demonstrated a strategy for establishing a flux dataset for model researchers. He proposed to construct the 'Asilomar dataset' as a subset of the global synthetic dataset (called the La Thuile dataset), under the agreement of the principal investigators of each tower site (Fig. 2). Such a dataset is undoubtedly valuable for modelers, for revising models at a variety of ecosystems and for benchmarking models. We should take care that there remains a problem of scale-gap between observation and model, which was not fully addressed in this workshop.

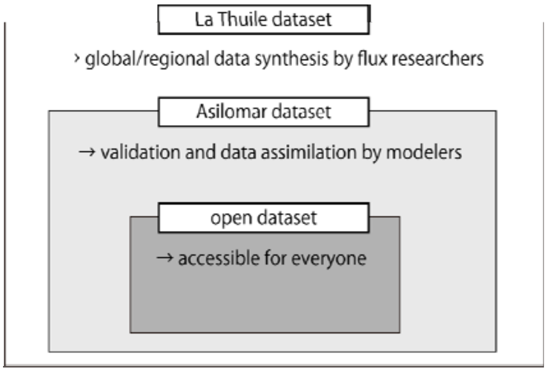

Figure 2. Concept of the Asilomar dataset: i.e., a dataset for terrestrial carbon cycle modelers.

Another advantage of this kind of meeting is that the modelers become aware of limitation and uncertainty in observational data. As is well acknowledged among observers, flux measurement data by the eddy covariance method applied to steep topography sites or under calm nighttime conditions can contain a serious bias and unrealistic variability. Absolute value of NEE is susceptible to the difference of data-handling procedures such as gap filling and data selection by a threshold friction velocity. Although several algorithms (e.g., Kalman Filter) presume noises and errors in observational data, we should fully take care that parameter optimization and data assimilation cannot reduce systematic biases intrinsic to observational data and provide a state closer to the real world. Uncertainties in the terrestrial carbon cycle would then be reduced through integrated studies by flux observation, biogeochemical process study, remote sensing, and modeling.

Outcomes of the Asilomar workshop are implicative for the AsiaFlux activities. Now we have tens of flux towers in this region and begin to operate a database, but long-term strategy in terms of data collection and utilization is not clear for participants. The workshop convinced me that the Asian flux data-model fusion should be promoted under the initiative of AsiaFlux to enhance modeling activities and to attain more realistic quantification of the carbon budget in this region. This will make a contribution to the Asian Carbon Tracking System (ACTS proposed by Dr. Joon Kim), which provides basic information on Asian carbon budget, by the bottom-up approach.

Figure 3. group photo of the Asilomar workshop participants

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Tropical Forests in Oxford?

Kho Lip Khoon

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The minute one gets an offer from the any prestigious universities in the world, it somehow creates a sense of excitement, high anticipation, and nervousness regardless of the outcome. An offer to study or conduct a research in these prestigious universities will create a whole new world of opportunity in your career and life. University of Oxford is one of the best and an esteemed university in the world. It has the reputation of being the oldest and highest ranked institution, and consistently producing many prominent scientists, writers, politicians and many other profound figures in other fields.

Being a second year Doctor of Philosophy (DPhil) student in the University of Oxford, I have the privilege of gaining valuable knowledge and precious experiences over the course of my research study. However, gaining is not as much excitement as to applying and interacting creative ideas generated. Such is the exemplar of such profound institution where research students are given generous liberty to explore their curiosity with quality supervision and discussion. The environment and community itself has provided excellent setting to progress further.

As a D.Phil. graduate student in Geography and the Environment at the Environmental Change Institute (ECI), my research focuses on carbon cycling and allocation in a Bornean tropical forest. The study aims to explore and quantify carbon allocation from below- and aboveground components within tropical forest. It is a great opportunity to be able to conduct such research in Borneo, particularly in Sarawak, due to it being one of the oldest tropical forests; an astounding biodiversity hotspot; numerous high quality researches being conducted, and a sense of satisfaction for it being in my home. Thus, this seems like an ideal plan where I am enjoying the best of both worlds.

My research site is located in the 52-ha plot within the natural forest of Lambir Hills National Park, 30km south of Miri city, Sarawak. The area is covered extensively with mixed dipterocarp forest, and widely acknowledged as the most diverse forest in species richness and composition in the Paleotropics (Ashton and Hall, 1992; Phillips *et al*, 1994; Lee *et al*., 2002).

En route to University of Oxford

There is no specific remedy to enroll or apply for University of Oxford. Hard work and determination were my main driving forces that kept me motivated. My motivation was set towards achieving my research study and successfully implementing it. The project proposal turned out to be an interesting idea and corroborates with the research theme in Ecosystems Dynamics Group.

Paving the way to this prestigious institution would require intensive planning to ensure successful entry, though this may not apply to certain individuals. The lengthy application processes were rigid and thoroughly assessed by the colleges and faculties applied, and in my case, it was

Figure 1. Before the rush hour on High Street.

Figure 2. Front quad of St Edmund Hall, the author's college.

the School of Geography and the Environment (SoGE) and St Edmund Hall.

Nevertheless, it would make much more sense if we would focus towards postgraduate level application requirements or perhaps the dos and don'ts. There are no strict procedures (except institution application requirement) as to how one could get successful entry. In my opinion, the motivation to be interested and excited in your research study (needless to mention, which is the driving force of every members in AsiaFlux) will ensure progressive and long-term commitment. Once you are quite certain with your research questions and topics, it would be ideal to hunt and identify your supervisor, and again in my case, I was lucky to be able to work with Prof. Yadvinder Malhi.

