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AsiaFlux Newsletter

Contents

Report of the 7th AsiaFlux International Workshop - 17 ~ 19 November 2008, Seoul, Korea -

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It was a timely and proper decision to choose the main theme of the 7th AsiaFlux workshop in Seoul as “*Re-thinking Global Change Science: From Knowledge to Policy*”. As the AsiaFlux chair (Prof. Joon Kim, Yonsei Univ., Korea) pointed out in the workshop announcement, we are standing at the crossroads where the risks can be minimized by developing and transferring the right scientific knowledge to society. The adverse effects of climate changes are being intensified, and it is the right time to promote interaction between science and policy, while continuing basic research programs. With this issue in mind, about 200 participants from 13 countries gathered at the Press Center, Seoul, Korea during 17-19 November 2008. It was to celebrate AsiaFlux’s 10 years of science, service & stewardship. The workshop symbolized the establishment of new leadership, framework and visions that will guide the next decade of AsiaFlux activities.

Introductory sessions (morning, 17th) started with the welcoming addresses and congratulations conveyed by the current AsiaFlux chair, the first chair (Prof. Yoshihiro Fukushima) and celebrities from APEC Climate Center, Japan Aerospace Exploration Center (JAXA), and Society of Agricultural Meteorology of Japan. A brief history of AsiaFlux was introduced by the 2nd AsiaFlux chair, Dr. Susumu Yamamoto, followed by the AsiaFlux visions and missions announced by Prof. Joon Kim. In the National & Regional report session, research activities and plans have been presented by the representatives from FLUXNET & AmeriFLUX, OzFlux, AsiaFlux, ChinaFLUX, IndoFLUX, JapanFlux, KoFlux, TaiwanFlux and ThaiFlux.

Regular sessions (morning and afternoon, 18th) under the theme of ‘*AsiaFlux Contribution to Global Change Sciences*’ consisted of oral and poster presentations on diverse topics ranging from observations to synthesis & assessment. Two keynote speeches were provided by Prof. Dennis Baldocchi (Lessons Learned from a Decade of Flux Measurements across a Global Network of Regional Fluxnetworks) and Dr. Ray Leuning (Land Surface Models and the Global Fluxnet Dataset) that emphasized the importance of collaboration among flux networks and establishment of long-term global datasets.

Special sessions were organized to convey the main issue of the workshop, i.e., interactions between science and policy. CarboEastAsia special session (afternoon, 17th) was an opportunity to deliver and discuss outcomes from collaborative researches among ChinaFLUX, JapanFlux and KoFlux. CarboEastAsia is a subset of the A3 Foresight Program that has been implemented to support international collaboration among global change scientists from China, Japan and Korea. Although CarboEastAsia is mainly a science program, its outcome will ultimately help build capacity to cope with climate change protocols for the participating countries. The HydroKorea special session (morning, 18th) specifically focused on water cycling studies (evapotranspiration measurements and forecasting) and their applications for water resource management. Ten presentations in this session dealt with practical theories and technologies for nationwide water resource management under changing climate conditions. One of the highlights of this workshop was 'ACTSociety (Asian Carbon Trackers' Society)' special session under the theme of '*From Implications to Applications*'. This special session was prepared with the intention to invite policy-makers and non-scientists to the scientific discussions on the climate change and encourage climate change scientists to outreach to meet the societal needs. Scientists, a CEO, a diplomat and students gave presentations to express their view on the climate change and the proper roles of scientists for the society.

The Synthesis & Discussion (afternoon, 18th) that concludes two days of science programs was led by Dr. Ray Leuning from CSIRO, Australia. Five main topics were laid out and free discussion was carried out among the participants. The five topics to be pursued by AsiaFlux scientists are,

(1) Model-data fusion. Techniques for integrating observations into models at multiple time and space scales.

(2) Remote sensing and surface fluxes of carbon, water and heat. How do we go from radiances to fluxes?

(3) How do we test global models? The link between local observations and global models at multiple time and space scales.

(4) Validating NEE and water runoff – small net differences between large gross fluxes. What measurements are useful to keep model predictions honest?

(5) Energy balance closure – an unresolved issue in micrometeorology?

