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Contents

Introduction to the site information on AsiaFlux website and overview of tower flux observation sites in Asia

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Aggregating and sharing information from flux observation sites shall result in a strong collaboration among various fields of study. Such data also become fundamental information for the future design of a tower flux observation network. We have collected Asian site information aiming at publication on a website. In the process, we obtained information from more than 100 sites in Asia from their websites and publications. In this article, we introduce the overview of tower flux observation sites in Asia.

Site information on AsiaFlux website

Site information pages on AsiaFlux website (http://www.asiaflux.net/network.html) was set up on April 6, 2007 with the support of many investigators. The number of the listed sites was originally 21 but by the middle of May 2008, it became 60 (Table 1). 38 out of 60 are forest and shrubland sites and the rest, 22 sites are in cropland, grassland, wetland and other land cover. Site information on the website includes general site description, flux and meteorology observation details and the related researchers and publications. These metadata are also referable when using flux data of the site from AsiaFlux Database.

Situation of flux observation sites in Asia

134 sites are listed as tower flux observation sites in whole Asia by Mizoguchi *et al.*, accepted. They cover the area widely from Siberia to Southeast Asia. 25 sites are temporary and closed observation sites and the rest, 109 sites include 84 active and 25 inactive

Table 1. Tower flux observation sites on AsiaFlux website. Background of forest and shrubland sites are painted green and those of cropland, grassland and other sites are painted yellow.

Site code[1]	Area	Latitude (deg)	Longitude (deg)	Altitude (m)	Climate[2]	Status[3]	Land cover
AKO	Japan	34.73	134.37		C	0	evergreen broadleaf forest
API	Japan	40.00	140.94	825	D	1	cool temperate deciduous broadleaf forest
BKS	Indonesia	-0.86	117.04	20	A	0	tropical secondary forest
CBF	China	51.78	123.02	773	D	1	boreal forest
FHK	Japan	35.43	138.75	1050 - 1150	C	1	Japanese larch forest afforestation
FJY	Japan	35.45	138.76	1030	C	1	natural evergreen needle-leaf forest
GDK	Korea	37.75	127.15	340	D	1	mixed deciduous / coniferous forest
HEF	Japan	42.99	141.39	165	D	0	young evergreen conifer plantation
K04	China	40.54	108.69	1024	D	1	poplar forest plantation
K05	China	40.38	108.55	1164	B	1	Shrubland
KEW	Japan	34.96	135.99	250	C	1	evergreen coniferous forest
KHW	Japan	33.14	130.71	165	C	1	planted evergreen coniferous forest
KMW	Thailand	18.80	98.90	1295	C	1	tropical mountain forest (hill evergreen forest)
KWG	Japan	35.87	139.49	26	C	0	deciduous broadleaved forest
KZW	Japan	36.40	138.58	1380	D	1	mixed deciduous forest
LHC	Taiwan	23.93	120.89	773	C	1	broadleaf forest
LSH	China	45.28	137.42	340	D	1	larch forest
MBF	Japan	44.38	142.32	585	D	1	birch forest
MKL	Thailand	14.58	98.84	231	A	1	tropical seasonal deciduous forest
MMF	Japan	44.32	142.26	340	D	1	mixed forest
MMP	Thailand	18.42	99.72	380	A	1	artificial teak plantation
NFT	Japan	36.55	140.13	40	C	0	fruit farm
PDF	Indonesia	-2.35	114.04	30	A	1	tropical peat swamp forest
PSO	Malaysia	2.97	102.30	75 - 150	A	1	primary lowland mixed dipterocarp forest
RFC	Thailand	13.67	101.44	69	A	1	mono-specific rubber tree plantation
SAP	Japan	42.99	141.39	180	D	1	deciduous broadleaf forest
SJP	Japan	36.21	139.95	20	C	1	Japanese pear orchard farm
SKR	Thailand	14.49	101.92	543	A	1	tropical seasonal evergreen forest
SKT	Mongolia	48.35	108.65	1630	D	1	larch forest

1: three letter code on AsiaFlux website, 2: Koeppen climate classification. (A: equatorial, B: arid, C: warm temperate, D: continental and E: polar zone), 3: '1' means active and '0' means inactive.

Table 1. Tower flux observation sites on AsiaFlux website (*Continued*).