Finalizing research questions took most of my time during my application. In the early stages of planning, we tend to be too ambitious at times with extreme creative ideas. Hence, such ideas become unreasonable. However, being too gentle and timid in exploring your research questions will not sell your research proposal. After months and months of editing and reorganizing my thoughts, the carbon cycling research study in Lambir was accepted, and still on going until today.

Whilst being motivated and optimistic, I found myself gradually immersed into the world of academic or rather postgraduate life. Though similar to any research institutions and conducting research, this life offers the opportunity to discover further in every aspect explicitly to improve research skills, expand research networks, collaboration opportunities, and exciting social life. Life in Oxford thought me to keep learning something new and never to abdicate.

So how did this all started? It was simply through my involvement and brief experience in carbon sequestration project during my early university years that got me excited. Later, I spent roughly two years working as research officer in Forest Research Institute Malaysia (FRIM) where I have gained extensive research skills and experience in climate change and carbon dynamics studies. It was during my tenure in FRIM that I was given the opportunity to attend AsiaFlux's inaugural training course. Since then, I have been trying to keep up with relentless updates and research studies on carbon dynamics, particularly in tropical forests, and the climate change news.

Ecosystems Dynamics Group

The Ecosystems Dynamics Group is lead by Prof. Yadvinder Malhi, and currently hosting seven postdoctoral researchers, fifteen DPhil candidates and two visiting research fellows. However, the group members are expanding and thus extensive research studies are spreading across the globe mainly in tropical forests, hence the ironic title. Major work within the group spread across the Amazon and the Andes region of South America, but the dynamic group has progressively grown to the tropical forests in Africa and Asia. Besides concentrating on tropical forests, research network in temperate woodlands is also expanding.

Current noteworthy research project:

1. Pan-Amazon project (includes Brazil, Bolivia, and Peru), which aims to monitor and estimates carbon storage and the shifts in ecosys-

Figure 3. View of Wytham from the flux tower in Wytham Woods (university-owned woodland and the busiest sites in the world involved in the study of forest-atmosphere interactions)

Figure 4. Oxford students in traditional academic dress during Matriculation.

Figure 5. Members of the Ecosystems Dynamics Group together with Prof. Yadvinder Malhi (not all members present as they are on "duty" – fieldwork).

tem carbon allocation and cycling driven by climate change

2. Land-atmosphere water fluxes modeling, and large-scale nitrogen and phosphorus amendment experiment in Peruvian Andes to understand nutrient dynamics of tropical montane forests

3. Quantifying carbon budget across Amazonian forests to understand drivers of the observed spatial variability of forest productivity and to estimate the influence of anthropogenic activities, such as fires, and climate on the carbon balance of this ecosystem.

4. The role of climate and humans on current trends of fire in different tropical ecosystems: Mesoamerican Biological Corridor, Amazonia and the Andes

5. Developing climate dataset for the tropics worldwide, combining weather station and satellite observations; and development of vegetation model for use in tropical cloud forests.

A complete list of current projects by the members of the group can be seen at www.eci.ox.ac.uk. Some of our research group's "discoveries"…

- Tropical rainforests can be affected by drought after only a week with little rain, and this drought has a direct effect on photosynthesis and carbon fluxes

- The biomass of tropical forests is increasing across the tropics and forests are accelerating in both growth and death (based on collation of field studies and direct fieldwork)

- Tropical ecosystems (and probably another undisturbed ecosystems) are shifting in composition (e.g. in liana frequency), probably in response to rising atmospheric CO_2. These are the first such measurements in undisturbed systems.

- To measure the daytime turbulent transfer of water above a forest, it is necessary to consider transport at time scales of up to four hours (much longer time scales than those usually considered)

The City of Dreaming Spires

On the lighter side of research, a brief view of Oxford from the eyes of a local Sarawakian. Oxford is famous for its University and place for history. For over 800 years, Oxford has been the home to royalty and scholars. It is inspiring to live in this city and the opportunity to study in such prestigious university. Inspirational to be able to enjoy the cozy and literary atmosphere where J.R.R. Tolkien (one of my favorite authors) used to frequent, and stimulating to be able to read in the one of the oldest library in Europe. These captivated me to Oxford, *The City of Dreaming Spires*.

The university and colleges is set within the bustling city. Ancient architectural designs remain in the city, which is distinctively conspicuous while strolling along High Street. Tourists flocked to Oxford to wander among the many beautiful colleges, experience the silence and fascination of Bodleian Library, and catch a glimpse of Oxford students in academic dress – the tradition.

The university offers endless possibilities to grow and exploit our dreams independently. Studying or working in the university allows everyone to participate in critical, and at times, philosophical discussions. Daily seminars or talks, and discussions are organized to keep researchers and academicians updated with the current news and discoveries. Recently, the university has even started podcasting public lectures and significant seminars or talks.

The Dream

Anyone studying in the University of Oxford has only one dream that is to graduate. That is my dream too. The Lambir project is another dream that I am hoping will achieve beneficial results to be shared and explored further.

The author would like to assert that this is not a guide for university application or a biography, but merely a brief self-introductory essay to all AsiaFlux members. The author appreciates the invite and opportunity to contribute in this newsletter.

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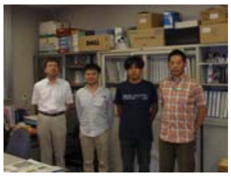

(Keisuke Ono with Drs. Miyata, Hirata and Mano)

I am deeply grateful to the authors for their great contributions to this issue and to the secretariat for his encouragement. It's the busiest season for most AsiaFlux sites and personnel. Have a exciting and tough summer!

The Editor of AsiaFlux Newsletter No. 29
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The Editor of AsiaFlux Newsletter No. 30 will be Dr. Jinkyu Hong (Yonsei University, Korea)..