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Contents

Report of AsiaFlux Workshop 2011
Bridging Ecosystem Science to Services and Stewardship

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10th AsiaFlux Worskop was held on 9-11 November, 2011 at Universiti Teknologi Malaysia in Johor Bahru, Malaysia (Fig. 1). This is the second AsiaFlux workshop held in Southeast Asia after the first workshop that was organized in Cheng Mai, Thailand in 2006. The theme of the 2011 workshop 'Bridging Ecosystem Science to Services and Stewardship' is part of continuous endeavour towards the fulfillment of the AsiaFlux mission which is to bring Asia's key ecosystems under observation to develop and transfer scientific knowledge which ensure the quality and sustainability of life in Asia.

Due to global climate change, population increase, rapid economic growth, and resultant changes in land usage, terrestrial ecosystems, particularly in Southeast Asia, are faced with critical issues which lead to degradation of ecosystem services (e.g., change in carbon, water and biogeochemical cycles), degradation of soil and freshwater, biodiversity loss, an increasing scarcity of freshwater for agricultural use, chemical pollution, weakening of cultural identify, and so on. Some of these issues are also becoming apparent in other regions of Asia subject to monsoons.

For this purpose, AsiaFlux Workshop 2011 provide a platform for scientists and anyone who are interested in ecosystem science in Southeast Asia to congregate, share information, and discuss future collaborations to consolidate and strengthen the Southeast Asian flux site networks.

Eight oral sessions and one poster session were organized to address the issues in order to bridging ecosystem science to services and stewardship. This workshop also provides opportunities for young scientists to express their views and experiences related to flux observation in the young scientist meeting that was also organized during this workshop.

More than 130 participants from 14 counties attended the workshop, where 56 oral and 63 poster presentations were presented in the workshop.

Fig. 1. Group picture of the participants of AsiaFlux Workshop 2011

Opening Session

AsiaFlux Workshop 2011 was opened on November 9, 2011. The opening started with the welcoming address by Assoc. Prof. Dr. Ab. Latif Ibrahim, the chair of local organizing committee, and followed by speech by Prof. Joon Kim the chairman of AsiaFlux Scientific Steering Committee. And opening speech was then given by Professor Ir. Dr. Mohd Azraai bin Kasim the Deputy Vice Chancellor (Academic and Internationalization), Universiti Teknologi Malaysia.

Plenary Session

There are 4 plenary sessions scheduled in the morning of 9-11 November. Two keynote papers have been presented on each day. Keynotes speakers and titles of their talks are; (i) Lulie Melling (Tropical peatland and indication of Green House Gaseous (GHG)s), (ii) Walter Oechel (Effects land surface type, land use, and land use change on aquatic-atmosphere fluxes of CO2 from tropical forests and peat landsof Bornea), (iii) Ab Latif Ibrahim (Estimating Net Primary Productivity of Malaysian Tropical Forest using Remote Sensing Techniques), (iv) Prabir K. Patra (The RECCAP/APN south and southeast Asian greenhouse gases budgets), (v) Khalid Harun (Carbon sequestration in oil palm plantations), (vi) Yoshiko Kosugi (Impact of climate change on canopy CO2 and H2O exchange of a tropical rainforest in peninsular Malaysia, Pasoh), (vii) Dario Papale (Fluxnet-a unique opportunity to integrate data, knowledge and people), and (viii) Takashi Hirano (Networking flux researches to assess the carbon balance of tropical peatland ecosystems in se Asia).

Regular oral sessions

Eight oral sessions based on various themes are main event of this AsiaFlux Workshop. Theme of the sessions has been divided into various categories as follow:

Tropical Wetland in Asia
Remote Sensing and Modeling
Improvement in Flux Measurement Techniques
Asian Tropical Forest Ecosystem
Various Ecosystems in Asia
CarbonEastAsia I
CarbonEastAsia II
CarbonEastAsia III

Poster Sessions

The only one poster session was held on 10 November with given two and half hours for presentation. The extended poster sessions provided more time for in-depth communication between the authors and the audience. Almost all the participants and authors exchanged their ideas and had deep discussions on the uses they were interested in.