Site code[1]	Area	Latitude (deg)	Longitude (deg)	Altitude (m)	Climate[2]	Status[3]	Land cover
SMF	Japan	35.25	137.07	205	C	1	mixed forest
TKC	Japan	36.14	137.37	800	D	1	planted evergreen coniferous forest
TKY	Japan	36.15	137.42	1420	D	1	cool temperate deciduous forest
TMK	Japan	42.74	141.52	140	D	0	artificial Japanese larch forest
TSE	Japan	45.05	142.10	70	D	1	coniferous mixed forest till 2003, young larch plantation since 2003
TUR	Russia	64.21	100.46	250	D	1	larch forest
YLF	Russia	62.26	129.24	220	D	1	larch forest
YMS	Japan	34.79	135.85	225	C	1	deciduous broadleaf secondary forest
YPF	Russia	62.24	129.65	220	D	1	pine forest
CM1	China	31.52	121.96	31	C	1	brackish marsh
CM2	China	31.58	121.90	31	C	1	brackish marsh
CM3	China	31.52	121.97	31	C	1	brackish marsh
D01	China	42.05	116.28	1350	D	1	typical Stipa krylovii steppe
D02	China	42.05	116.28	1350	D	1	cropland
DSX	China	44.09	113.57	970	B	1	desert steppe
DW7	China	45.56	117.00	865	D	1	typical steppe
HFK	Korea	34.55	126.57	14	C	1	rice / farm land
JAS	China	41.82	121.20	17	D	1	cropland
KBU	Mongolia	47.21	108.74	1235	B	1	uniform grassland
KBY	Japan	31.97	130.93	298 - 301	C	1	hay meadow (chemical and manure plots)
MSE	Japan	36.05	140.03	13	C	1	rice paddy field
MYM	Bangladesh	24.73	90.42	18	A	1	rice paddy field
NRW	China	41.14	121.91	7	D	1	reed marsh
NSS	Japan	36.92	139.97	320	C	1	hay meadow
PRW	China	41.14	121.91	7	D	1	rice paddy field
QHB	China	37.61	101.30	3200	E	1	alpine meadow
SZN	Japan	42.43	142.48	120 - 130	D	1	hay meadow (chemical and manure plots)
TGF	Japan	36.12	140.13	20	C	1	C3/ C4 grassland
TSX	China	44.13	116.33	1030	B	1	grassland
X03	China	43.55	116.67	1250	D	1	degraded steppe
X06	China	43.55	116.68	1250	D	1	fenced steppe

1: three letter code on AsiaFlux website, 2: Koeppen climate classification. (A: equatorial, B: arid, C: warm temperate, D: continental and E: polar zone), 3: '1' means active and '0' means inactive.

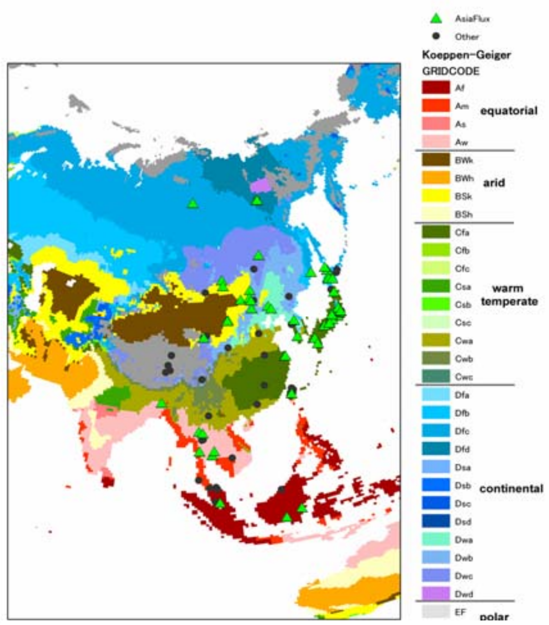

Fig. 1. Tower flux observation sites on the Koeppen-Geiger climate classification map (Kottek *et al.*, 2006). GIS format data for climate classification were downloaded from the Internet (URL: http://koeppen-geiger.vu-wien.ac.at/)

sites with long-term observation. We have dealt with these 109 sites in this article. 33 sites including 17 forest sites started flux observations before 1999. The number of old sites in Asia is not few compared to other region like North America and Europe. 21 sites including 10 forest sites were established after 2005. Having many new sites is a distinction of Asia.

Spatial distribution

All Koeppen - Geiger climate zones from equatorial to polar exists in Asia (Kottek *et al.* 2006). Most observation sites are located in warm temperate and continental zones from East to Southeast Asia (Fig. 1). 17 sites are in equatorial zone, 5 in arid zone, 40 in warm temperate zone, 40 in continental zone, and 7 in polar zone. Although there are many forest sites in equatorial zone, there are a few cropland sites in spite of its wide coverage in that zone.

51 out of the 109 sites are in forest. They can be divided into 8 evergreen needle leaf, 17 evergreen broadleaf, 8 deciduous needle leaf, 13 deciduous broadleaf and 5 mixed forest sites. Most sites in evergreen broadleaf forest are located in equatorial zone. Lucidophyllous forest is a kind of evergreen broadleaf forest which is a typical forest in warm temperate zone in Asia but rare in other region. Therefore, enriching observation at lucidophyllous forest sites are more expected in Asia.