Field excursion (19th) to Gwangneung supersite, led by KoFlux leading scientist Dr. Hyojung Kwon, unfortunately put the

Figure 1. A blurry photo of the survivors who stayed until the last moment of the workshop

participants in an excruciating situation due to freezing weather. Nevertheless, the hilly complex terrain in Gwangneung site clearly illustrated for the participants the challenges that KoFlux scientists are facing. Another small group headed to the southernmost island of the country called Jeju. While enjoying exotic sightseeing in the island, the participants visited Gosan (19^{th}) observatory which is one of the leading atmospheric observatories in East Asia monitoring regional atmospheric conditions. The schedule in Jeju also included participation in 'International Conference on Climate Change: Science and Impacts (19 ~ 21 November)' hosted jointly by various Korean organizations on climate studies.

Finally, the workshop organizing committee appreciates the financial support from sponsors in China, Japan, Korea and many other countries including government agencies, institutes, science communities, and private companies. The organizing committee also appreciates the valued participants from all over the world who shared their knowledge and experience with AsiaFlux community. The effort of the staffs must be acknowledged with heartfelt gratitude for the successful management of the workshop. As the last word, I'd like to thank my colleagues to help write this report by providing their vivid memories of the workshop.

Brief results of a research project "Establishment of good practices to mitigate greenhouse gas emissions from Japanese grasslands"

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5) Miyazaki University, 6) Japan Grassland Agriculture and Forage Seed Association

1. Background

The livestock production in Japan has been improved through the processing-type livestock husbandry. However, the processing-type livestock husbandry is causing various environmental problems, especially the greenhouse gases emission. Since the Kyoto Protocol came into effect in February 2005, developing suitable technologies for controlling the greenhouse gases emission has become very important.

Proper management of the livestock waste is crucial because it might become a source of greenhouse gases such as carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4). An effective use of the compost might be useful to mitigate greenhouse gases emission in grasslands.

Figure 1. Locations of the study sites.

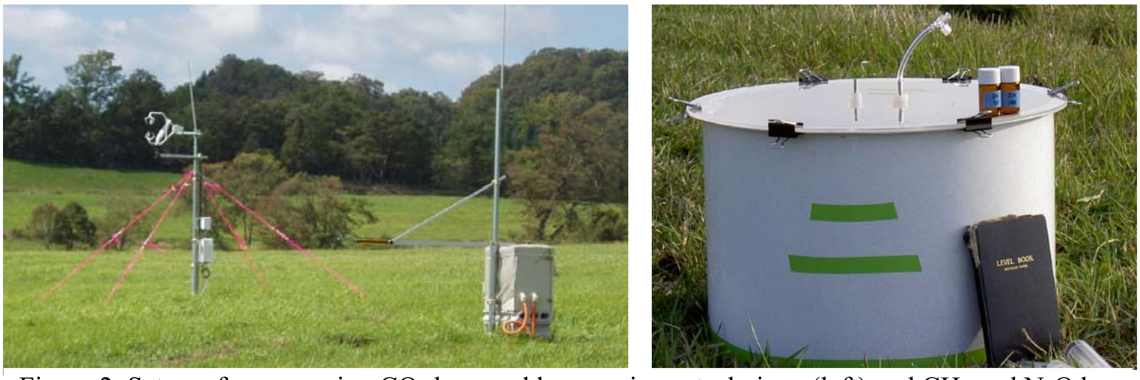

Figure 2. Sets up for measuring CO_2 by an eddy-covariance technique (left) and CH_4 and N_2O by chamber method (right)

Sponsored by Japan Racing and Livestock Promotion Foundation, Japan Grassland Agriculture and Forage Seed Association, We conducted an investigation on the uptake and emission of greenhouse gases in 2004-2006 on the grasslands of four sites in Japan. The objectives of this project were (1) to clarify the role of Japanese grasslands in the greenhouse budgets throughout the country, (2) to elucidate the impact of using of compost on greenhouse gases emissions.