Young Scientist Meeting

AsiaFlux Young Scientist Meeting (YSM) is an important part of the AsiaFlux Workshop. YSM has been started in January 2008 under the framework of AsiaFlux. This year's YSM was

Fig.2. Young scientist meeting

held in the night of November 10 (Fig.2.). Nearly 50 young scientists from China, Korea, Malaysia, Singapore, Japan, and Philippine participated in this meeting.

Post Workshop Activities

Asiaflux worksop 2011 also organized three activities after the main workshop. Participants were given three options as follow:

Option A: field trip to Pasoh Forest Reserved (PFR)
Option B: Field trip to Tanjung Piai Ntional Park
Option C: LICOR traning course

Field Trip to Pasoh Forest Reserve

About 70 participants join the field trip to Pasoh Forest Reserve. It is a nature reserve located about 8 km from Simpang Pertang, Malaysia and around 70 km southeast of Kuala Lumpur, has a total area of 2450 hectares, with a core area of 600ha surrounded by a buffer zone. Palm oil plantations surround on three sides of the reserve while the other side adjoins an intact dipterocarp forest. The main attraction at Pasoh is its floristically rich forest. Within an area of 50 ha, a total of 335,256 stems 1 cm dbh (diameter at breast height) and above belonging to 814 species, 294 genera and 78 families has been recorded. The most common plant families are the Euphorbiaceae and Annonaceae among the smaller trees, and the Dipterocarpaceae, Leguminosae and Burseraceae most common species is Xerospermum noronhianum (Sapindaceae) locally called rambutan pacat, which accounts for 2.5% of the total number of plants. For trees above 30 cm dbh, the most abundant species is Shorea leprosula (meranti tembaga), a member of the Diptrerocarpaceae. Being an isolated forest surrounded by oil palm estates, forest gaps, formed by windthrow of a large tree or a group of trees, are a fairly common feature at Pasoh. Within these gaps, one can find many regenerating seedlings and saplings.

Field Trip to Tanjung Piai

Around 35 participants join the trip to Tanjung Piai. Tanjung Piai is a place where the earth and sea, plant and animal life, live in blissful harmony. Tanjung Piai Johor National Park covers an area of over 926ha; 526ha of which comprise of coastal mangroves and the muddy terrain of 400 hectares. Tanjung Piai is home to some 20 species of true mangrove plants, and also to the other nine species of mangrove-related, which indicates a high rate of species diversity.

Training Course

Two-day training course was organized by LICOR, Inc and EKO Instruments Co, Ltd on November 12 at Faculty of Geoinformation and Real Estate for those AsiaFlux participants. Total of 30 participants attended this training course. A comprehensive training regarding to the correct way using instrument and the correct method to collect flux data was given to those participants.

Acknowledgements

The organizing committee of AsiaFlux Workshop 2011 would likely to special thanks to all the companies to have given great support through their participations in business display throughout the workshop. The participating companies are LICOR, Inc, EKO Instruments Co., Ltd., PICARRO, Campbell Scientific, Hukseflux Thermal Sensors, Kipp & Zonen Asia Pacific Pte. Ltd., Elite Scientific Instruments Sdn. Bhd. TSKAY Technologies Sdn Bhd, and Surechem Marketing Sdn Bhd.

The workshop proceedings can be viewed at AsiaFlux web site.(http://www.asiaflux.net)

Fig.3. Picture from Pasoh Forest Reserve field trip (Participants climed up to the tower)

Tropical Peatland – A Strong Carbon Sink?

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Tropical peatlands are recognized for their capacities to sequester vast amounts of carbon and compensate for the carbon loss to the atmosphere. On the other hand, however, they are also regarded as fragile ecosystems because they are sensitive to both natural and anthropogenic activities. Malaysia holds the second largest extent of peatland (2.4 million ha) in Southeast Asia after Indonesia (21 million ha), with more than 65% found in Sarawak. Tropical peatlands being one of the most important arable lands for agriculture development play an imperative role in the socio-economic well-being of the country. Concurrently, it also draws a great concern on the impact of land use change on the greenhouse gas emissions due to deforestation and drainage that has therefore been asserted to shift the ecosystem carbon balance from sink to source. Nonetheless, there are still very limited empirical studies on long-term continuous measurements of carbon balance in the context of environmental-biological control of tropical peatlands particularly in Asia. Thus its role as a carbon source or sink remains largely unknown. Eddy covariance which emerged in the last few decades has become an important tool to quantify the C sequestration rates for terrestrial ecosystems. Therefore, eddy covariance flux towers have been established in three different ecosystems in Sarawak, Malaysia. The initial focus of this study is to assess their overall sink-source status and to determine the underlying environmental factors that regulate the carbon balance in these three ecosystems.