Forests exist usually in mountainous area in temperate zone in Asia and we often have to conduct flux observations in complex terrain. More than 20% of forest sites are classified as having complex terrain. Development of a flux evaluation method for complex terrain sites is urgently expected.

58 unforested sites include 24 grassland and 19 cropland sites. Cropland sites include 12 rice paddy field sites. Rice paddy field is a typical cropland in Asia. Intensive synthesis analyses are expected to be conducted to figure out the influences of field management on fluxes.

As described above, organized site information helps us to see the trend in the field of flux study. We have found out that some new sites have been developed in some new regions such as India. There may be more unknown sites in China and other regions, but general trend should not change much.

It is expected that site we could not pick up this time should be publicized immediately in ways that will be opened for many people. Site information is always welcomed at AsiaFlux community. We expect that site information on website will be enriched and more useful for everyone.

Acknowledgments

We would like to thank all principal investigators of flux observation sites and many other people for providing site information and the network management & database management sub-workgroups of AsiaFlux (leader: Prof. Y. Fujinuma & T. Hirano, respectively) for supporting our work. We would like to also thank Dr. H. Daimaru for his help in making GIS map and Dr. A. Miyata & Y. Ohtani for advices in assembling site information. This work was supported by the Special Coordination Funds for Promoting Science and Technology of the Ministry of Education, Culture, Sports, Science and Technology, Japan.

References

Mizoguchi, Y., Miyata, A., Ohtani, Y., Hirata, R., Yuta, S.' *accepted*. Review of tower flux observation sites in Asia. *Journal of Forest Research*

Kottek, M., Grieser, J., Beck, C., Rudolf, B., Rubel, F., 2006. World Map of the Köppen-Geiger climate classification updated. *Meteorolgische Zeitschrift* **15**: 259-263.

Research Activities of Korea Polar Research Institute: Flux Observation in the Arctic and Antarctic Regions

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Korea Polar Research Institute (KOPRI) has involved in the research activities in the Arctic and Antarctic regions to address key research issues relating to the global climate change. Given the apparent sensitive nature of these regions to climate change, it is imperative to enhance understanding of and quality of how energy, carbon, and water cycles contribute to climate change. In order to achieve the research goals, KOPRI has conducted flux measurements at the King Sejong station in the Antarctic since December 2002 and at the *Dasan* station in the Arctic since August 2003. These two sites have been registered in KoFlux and here in this article, we provide a brief introduction of the flux measurements at the two sites.

King Sejong Station Site

Site description

The King Sejong station site is one of the KoFlux sites located at King George Island, South Shetlands close to the Antarctic Peninsula (62°13'S, 58°47'W). The flux site is managed by Korea Polar Research Institute, KORDI. The eddy covariance flux tower was established to measure turbulent energy fluxes between the land surface covered with lichen and mosses and the atmosphere in December, 2002. In February 2008, the flux tower was moved toward coast area with a footprint on the Marin Cove to better understand the air-sea CO_2 flux at the Southern Ocean.

Marin Cove is a fjord with a length of 4 km and a width of 1.1 km that develops from northeast to southwest. A glacier in Marian Cove is a grounded tidewater glacier and ends with a 1.2-km wide and 2.8-km long calving front in Marian Cove. Based on aerial photographs, satellite image, and ground measurements, Marian Cove has experienced pronounced retreat of ice shelves.

The climate around the Antarctic Peninsula and neighboring islands differs greatly from that of the main Antarctic continent with relatively high temperatures and precipitation in summer. Due to the geographic location, depressions on synoptic- or meso-scale move eastward with frequent succession. This phenomenon brings about frequent precipitation or cloudy days. Based on meteorological measurements at the King Sejong station during the period of 1988–2004, the annual mean air temperature, wind speed, and precipitation at the study site were - 1.6 °C, 8.0 ms^{-1}, and 484 mm, respectively

Instrumentation

A 10-m tower was established about 10 m onshore for the flux measurement in February 2008. At the moment, only a three dimensional sonic anemometer (CSAT3, Campbell Scientific Inc., USA) has been operated. Sampling rate is 20 Hz and half-hourly averaged turbulent statistics are calculated and stored in a data logger (CR5000, Campbell Scientific Inc., USA). A radiometer (CNR-1, Kipp & Zonen, The Netherlands) is installed to measure downward/upward short and long wave radiations at 2 m above the ground. Meteorological observations such as wind speed and direction, air temperature, relative humidity and radiative components including UV are made about 500 m southwest of the flux tower and used for quality control of the flux data and the evaluation of the meteorological conditions. Seawater temperature, salinity, nutrients and chlorophyll α concentration are measured manually from the sampling of seawater 400 m west of the flux tower. In 2009, an open-path CO_2/H_2O analyzer (LI-7500, LI-COR, USA) will be added to measure CO_2 and energy fluxes at the site.