2. Methods

We measured greenhouse gases fluxes at four grassland sites in Nakashibetsu, Shizunai Towns in Hokkaido, Nasushiobara City in Ibaraki Prefecture, and Kobayashi City in Miyazaki Prefecture during 2004-2006 (Fig. 1). Greenhouse gases were measured by setting up two experimental plots using both compost and chemical fertilizer (compost plot) in one and only chemical fertilizer (chemical fertilizer plot) in the other.

Major greenhouse gases CO_2, CH_4, and N_2O were measured. Net ecosystem production (NEP) was measured by the eddy-covariance technique (positive NEP means ecosystem absorbs net CO_2 from the atmosphere). Fluxes of CH_4 and N_2O were measured with the chamber method (Fig 2).

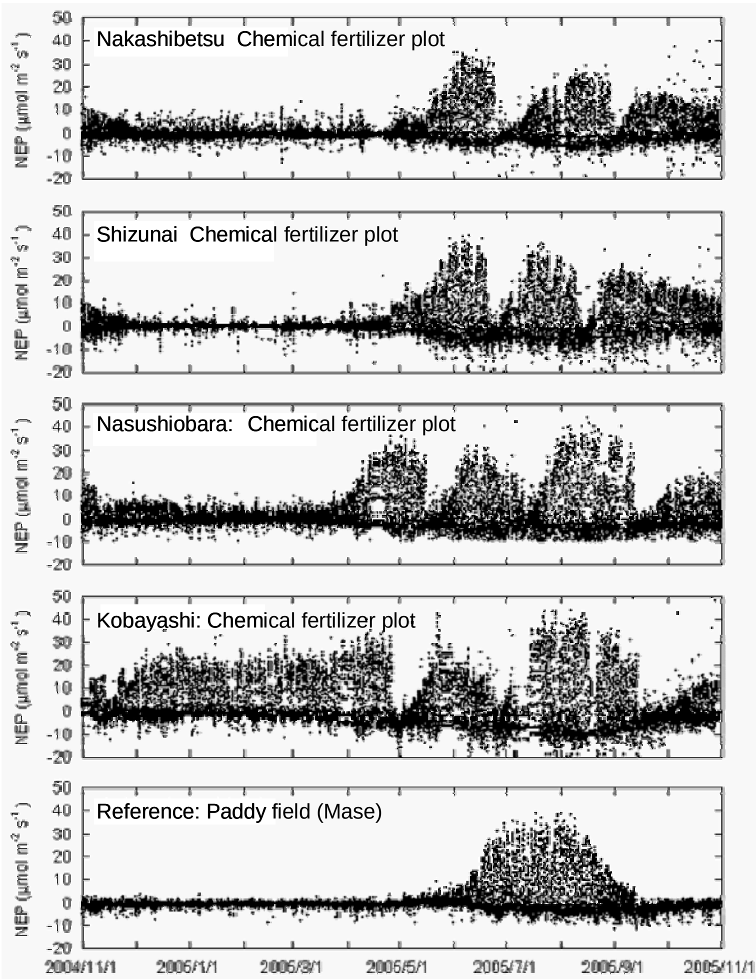

Figure 3. Seasonal variations in NEP of the study sites.

Table 1. Global warming potential (GWP) at the study sites

Region	Year	GWP (Mg CO_2 ha^{-1} y^{-1})							
		Compost manure plot				Chemical fertilizer plot			
		GWP components			GWP	GWP components			GWP
		NBP	CH_4	N_2O		NBP	CH_4	N_2O	
Nakashibetsu	2005	-13.1	-0.01	0.3	-12.8	3.3	-0.02	0.1	3.4
	2006	-12.9	0.00	0.9	-12.0	-0.4	0.01	0.2	-0.2
Shizunai	2005	-19.0	0.01	1.8	-17.2	2.7	0.01	1.3	4.0
	2006	-20.6	0.00	2.3	-18.3	-2.6	0.00	1.3	-1.3
Nasushiobara	2005	-8.6	-0.02	3.3	-5.4	-6.7	-0.03	2.2	-4.5
	2006	-6.7	0.00	5.1	-1.6	0.8	-0.02	4.2	5.1
Kobayashi	2005	-6.5	-0.01	5.3	-1.2	-5.5	-0.01	0.9	-4.6
	2006	-17.7	-0.01	2.5	-15.3	-4.8	-0.01	1.4	-3.4

The global warming potential (GWP) was estimated to evaluate the contribution to global warming. For the greenhouse gases measured, CO_2 has a GWP of exactly 1 (since it is the baseline unit to which all other greenhouse gases are compared), CH_4 and N_2O has a GWP of 23 and 296, respectively. The GWP of the ecosystem was the sum of the three. Positive GWP indicates the ecosystem is a greenhouse gas source and the negative indicates a greenhouse gas sink.