Introducing our study sites

The study sites consist of three different tropical peatland ecosystems, oil palm (*Elaeis guineensis*) plantation, secondary peat swamp forest and tropical peat swamp forest. Situated close to the equator, Malaysia's climate is typically humid tropical, characterized by year round high, even temperatures and heavy rainfall (Fig. 1 & Fig. 2). Three study sites are briefly described as follows:

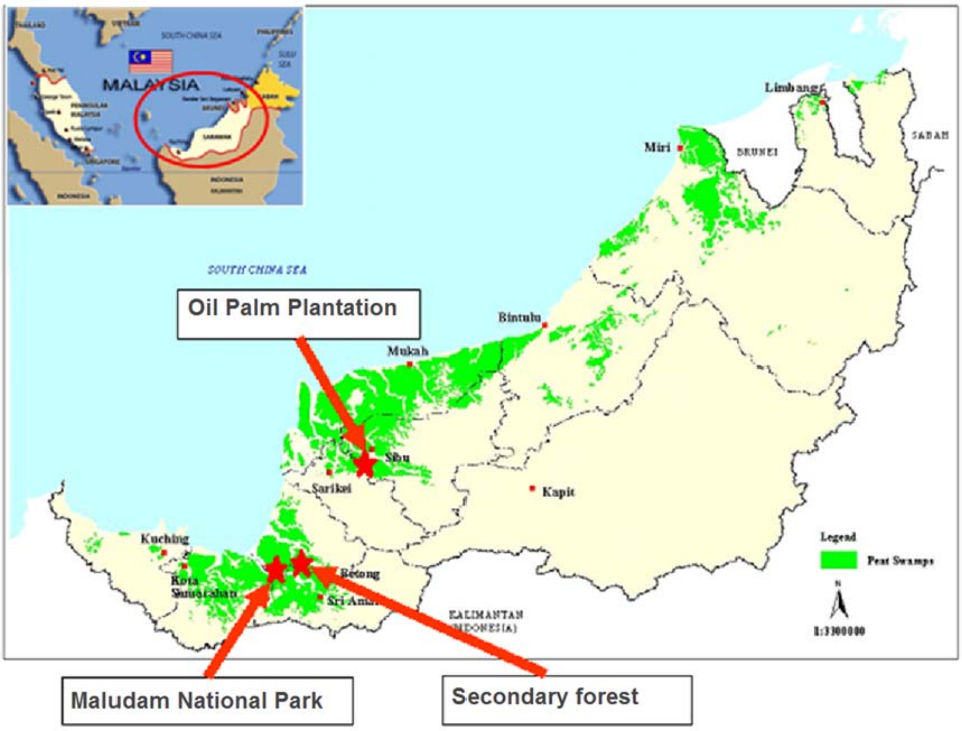

Fig. 1. Distribution of peat swamps and the locations of tower sites in Sarawak, Malaysia.

Oil Palm Plantation

The first EC tower was set up in about 10000 ha oil palm plantation which is located in the vicinity of Sibu town, Sarawak (SBW, 2º11'12.0N, 111º50'31.9''E). Elevation of the site is between 5 and 5.5 m above mean sea level. This area is covered primarily by a mixed peat swamp forest. The footprint area of the flux tower is about 1300 m. An important objective of this study is to elucidate interactions between CO_2 flux and the environmental factors in the oil palm agro-ecosystem.