Researches

The ocean is the largest pool in removing the atmospheric CO_2 on earth. However, with the increase in the atmospheric CO_2 concentration, it is expected that the capacity of the ocean in absorbing the atmospheric CO_2 could be weakened, indicating a positive feedback to the increase in the atmospheric CO_2. In addition, it is not clear whether the feedback of the marine ecosystem to the increased atmospheric CO_2 is positive or not. It is known that the Southern Ocean removes about 35% of the total atmospheric CO_2 although its surface area is about 20 % of the total ocean area. Phytoplankton, which makes an important role in removing the atmospheric CO_2 (i.e., biological pump), can be also used as a major parameter at polar coast area against environmental changes such as the increase in water temperature or the depletion of the ozone concentration at the stratosphere. Therefore, long term flux measurement began to better understand the air-sea CO_2 exchange with environmental changes in terms of two primary removal processes of the atmospheric CO_2 (i.e., physical and biological pumps) at coast area with pronounced environment changes (e.g., retreat of ice shelves and the increase in air temperature) in the Southern Ocean in 2008. Although the study is at the initial stage at this moment, additional measurements will be conducted automatically or manually by the overwintering team at the King Sejong Station in order to better understand the air-sea CO_2 exchange.

Dasan Station site

Site description

The *Dasan* station site is one of the KoFLUX sites located at Ny-Ålesund (78˚ 55' N, 11˚ 56' E), on the high Arctic island of Spitsbergen, which is a part of the Svalbard archipelago. The flux site is managed by KOPRI. Ny-Alesund is situated on the south side of the deep and sheltered Kongs Fjord on the west coast of Spitsbergen. The southern shore alone provides 50 km of tundra and alluvial plain. A plant protection area at the head of the fjord is bounded by glaciers and the sea. Numerous glaciers of various types bisect the 500 m peaks. The land cover type is tundra which consists of moss (e.g., *Sanionia georgico-uncinata*), lichen phanerogamous plant (e.g., *Silene Acaulis* and *Salix Polaris*) and peat. The soil type is silt loam or silt clay loam. The last remnant of the North Atlantic Drift produces a climate on Spitsbergen's west coast that is milder than normal at that latitude (coldest winter month average is -15°C and the warmest summer month average is +5°C). The sun is down October to March and midnight sun lasts April to August.

Instrumentation

A Flux tower was established about 70 m south of the *Dasan* station in 2003. Eddy covariance system, consisting of three-dimensional sonic anemometer (CSAT3, Campbell Scientific Inc.) and open-path H_2O/CO_2 gas analyzer (LI7500, LI-COR) is installed at the tower of 3.5 m height above the ground. A Radiometer (CNR-1, Kipp&Zonnen) is installed at 2.2 m height. Soil heat flux plates (HFP01SC, Hukseflux, the Netherlands), soil temperature probe (TCAV, Campbell Scientific, USA) and soil moisture probes (CS615, Campbell Scientific Inc., USA) are buried at 0.1 m below the ground surface. To quantify the contribution of soil CO_2 emission to net ecosystem exchange in summer season, the measurements of soil CO_2 efflux tower were executed within the major footprint area of the

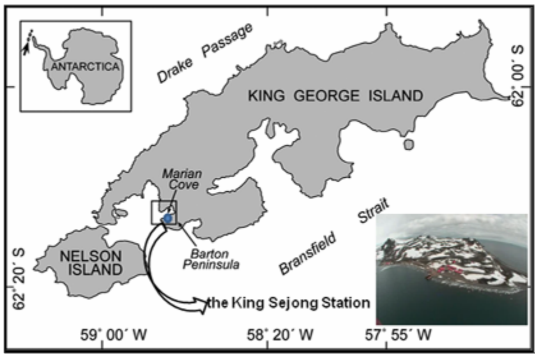

Fig. 1. Location of the King Sejong station site

Fig. 2. The 10-m flux tower with a 3-D sonic anemometer and a net radiometer at the King Sejong station site

flux during the summer of 2007 and 2008. The soil CO_2 efflux were measured at 16 sampling locations in the plot (30 m x 30 m) using a closed-dynamic chamber system (LI-6400 with LI-6000-9 soil chamber, LI-COR, USA).