3. Results

(1) The NEP of compost plot was smaller than that of chemical fertilizer plot in all investigation sites.

(2) The seasonal change in NEP from spring to autumn increased with the re-growth of vegetation after grass harvesting at each site (Fig. 3). Positive NEP was observed for seven months even in the site with short growing season (Nakashibetsu)

(3) The compost plots had negative values of GWP for all ecosystems and the use of compost was able to mitigate the global warming (Table 1). CO_2 is the main contributor to the ecosystem GWP.

(4) In the chemical fertilizer plots, the GWP was significantly negatively correlated with annual mean temperature and the duration of sunshine during the growing season, implying warming climate may mitigate the gas emission under this treatment (Fig. 4).

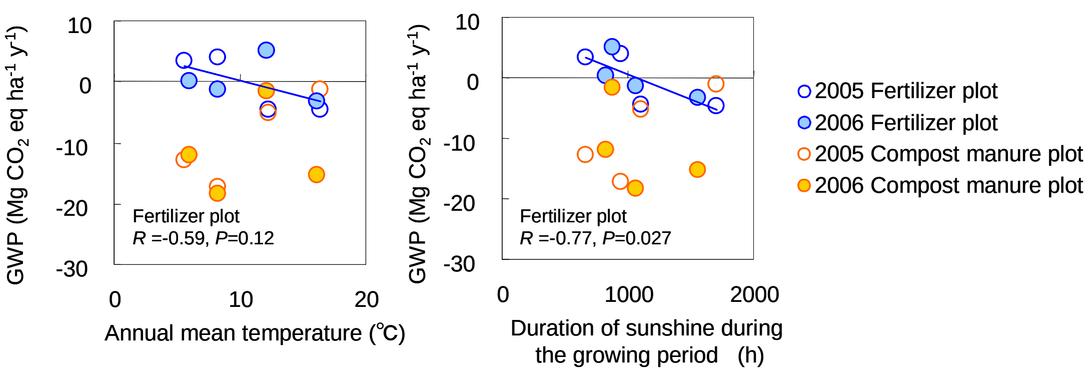

Figure 4. The relationship between global warming potential (GWP) and (left) annual mean temperature, (right) duration of sunshine during the growing period.

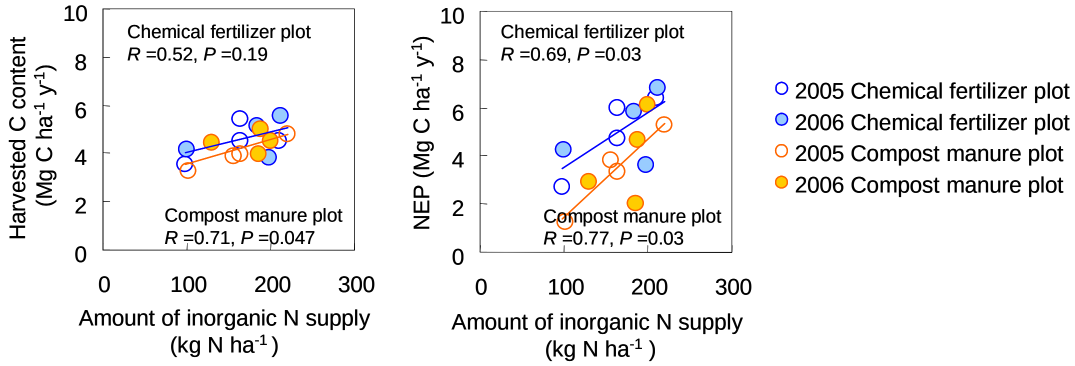

Figure 5. Relationship between the amount of inorganic N supply and (left) the harvested carbon content, (right) net ecosystem production (NEP).