Fig. 2. Oil Palm station (SBW)

Secondary Forest

Secondary peat swamp forest is situated in Betong division (01º24'01.6''N, 111º23'54.0''E), 8 m above mean sea level with a total area of 1020 ha. The forest ecosystem is a Padang Paya forest with the overstory dominated by Litsea spp that can reach a height of 25 m. This forest has been logged before and is to be converted to an oil palm plantation. Thus, there is considerable interest in evaluating the impact of land use change, i.e. the conversion of peat swamp forest into oil palm estate on greenhouse gas emission and its implication and contribution to global warming and climate change.

Fig.3. Logged-Over Forest

Maludam National Park

Maludam National Park is located in the Sri Aman Division of Sarawak and it is about 20-25 km from the secondary forest. The tower site (MLM, 01º27'14.8''N, 111º8'45.3''E) is about 4.5 km from the river bank of Batang Lupar. This forest is identified as Alan Bunga swamp forest with the canopy height of 30-35 m. The forest floor is covered with understory species that mainly consist of *Pandanus tectorius*, whilst the overstory species is dominated by *Shorea albida*. The minimum and maximim fetch of the forest are 600 m and 1100 m respectively. Ample data generated from this study will ultimately provide a thorough understanding on the carbon dynamics and ecosystem production of tropical peat swamp forest.

Fig.4. Maludam National Park

What are we measuring?

Since January 2011, CO_2, energy, and water vapor fluxes have been measured at three sites with eddy covariance system consisting of a three-dimensional sonic anemometer (CSAT3, Campbell Scientific Inc.) and an open-path CO_2/ H_2O gas analyzer (LI-7500A, Li-COR). Signals from all the sensors are recorded at 10 Hz with a datalogger (CR3000, Campbell Scientific Inc.). An open-path gas analyzer is mounted at 21 m (SBW) / 41 m (CMC and MLM) above the ground to measure CO_2 and water vapor densities at one-second interval. Closed-path CO_2 analyzer (LI-820, Li-COR) is deployed to measure the vertical profiles of CO_2 concentrations at six levels within and above the canopy at a constant flow rate of 1.2 l min^{-1}. A variety of auxiliary meteorological measurements are taken at 5-min interval as to substantiate the flux measurements. These measurements include short- and long-wave downward and upward radiation (CNR4, Kipp & Zonen), photosynthetic photon flux density (PPFD) (LI-190, Li-COR), air temperature and relative humidity (CS215, Campbell Scientific Inc.), wind speed and wind direction (01003-5 R.M. Young Co). Soil temperatures are measured at depths of 5 and 10 cm with thermocouples whereas soil moisture profiles are measured using water content reflectometer sensors (CS616, Campbell Scientific Inc.). The TE525 (Campbell Scientific, Inc.) tipping-bucket rain gauge is positioned one meter from the ground surface in the open canopy used to measure precipitation. Groundwater levels (GWL) are measured on an hourly basis using water level datalogger (DL/N 70 STS Sensor Technik Sirnach AG).

In a nutshell

It is of paramount importance to establish long-term flux measurements for providing accurate estimates of net carbon balance of tropical peatlands. In addition, this study is undertaken in the fervent hope to provide scientific information in relation to sustainable management of tropical peatland in attaining a delicate balance between conservation and development.

Acknowledgements

This study is supported by the both Sarawak State and Federal Government of Malaysia. We would also like to thank Professor Takashi Hirano, Professor Ryusuke Hatano, Dr Ryuichi Hirata and Dr. Mariko Shimizu, Graduate School of Agriculture, Hokkaido University, Japan for their invaluable advice and assistance.

Fig.5. EC group members doing maintenance at the top of the tower.

Influence of El Niño / La Niña events (2008-2010) on ecosystem CO2 exchange in flooded and non-flooded rice fields in the Philippines

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Introduction

El Niño/La Niña-Southern Oscillation, or ENSO, is an interannual perturbation of the climate system that occurs across the tropical Pacific Ocean every 3 to 8 years. During El Niño events, there are higher sea surface temperatures in the central and eastern tropical Pacific Ocean as well as higher air surface pressure in the western tropical Pacific (Fig.1).