Researches

The four potential feedbacks between the impacts of climate change on the Arctic and the global climate systems have been identified as follows based on the Paleoclimate studies and the contemporary Arctic ones (Callaghan *et al*., 2004): 1) albedo, 2) greenhouse gas emissions and/or uptake through biological response to warming, 3) greenhouse gas emissions from methane hydrates released from thawing permafrost and 4) increased freshwater fluxes that could affect thermohaline circulations. The Ny-Alesund science town in Svalbard provides scientists with a good opportunity of the researches related with the feedbacks due to its north most location with human residence. Scientists from Norway, Germany, Japan, China, Korea and other nations, reside or visit Ny-Alesund and do various meteorological and climate researches such as meteorological observation, aerosol, ozone concentration at the stratosphere, and permafrost. The objectives of the operation of eddy covariance system are mainly three-folded, 1) CO_2 emissions and/or uptake through biological response to warming, 2) energy exchange with related to the possible change in permafrost thermal properties by warming and 3) boundary layer processes associated with profile measurement using radiosonde. Although the eddy covariance system is monitored through the internet at Korea, since no Korean researchers reside in the *Dasan* station for a year-round, data retrieval from the flux tower is not continuously due to system or power failure. However, based on data retrieved during a summer season when researchers visit, net ecosystem exchange fluctuates between - 0.15 – 0.15 mg $m^{-2}s^{-1}$ due to small biomass and low temperature. In the meanwhile, averaged soil respiration was in the range of 0.0088 to 0.044 mg m^{-2} s^{-1} corresponding to soil temperature with a range of 4 ～ 14℃ and soil water content with a range of 10～40 %.

Fig. 3. The geographical location of the *Dasan* station

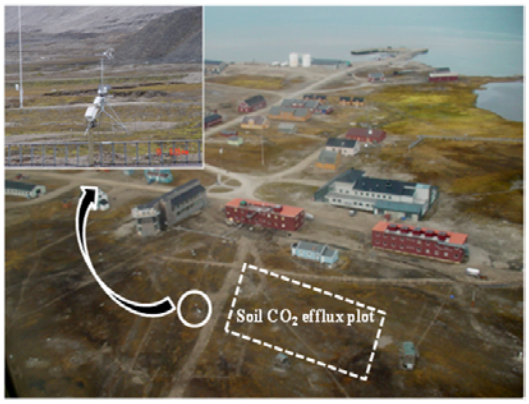

Fig. 4. The Aerial view of the *Dasan* station site

Inter-comparison of eddy flux calculation and QC/QA procedures of three flux networks (ChinaFLUX, JapanFlux and KoFlux) under AsiaFlux

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Introduction

In China, Japan and Korea, a domestic flux network is organized each country (ChinaFLUX, JapanFlux, and KoFlux) under the framework of AsiaFlux (Ohtani, 2008). Each flux network adopts its own evaluation procedure for its research activities and purposes. Moreover, there is a large variety on the flux evaluation protocols in JapanFlux. Under such situation, possible differences in the flux calculation methods and the magnitude of the calculated fluxes among flux networks, must be recognized before synthesizing the flux data from these countries to express carbon, water and heat (CWH) fluxes characteristics of East Asia.

'CarboEastAsia' (Ohtani, 2008) held a field campaign in 6-12 July at Fujihokuroku Flux Observation site in Fujiyoshida, Japan, as an activity of A3 Foresight Program, which aims capacity building among ChinaFLUX, JapanFlux and KoFlux to cope with climate change protocols by synthesizing measurement, theory and modeling in quantifying and understanding of carbon fluxes and storages in East Asia. Preceded this campaign, Ryuichi Hirata (National Institute for Agro-Environmental Sciences, Japan) provided 10Hz raw data set for flux calculation to the participants in these three networks and they applied their own procedures of flux calculation and QC/QA to calculate the CWH fluxes. Their results were compared and presented during the Field Campaign in order to validate the differences in flux calculation procedures and discuss the possible cause of the difference and the effect on the annual sum. In this newsletter, we present a concise summary of the methods, topics and conclusions.

Materials and Methods

A whole year dataset obtained in 2003 at Tomakomai Flux Research Site (42°44'N, 141°31'E, 140 m asl.) in Hokkaido, Japan, was used for the comparison. The site vegetation was manmade Japanese larch (*Larix kaempferi*) forest and the tree age, canopy height, and stand density were 45 years, 15 m, 1150 stems ha^{-1}, respectively.

Raw data with 10Hz sampling rate for flux evaluation were obtained at 27 m in height and recorded by a digitizing data recorder. Three dimensional wind velocities and virtual temperature were measured by a sonic anemometer-thermometer(DA-600-3TV (Probe TR-61C), Kaijo, Tokyo, Japan). Both open- (LI7500, Li-cor, Lincoln, NE, USA) and closed- (LI6262, Li-Cor) path infrared gas analyzers (IRGAs) were used to obtain CO_2 and H_2O fluctuations. In addition to these fast response signals, air temperature and humidity were obtained by a slow response sensor (HMP 45, Vaisala, Helsinki, Finland). Details for the site characteristics and flux observation can be