(5) The harvested carbon and NEP were significantly enhanced by the application of nitrogen input (Fig. 5).

4. Conclusions

(1) Main grasslands in Japan are greenhouse sinks, which can mitigate the global warming.

(2) The use of compost in the grasslands of Japan has a mitigating effect on global warming. This effect is especially obvious in the cold region.

Effects of Solar Radiation on Net Ecosystem Exchange of a Broadleaved Korean Pine Mixed Forest

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1. Introduction

Solar radiation drives the photosynthesis of forest ecosystem. When there is cloud in the sky, solar radiation, diffuse radiation and direct radiation on ground surface will be changed, causing other environmental factors such as temperature, vapour pressure deficit change as well, which would affect the net ecosystem exchange (NEE) of carbon dioxide of forest ecosystem. Many researches found that the increased diffuse radiation as result of the increase of cloudiness could enhanced the NEE and light use efficiency of forest ecosystems (Goulden et al., 1997; Gu et al., 1999; Law et al., 2002; Alton et al., 2007). Here we report the responses of NEE to changes in solar radiation with cloudiness in a temperate mixed forest ecosystem. Our purpose is to elucidate whether the cloud condition would promote the NEE at this ecosystem.

2. Methods

The study site is located at 42°24′09″N, 128°05′09″E with an elevation of 738 m in Changbaishan Mountain. Annual mean temperature and total precipitation are 3.6℃

and 695 mm, respectively. The soil is montane dark brown forest soil. The topography is flat and the Predominant species are *Pinus koriaensis*, *Tilia amurensis*, *Quercus mongolica*, *Fraxinus mandshurica*, *Acer mino*. The forest is multi-layer structure, with understory coverage 40%. The average height of canopy is 26 m and stem density is 560 stems hm^{-2}. 30-min CO_2 flux data and routine meteorological data that we used in this study were obtained by a open-path eddy covariance system and a routine meteorological system, which were mounted on 62 m flux tower.

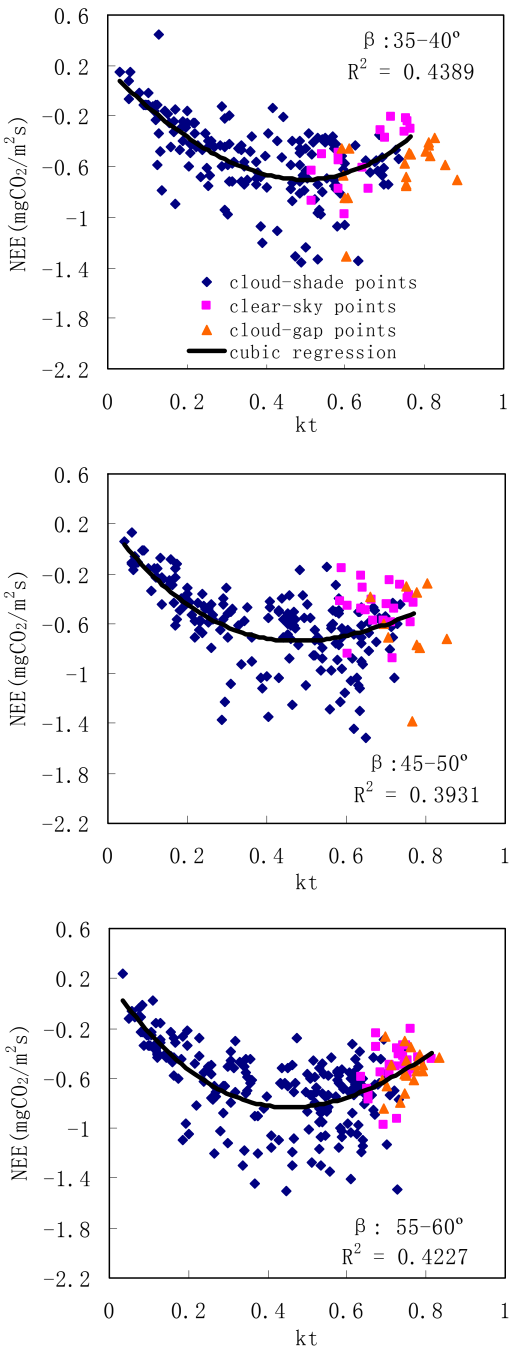

Figure 1. Responses of NEE to clearness index (k_t) for different intervals of solar elevation angles from June to August in 2003