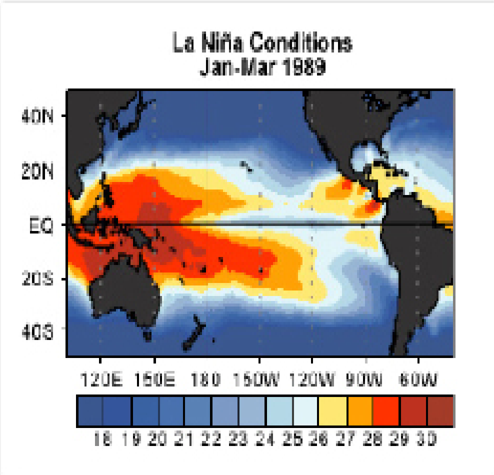

Fig. 1. Sea surface temperature in the central and eastern tropical Pacific Ocean during El Niño.

Whereas, during La Niña events, there is lower sea surface temperatures as well as lower air surface pressure in these regions (Fig. 2). ENSO is widely recognized as a significant determinant of climate variations in the Pacific region (Mason and Goddard, 2001; Ropelewski and Halpert, 1996).

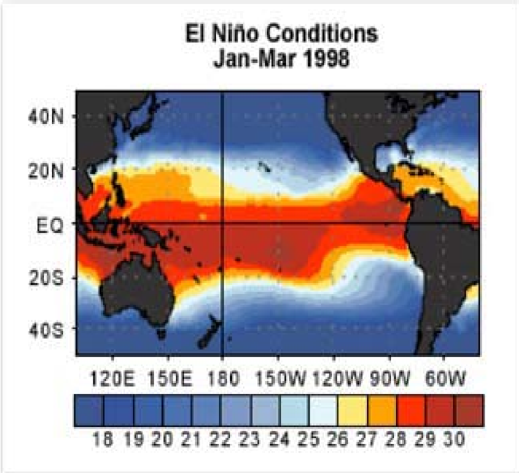

Fig. 2. Sea surface temperature in the central and eastern tropical Pacific Ocean during La Niña.

Seasonal rainfall in the Philippines is known to be modulated by ENSO phenomenon, with El Niño frequently contributing to reduced rainfall and drought (Fig. 3) (Lyon et al., 2006; Jose et al., 1999) while La Niña resulting in excessive rainfalls, floods and more intense typhoons in many areas (Fig. 4) (Lyon et al., 2006; Mason and Goddard, 2001; Ropelewski and Halpert, 1996; Harger., 1995).

Climatic changes associated with ENSO events can significantly affect rice production in the Philippines (Roberts et al., 2009; Dawe et al., 2009; Lansigan, 2005; Lopez and Mendoza, 2004; Lansigan et al., 2000; Buan et al., 1996). In the study of Roberts et al. (2009), they have reported that both irrigated and rainfed rice ecosystems were impacted by ENSO events (Fig. 5).

Fig. 3. An example of drought during El Niño

Fig. 4. An example of floods during La Niña

However, most of these impact studies are focused on rice production and yield. Considering the feedback on radiation, air temperature, and soil moisture with the alterations in rainfall patterns brought by the ENSO events, the ecosystem CO^2 exchange could also be significantly altered. Numerous studies on forests have established strong links between ENSO events and vegetation carbon exchange. In rice production systems, however, limited investigations were reported on the influence of ENSO on ecosystem CO^2 exchange.
Therefore, in this paper, we assessed the effects of the ENSO events in 2008 to mid-2010 on the climate conditions and determined how it affected the net ecosystem CO^2 exchange (NEE) of two contrasting rice environments: flooded and non-flooded.

Methodology

The study sites are situated within the Experimental Station of the International Rice Research Institute (IRRI) in Los Baños, Laguna, the Philippines (latitude: 14.14º N, longitude: 121.26º E), about 66 km south of Manila (Alberto et al., 2009, 2011). The site has flat terrain with an elevation of 21 m above sea level. The non-flooded rice fields chosen had been used for screening of aerobic rice varieties (Fig. 6) (Alberto et al., 2009, 2011). Aerobic rice is a new cropping system in which specially developed varieties are directly seeded in well-drained and non-puddled soils and rice is grown in unsaturated soil moisture conditions for most of the crop duration (Bouman et al., 2005).

Fig. 5. Rainfed (left) and irrigated (right) rice ecosystems impacted by ENSO events.