Table 1. Summary of flux cacluation procedures

	C01	K01	J00	J01	J02	J03
Flux calculation	Open & Closed	Open	Open & Closed	Open & Closed	Closed	Open & Closed
Coordinate rotation	Planar fit*1 (Angle was determined every month)	Planar fit (fixed angle)	Planar fit (fixed angle)	Planar fit (Angle was determined every days using 15-day moving window)	Double rotation*2	Planar fit (Angle was determined every 10 days)
Trend removing & Low frequency correction	none	none	none	none	none	none
Crosswind speed correction*3	none	none	applied	applied	none	applied
Water vapor correction*4	applied	applied	applied	applied	applied	applied
High frequency loss for sensible heat flux	Moore correction*5	none	Moore correction	Moore correction	none	Band-path correction*6
High frequency loss for open-path CO_2 and latent heat flux	Moore correction	none	Moore correction	Moore correction	-	Band-path correction
WPL correction for open-path CO_2 and latent heat flux*7	applied	applied	applied	applied	-	applied
High frequency loss for closed-path CO_2 and latent heat flux	Theoretical transfer function*8	-	Empirical transfer function*8	Band-path correction (correction equation using wind speed)*9	Theoretical transfer function*8	Band-path correction
WPL correction for closed-path CO_2 and latent flux*10	applied	-	none (using mixing ratio)	applied	none (using mixing ratio)	none (using mixing ratio)
Remarks		LI7500 surface heat correction*11 was applied		Dynamic calibration*12 was applied to open-path CO_2 and H_2O fluxes and closed-path H_2O flux		

*1 following Wilczak et al. (2001); *2 following Kaimal and Finnigan (1994); *3 following Kaimal and Gaynor (1991); *4 following Hignett (1992); *5 following Moore (1986) and Kaimal et al. (1972)
*6 See Ono et al. (2007) for detail; *7 following Webb et al. (1980); *8 following Aubinet et al. (2000); *9 following Kowalski et al. (2003), *10 following Leuning and King (1992)
*11 following Burba et al. (2006); *12following Shimoyama et al. (2004)

found in Hirata *et al.*, 2007.

One calculation result from ChinaFLUX (C01) and KoFlux (K01), respectively, and four results (J00, J01, J02, and J03) from JapanFlux were compared. J00, J01, J03, and C01 calculated both open- and closed-path CO_2 and H_2O fluxes, and J02 and K01 calculated only closed- and open-path flux, respectively. Summary of flux calculation and QC/QA procedures are shown in Table 1 and 2, respectively. All participants applied 30-min block averaging for the covariance determination and did not applied trend removing to all the raw fluctuation data.

To compare the annual flux values, survived flux data after QC/QA and u_* filtration were gap-filled using an on-line server (http://www.bgc-jena.mpg.de/bgc-mdi/html/eddyproc/) for gap-filling and flux partitioning calculation (Reichstein *et al.*, 2005), which is similar procedure for FLUXNET synthesis activity. Before the gap-filling, net ecosystem CO_2 exchange (NEE) was determined as the sum of the eddy CO_2 flux and the CO_2 storage change in the air column from the forest floor to the flux measurement height for open- and closed-path fluxes, where the CO_2 storage change was calculated from the observed CO_2 profiles (Hirata *et al.*, 2007) and the same values were used for each participant. Friction velocity (u_*) filtering was applied to the NEE data and the threshold value of the u_* filtering was fixed at 0.3 m s^{-1} (Hirata *et al.*, 2007). NEE, which survived for all (excepting J02) the participant's data set, was used for the gap-filling to eliminate the effect of survived data number of 30-min values on the annual flux estimation.

Topics and conclusions

J00 was used as the reference for eddy flux comparisons. The slopes of the regression lines (y=ax) between J00 and others were ranging 0.86-0.98 (with r^2 of 0.96-0.99) for 30-min open-path CO_2 flux, and were 0.88-1.00 (with r^2 of 0.97-0.99) for closed-path CO_2 flux. For the H_2O flux, the slope was ranging 0.88-0.99 (with r^2 of 0.92-0.98) for open-path, and was 0.94-1.26 (with r^2 of 0.90-0.96) for closed-path. Accordingly, among flux calculation and QC/QA procedures by six participants from AsiaFlux, there were 14 and 12% differences for open- and closed-path CO_2 fluxes, respectively, and 12 and 32% differences for open- and closed-path H_2O fluxes, respectively. In brief summary, C01 and J00 evaluated higher, and K01 and J01 evaluated lower absolute values for open-path CO_2 flux; J00 and J01 evaluated higher and J02 evaluated lower absolute values for closed-path CO_2 flux; J01 estimated lower and higher absolute values for open- and closed-path H_2O

fluxes, respectively. Sensible heat flux evaluation and high frequency loss correction were considered to be the crucial cause for the difference among procedures for open- and closed-path fluxes, respectively.