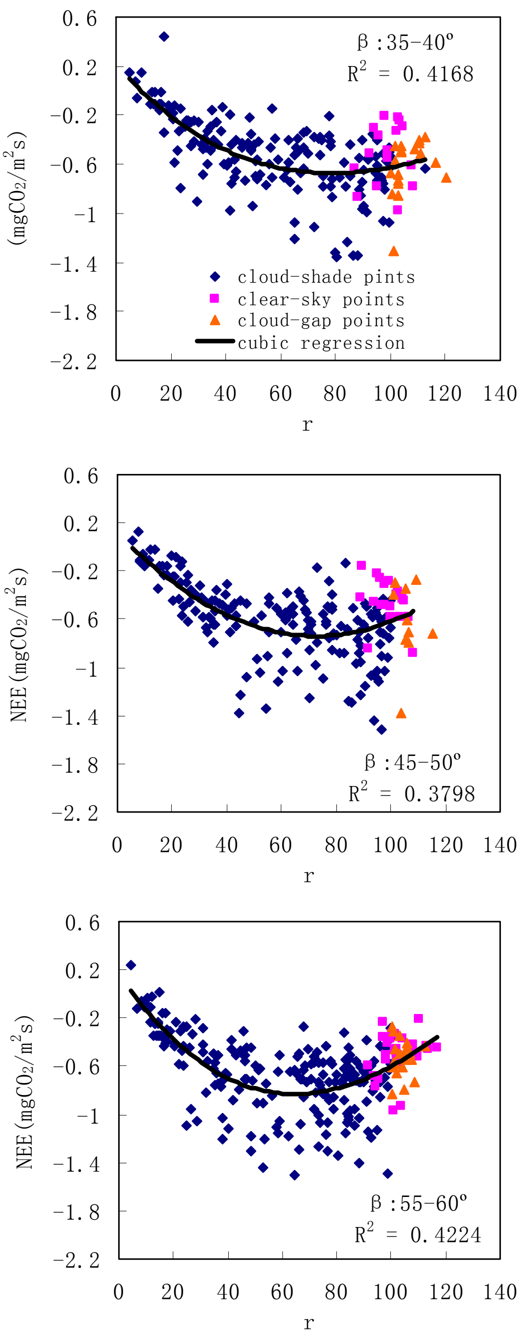

Figure 2. Relationship between NEE and relative irradiance (r) for different intervals of solar elevation angles from June to August in 2003