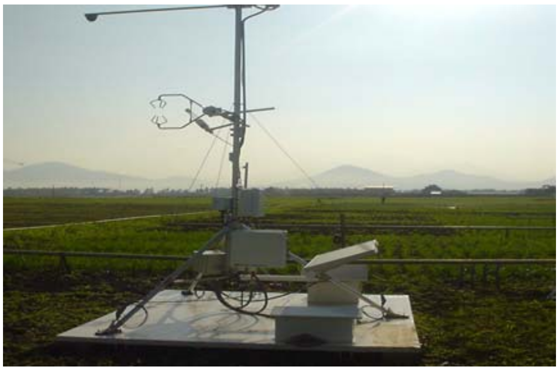

Fig. 6. Non-flooded rice field

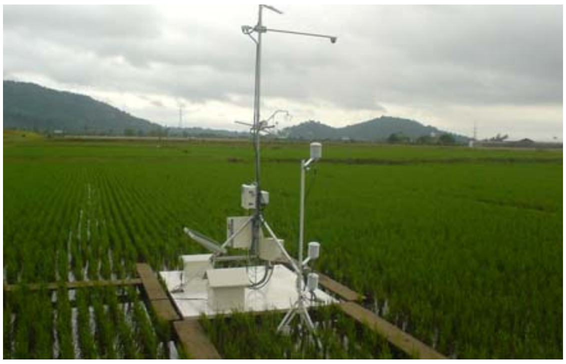

Fig. 7. Flooded rice field

In contrast, the flooded rice field chosen was managed as a typical paddy field that was flooded with 3-5 cm depth standing water for most of its cropping period except during 2 weeks after transplanting when the field was kept saturated but not flooded to prevent damage from golden snails and 2 weeks before harvest when it was totally drained to hasten the ripening of the grains. Within three weeks after harvest, the rice stubbles were plowed under the soil and the field was kept flooded with about 1 cm standing water during fallow period (Fig. 7).

Flux densities of CO_2 over the rice canopy were measured by the eddy covariance technique (Alberto et al., 2009). A sonic anemometer-thermometer (CSAT3, Campbell Scientific, Inc., USA) measured three dimensional wind speed and sonic or virtual temperature. An open-path infrared analyzer (LI-7500, LI-COR Inc., Lincoln, NE, USA) was used to measure the fluctuations in CO2 densities. Both the sensors, CSAT3 and LI-7500, were installed at 2.25-m height on an aluminum tripod mast with 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 vertical to minimize the amount of precipitation that accumulated on its window. The details of the measurements, calculations and quality control of the CO_2 flux data were reported in Alberto et al. (2009).

Results

There are two distinct cropping seasons in the Philippines: the dry season (DS) which is climatically characterized by high solar radiation, less precipitation and lower air temperature and the wet season (WS) which has lower solar radiation, more precipitation and higher air temperature (Yang et al., 2008). The dry season usually starts in December and ends in May while the wet season is from June to November (Alberto et al., 2011).

The 2008 dry season (DS) was under a La Niña event while the 2008 wet season (WS) was a neutral one with strong typhoons associated during the wet season. The 2009DS was also La Niña while the 2009WS was El Niño; however, the northern part of the Philippines experienced strong tropical typhoons. The 2010DS was under an El Niño event while the 2010WS was another La Niña.

The 2008 and 2009 dry seasons received low solar radiation, 14.8 MJ m^{-2} d^{-1} and 14.7 MJ m^{-2} d^{-1}, respectively, compared with the 28-year average solar radiation, 17.4±1.3 MJ m^{-2} d^{-1} (average ± standard deviation for 1979-2007), from the IRRI weather station (Fig. 8a). Significantly, these values were about 15% below the average solar radiation in the dry season and the lowest since 1979 (IRRI, 2009). On the other hand, the solar radiation during 2010DS was high at 18.5 MJ m^{-2} d^{-1}. The 2008 and 2009 wet seasons also received slightly lower radiation, 15.3 MJ m^{-2} d^{-1} and 14.7 MJ m^{-2} d^{-1}, respectively, than the 28-year average solar radiation in the wet season, 15.8 ± 1.1 MJ m^{-2} d^{-1} (Fig. 8a). However, the values were still within the standard deviation of a 28-year record. Precipitation totaled 741 mm and 1045 mm during the 2008 and 2009 dry seasons, respectively, and these values were higher than the average of 463 ± 233 mm (Fig. 8b); while the 2010DS had only 154 mm of rainfall. The 2008 wet season total precipitation was 1196 mm and it was lower than the average of 1604 ± 353 mm, whereas, the 2009 wet season precipitation was 1810 mm and it was higher than the average. The 28-year average air temperature is 27.2 ± 0.4 ºC in the dry season, which is normally lower than in the wet season, 27.7 ± 0.4 ºC (Fig. 8c). The mean air temperatures in 2008 and 2009 dry