The annual NEE estimations ranged 182-343 gC m^{-2} y^{-1} (closed-path), and shows ca. 150 gC m^{-2} yr^{-1} difference (in maximum) exists among procedures. Dr. Hirata showed that 10% systematic error (amplitude) or 0.53 μmol m^{-2} s^{-1} systematic error (offset) in 30-min NEE data produce 100gC m^{-2} yr^{-1} error in annual NEE. These results suggest that 1) differences in the flux calculations and QC/QA procedures can results in disparity in the magnitude of seasonal and annual carbon balance and 2) these differences should be recognized. In order to synthesize carbon cycles, unified procedure for flux calculation are recommended for precise comparison.

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References

Aubinet M, Grelle A, Ibrom A, Rannik Ü, Moncrieff J, Foken T, Kowalski AS, Martin PH, Berbigier P, Bernhofer Ch, Clement R, Elbers J, Granier A, Grünwald T, Morgenstern K, Pilegaard K, Rebmann C, Snijders W, Valentini R, and Vesala T, 2000. Estimates of the annual net carbon and water exchange of forests: the EUROFLUX methodology. *Advances in Ecological Research*, **30**, 113-175.

Burba GG, Anderson DJ, Xu L, and, Mcdermitt DK, 2006. Additional term in the Webb-Pearman-Leuning correction due to surface heating from an open-path gas analyzer. Eos Transactions AGU 87 (52), *Fall Meeting Supplement*, C12A-03.

Foken T and Wichura B, 1996. Tools for quality assessment of surface-based flux measurements. *Agricultural and Forest Meteorology*, **78**, 83-105.

Hignett P, 1992. Corrections to temperature measurements with a sonic anemometer. *Boundary-Layer Meteorology*, **61**, 175-187.

Hirata R, Hirano T, Saigusa N, Fujinuma Y, Inukai K, Kitamori Y, Takahashi Y, and Yamamoto S, 2007. Seasonal and interannual variation in carbon dioxide exchange of a temperate larch forest. *Agricultural and Forest Meteorology*, **147**, 110-124.

Kaimal JC and Finnigan JJ, 1994. *Atmospheric boundary layer flows*. Oxford University Press, New York, pp. 289.

Kaimal JC and Gainor JE, 1991. Another look at sonic thermometry. *Boundary-Layer Meteorology*, **56**, 401-410.

Kaimal JC, Wyngaard JC, Izumi Y, and Cotè OR, 1972. Spectral characteristics of surface-layer turbulence. *Quarterly Journal of the Royal Meteorological Society*, **98**, 563-589.

Kowalski AS, Sartore M, Burlett R, Berbigier P, and Loustau D, 2003. The annual carbon budget of a French pine forest (*Pinus pinaster*) following harvest. *Global Change Biology*, **9**, 1051-1065.

Leuning R and King KM, 1992. Comparison of eddy-covariance measurements of CO_2 fluxes by open- and closed-path CO_2 analysers. *Boundary-Layer Meteorology*, **59**, 297-311.

Moore CJ, 1986. Frequency response corrections for eddy correlation systems. *Boundary-Layer Meteorology*, **37**, 17-35.

Ohtani Y, 2008. Message from former chair of AsiaFlux. *AsiaFlux Newsletter*, 24, 4-5.

Ono K, Hirata R, Mano M, Miyata A, Saigusa N, and Inoue Y, 2007. Systematic differences in CO_2 fluxes measured by open- and closed-path eddy covariance systems: Influence of air density fluctuations resulting from temperature and water vapor transfer. *Journal of Agricultural Meteorology*, **63**, 139-155.

Papale D, Reichstein M, Aubinet M, Canfora E, Bernhofer C, Kutsh W, Longdoz B, Rambal S, Valentini R, Vesala T, and Yakir D, 2006. Towards a standardized processing of Net Ecosystem Exchange measured with eddy covariance technique: algorithms and uncertainty estimation. *Biogeosciences*, **3**, 571-583.

Reichstein M, Falge E, Baldocchi D, Papale D, Aubinet M, Berbigier P, Bernhofer Ch, Buchmann N, Gilmanov T, Granier A, Grünwald T, Havránková K, Ilvesniemi H, Janous D, Knohl A, Laurila T, Lohila A, Loustau D, Matteucci G, Meyers T, Miglietta F, Ourcival J-M, Pumpanen J, Rambal S, Rotenberg E, Sanz M, Tenhunen J, Seufert G., Vaccari F, Vesala T, Yakir D, and Valentini R, 2005. On the separation of net ecosystem exchange into assimilation and ecosystem respiration: review and improved algorithm. *Global Change Biology*, **11**, 1424-1439.

Shimoyama K, Hiyama T, Fukushima Y, and Inoue G, 2004. Controls on evapo-transpiration in a west Siberian bog. *Journal of Geophysical Research*, 109, D08111, doi: 10.1029/2003JD004114.