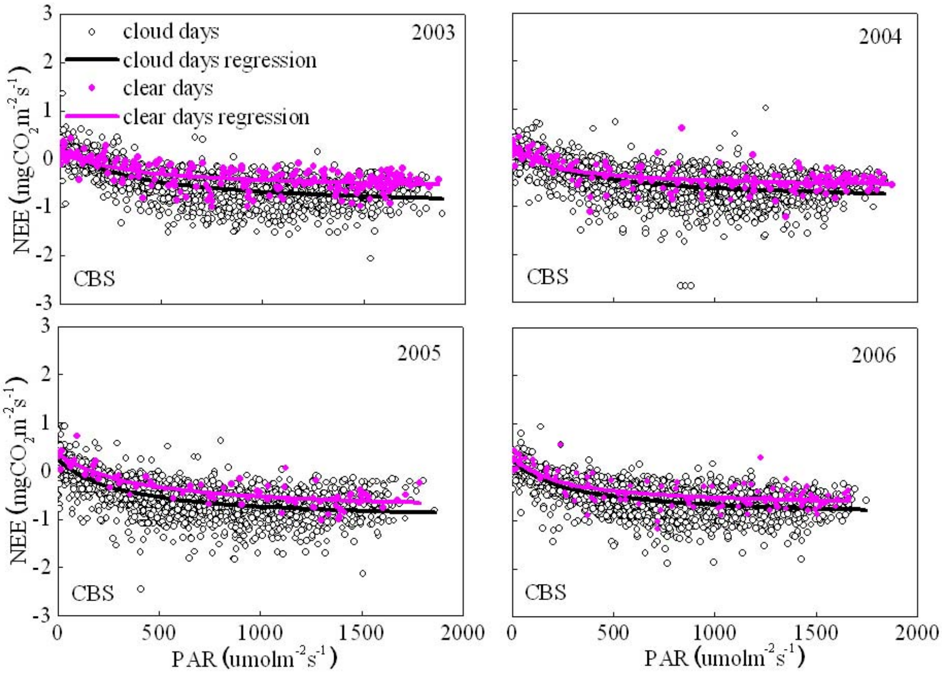

Figure 3. Light response curves under clear days and cloud days in June to August 2003-2006

Only the data of mid-growing season (Jun.-Aug.) when LAI keeps relatively constant (5.3±0.1m^2 m^{-2}) was used for analysis. The solar elevation angles were grouped with 5° intervals to exclude the effect of changing solar elevation angles. In order to quantify the effect of cloud on solar radiation above the canopy, clearness index (k_t) and relative radiation (r) were calculated. k_t is defined as the ratio of global solar radiation received at the Earth surface to the extraterrestrial irradiance at a plane parallel to the Earth surface. r is the ratio of the total irradiance received under a given sky condition to the clear-sky irradiance multiplied by 100 (Gu *et al.*, 1999). When the values of r and k_t are high, the sky will be clear, and the solar radiation on the ground will be strong.

3. Results

NEE showed nonlinear response to the changes in clearness index (Fig. 1). NEE increased (more negative) with the clear index when the sky had moderate cloud and reached the maximum when k_t was 0.4-0.6. As k_t exceeded 0.6, i.e., the sky became high clear, NEE decreased (more positive) obviously.

The response of NEE to changes in the relative irradiance was similar to the responses of NEE to changes in the clearness index. NEE increased at first and then decreased with increasing relative irradiance. Cubic polynomial functions were used to fit the relationship between NEE and relative irradiance (Fig. 2). The maximum NEE was archived when r at the level of 60-80%.

With the data in June to August for each year, rectangular hyperbolic functions were used to fit the light response curve both in clear days and cloudy days (Fig. 3). NEE tended be more in cloudy days negative only under high PAR level than that in clear days. The maximum photosynthetic rate on cloudy days was 4-34% higher than that on clear days in 2003-2006. This result indicates that moderate increase in cloud will be benefit for carbon uptake in this temperate forest ecosystem.

Conclusion

NEE increased at first and then decreased with the increasing clearness index and relative irradiance. Maximum NEE occurred under moderate cloudy skies with clearness index ca. 0.5, and relative irradiance 60-80%. Increase of cloudiness can obviously enhance net carbon uptake for this temperate forest only under high PAR levels.

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Sharing Some Thoughts after Attending AmeriFlux Science Team Meeting 2008

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AmeriFlux Science Team Meeting was held from October 15 to 17, 2008 in the town of Boulder, Colorado, USA, which is located in the foothills of Rocky Mountains and known as one of the fabulous winter wonderlands in USA. The meeting proceeded with several major topics such as AmeriFlux progress, continuous flux measurements, integration of flux, remote sensing, and models, and global flux synthesis.

On the 1st day of the meeting, Dr. Bev Law, the AmeriFlux team chair, opened the meeting with a welcoming speech, and the presentations on several on-going AmeriFlux activities (e.g., cross-site comparison and central data base) were followed. There was also an introductory presentation on the interaction between AmeriFlux and National Ecological Observatory Network (NEON) (Figure 1). In addition, the continuous flux measurements concentrated on the coupling and inter-annual variations of carbon and water cycles were presented. During the morning session of the 2nd day meeting, the main topics were the

Figure 1. A presentation during AmeriFlux annual meeting

synthesis of flux data, remote sensing, and models, and regional carbon budgets estimation (i.e., North America carbon budgets). In the afternoon- session, the topics focused on fossil CO_2 and non-CO_2 green house gases emissions, and the discussion of standardized data processing was also discussed. On the 3rd day of the meeting, there were presentations on regional and global flux synthesis (e.g., Canadian carbon program flux synthesis and FLUXNET data progress), and other presentations on the topics of albedo were followed. After all these presentations for two and half days, the meeting was ended on a crispy sunny day of autumn in Boulder, CO (Figure 2).