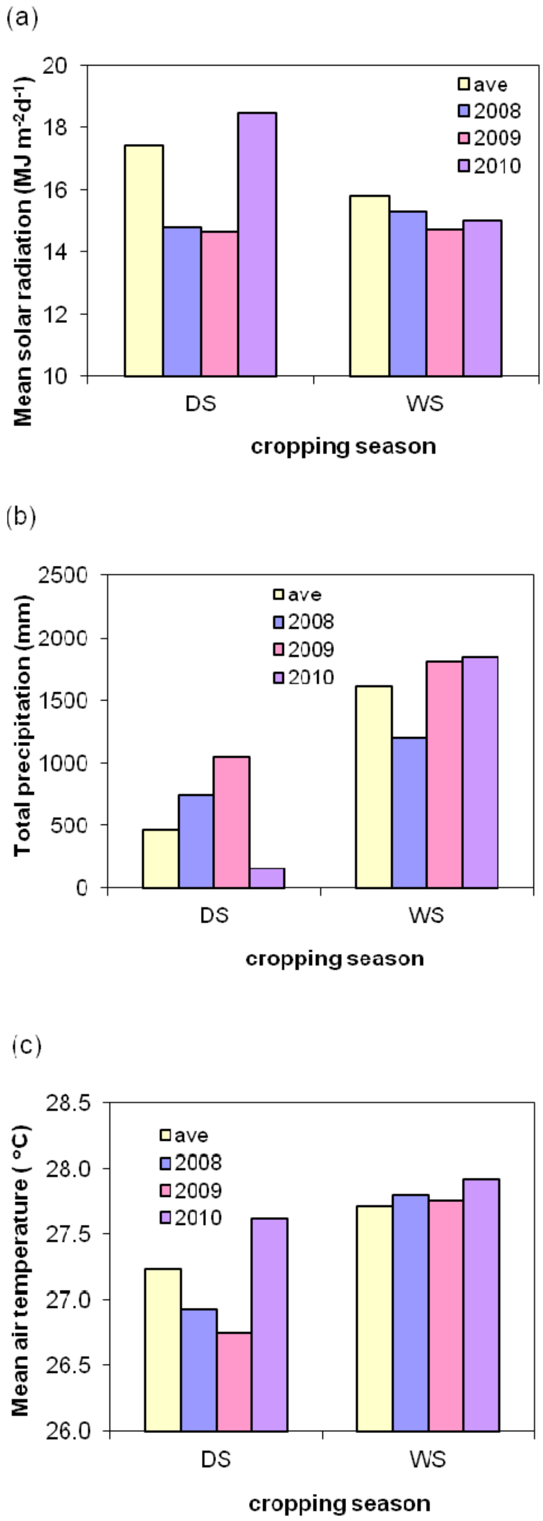

Fig. 8. The differences in the magnitudes of mean solar radiation (a), total precipitation (b), and mean air temperature (c) during two distinctive cropping seasons. DS indicates dry season, whereas WS indicates wet season.

seasons were lower, whereas, that in the 2010DS was higher than the average temperature. However, the mean air temperatures in the dry and wet seasons of 2008, 2009 and 2010 were generally within 1ºC of the 28-year average.