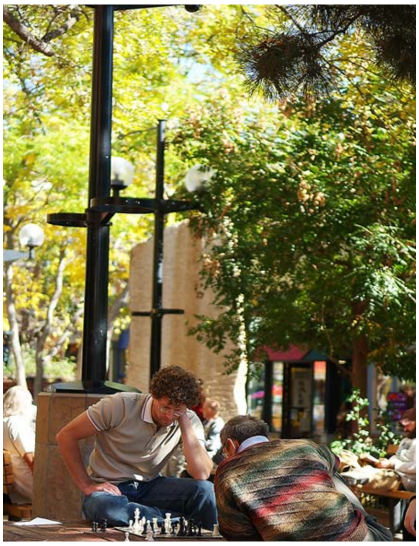

Figure 2. Chess players on a sunny day of autumn in Boulder, CO.

There were many interesting and insightful presentations, I admitted. However, there were two key words, which grabbed my attention more than those exciting scientific results throughout the meeting: uncertainty and standardization. Dr. Dario Papale also mentioned that EUROFLUX puts its emphasis on uncertainty and standardization.

Uncertainty (i.e., error) in the flux measurements is unavoidable. The sources of uncertainty can be systematic errors (e.g., nocturnal biases, advection, and energy balance closure) and/or random errors (e.g., surface heterogeneity, turbulence sampling errors, and equipment). Systematic errors can be identified and corrected but the correction itself is also uncertain. Random errors can be identified via statistical analysis but they cannot be corrected (Richardson and Holllinger, 2007). Common notion on uncertainty in the data, at least to me, was incredulity of the data, resulting in a lack of confidence in the data. When the concept of uncertainty is understood as the indication of confidence degree within the data, however, the assessment of uncertainty becomes an important process to uncover errors quantitatively and to increase confidence in the data. Raupach *et al.*, (2005) pointed out that the estimates of these uncertainties in the data can be as critical as the data values themselves. There have been several methods proposed to assess the uncertainties (Massman and Lee, 2002, Raupach *et al.*, 2005, and Richardson and Hollinger, 2005). I don't think that there is a panacea (i.e., an absolute criterion) for uncertainty estimates. but However, careful methodology can reduce the uncertainty within the data by correcting the systematic errors and minimizing the random errors.

The focus of standardization is not only on the flux and biological measurements but also on the data processing. As the research synthesis activities from measurement to modeling are increasing for the estimate of both regional and global carbon budgets, the necessity of the standardization becomes more and more necessary has been amplified. The activity of FLUXNET synthesis data, as a result of FLUXNET-TCO synthesis workshop in LaThuile, Italy, is a good example of data standardization (Papale *et al.*, 2006). The number of the flux tower sites has been rapidly increased, and collaborations have been active in the AsiaFlux community (e.g., CarboEastAsia; http://www.carboeastasia.org/). AsiaFlux plays a very critical role in bringing together scientists and collecting the flux data as a main access point Asia. As FLUXNET synthesis activity at La-Thuile illustrated, the scope of flux research is no longer confined in only one local location or region. Further more, on the time that the understanding of carbon and water vapour fluxes focuses not only on the process studies at a local scale but also on the diagnoses of regional and global scales. The standardization of the data processing in AsiaFlux community may be more needed than before in order to expedite the usage of the extensive data and to facilitate the regional research of carbon and water vapour fluxes.

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I sincerely appreciate the authors for contributing to this issue of Asiaflux newsletter.
2009 is a 牛(Ox) year in China and 牛 sounds like the "new", which means diligence and success. So Happy 牛 year to all Asiaflux members! Hope you make great success in 2009!

The editor of AsiaFlux Newsletter No.27
Zhongmin Hu
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The Editor of AsiaFlux Newsletter No. 28 will be Prof. Hsieh Cheng-I (National Taiwan University, Taiwan).