Figure 9 shows the NEE of both flooded and non -flooded rice fields integrated over each season. The NEE in flooded rice field was higher than in non-flooded field in all cropping seasons. Both flooded and non-flooded rice fields had lower net C uptake in 2008DS (-164 and -14 g C m^{-2}, respectively) than in 2008WS (-295 and -82 g C m^{-2}, respectively) because the La Niña event during 2008DS resulted in low solar radiation and this climate anomaly decreased the GPP in both fields. The net C uptake was highest in 2009DS in both flooded and non-flooded rice fields (-351 and -218 g C m^{-2}, respectively) because of the cooler and wetter climate brought by the 2009 La Niña event. This climate anomaly resulted in lower Re in both fields as well as higher GPP in non-flooded field since the climate was favorable for the growth of the aerobic rice, the ratoon crops and the weeds. The NEE decreased in 2009WS in both flooded and non-flooded rice fields (-225 and -39 g C m^{-2}, respectively) due to the devastating effects of the strong typhoons that hit the Philippines in the wet season. In 2010DS, the net C uptake of flooded rice fields decreased to -187 g C m^{-2} because of the hotter and drier climate brought by the El Niño event. This climate anomaly resulted in higher Re in the flooded field. However in the non-flooded field, the El Niño event did not result to high Re so that NEE increased to -174 g C m^{-2}. This shows the advantage of the aerobic rice during El Niño event. The aerobic rice varieties are bred by combining the drought resistance of upland varieties with the high-yielding characteristics of lowland cultivars (Lafitte et al., 2002; Atlin et al., 2004). Aerobic rice is one of the water-saving technologies being developed to address the issues of water-scarcity and it targets irrigated or rainfed lowlands where water is insufficient to keep paddy fields permanently flooded (Bouman et al., 2007).

These short-term results have shown that climate anomalies brought about by ENSO events can affect both flooded and non-flooded rice ecosystems. Both ecosystems can have the potential to become weaker or stronger sinks of atmospheric CO_2 during ENSO events.

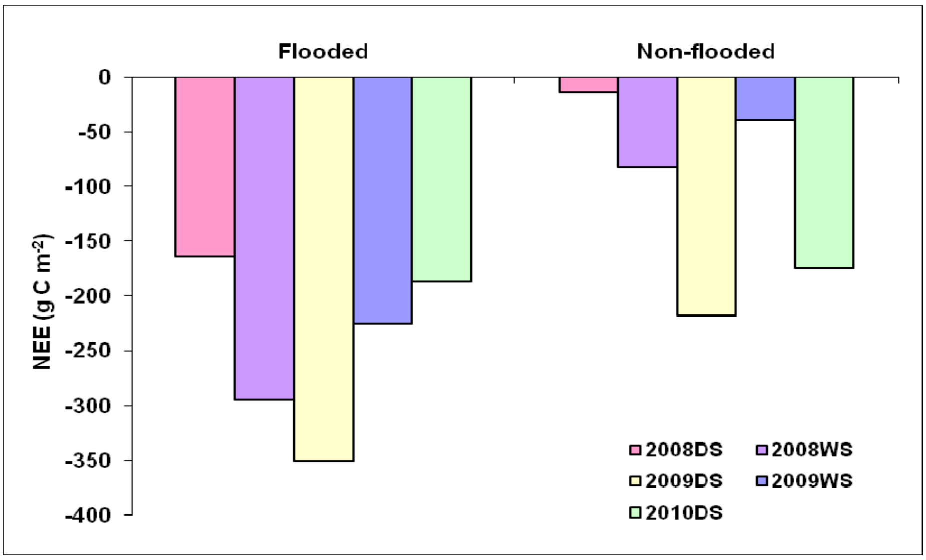

Fig. 9. The interannual patterns of net ecosystem CO_2 exchange of both flooded and non-flooded rice fields integrated over each season.

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This newsletter was aimed to report the general summary of 10th AsiaFlux Workshop from the perspective of the workshop organization and to introduce the flux measurements over tropical peatland in Malaysia and rice field in Philippine. It was my privilege to serve AsiaFlux as the editor of the newsletter. I am sincerely thankful to Dr. Lattif, Dr. Alberto, and Dr. Melling for their articles in this issue.

The Editor of AsiaFlux
Newsletter No. 34
Hyojung Kwon
(Seoul National University, Korea)