Vickers D and Mahrt, L, 1997. Quality control and flux sampling problems for tower and aircraft data. *Journal of Atmospheric and Oceanic Technology*, **14**, 512-526.

Webb EK, Pearman GI, and Leuning R, 1980. Correction of flux measurements for density effects due to heat and water vapour transfer. *Quarterly Journal of the Royal Meteorological Society*, **106**, 85-100.

Wilczak JM, Oncley SP, and Stage SA, 2001. Sonic anemometer tilt correction algorithms. *Boundary-Layer Meteorology*, **99**, 127-150.

CarboEastAsia Joint Field Investigation

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The Field Campaign 2008, which was the first Joint Field Investigation of CarboEastAsia, was held at the Fuji-Hokuroku flux site in Fujiyoshida city, Yamanashi prefecture, Japan, on 7-11 July, 2008. About 40 participants from ChinaFLUX, JapanFlux, and KoFlux participated in this campaign. The Fuji- Hokuroku flux site (35°26'35"N, 138°45'53"E; 1,085 m elevation) is located in a 50-year-old larch plantation at the northern-foot of Mt. Fuji (Fig. 1). The Center for Global Environmental Research (CGER) of National Institute for Environmental Studies (NIES) installed the Fuji-Hokuroku site in autumn of 2005, and began the tower- and ground-based measurements at the beginning of 2006.

Background

East Asian terrestrial ecosystems – the richest in the world – are distributed continuously from tundra and boreal forests through temperate to subtropical and tropical forests latitudinally, as well as from monsoonal rainforests through semi-arid grassland to desert longitudinally. The magnitude of carbon sequestration here has been predicted to play a key role in the global carbon cycle, and therefore, it is thought to be indispensable in understanding global climate changes caused by anthropogenic greenhouse gas emissions. Moreover, the temporal and spatial variations of carbon sequestration caused by distinctive climate conditions, such as monsoons, impose an additional scientific challenge. CarboEastAsia – capacity building among ChinaFLUX, JapanFlux and KoFlux to cope with climate change protocols by synthesizing measurement, theory, and modeling in quantifying and understanding of carbon fluxes and storages in East Asia – is a 3-year project started in August 2007, and is funded by the National Natural Science Foundation of China (NSFC), the Japan Society for the Promotion of Science (JSPS), and the Korea Science and Engineering Foundation (KOSEF). CarboEastAsia is the first international attempt that brings together scientists from China, Japan and Korea to (1) measure carbon and water fluxes in individual ecosystems, (2) scale up site-specific results to regional and national values, and (3) evaluate the dynamics and feedback of East Asian terrestrial ecosystems to global warming. More detail information of the project at http://www.carboeastasia.org/.

Fig. 1

Topics

Based on the Summary of CarboEastAsia Meeting 2007 (http://www.chinaflux.org/), the

Fig. 2

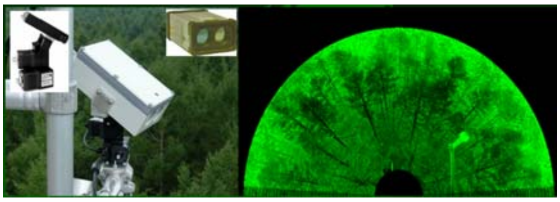


Fig. 3 (top) / Fig. 4 (middle) / Fig. 5 (bottom)

sub-theme 1 – inter- and multi-disciplinary Joint Field Investigation – is responsible for developing the relative standard method for data quality control and gap-filling technique based on the comparison of multi-technique measurements from different ecosystems. We selected the Fuji-Hokuroku site for the Field Campaign 2008 because it is one of the major AsiaFlux super sites (after the Tomakomai site where was located in a 45-year-old larch plantation but was unfortunately destroyed by a typhoon during the summer, 2004) and it has an accommodation (i.e., Fuji Calm (http://www.fujicalm.jp/) near, which can be easily accessed from the site (Fig. 2).

The followings are some of the topics discussed during the Field Campaign 2008:

(1) Tower Observations: flux and corresponding measurement equipment was introduced (Fig. 3). In addition, several participants from the three countries were provided with one year of flux raw data obtained with the open- and closed-path systems at the Tomakomai flux site in 2003. The data were analyzed using their own data processing procedures (e.g., flux calculation, flux correction, and quality control) prior to the campaign. The flux calculation procedures and flux estimations were compared and discussed during the campaign.

(2) Leaf Area Index (LAI) measurements: several techniques, which are used at the Fuji-Hokuroku flux site for measuring LAI were introduced, including tree harvesting, plant canopy analyzer (LAI-2000, Li-Cor Inc., USA.), photosynthetic photon flux density (PPFD) sensors, and (particularly) remote sensing method (using spectral camera; Fig. 4); the results were then compared .

(3) Soil respiration measurements: participants measured soil CO_2 efflux at the Fuji-Hokuroku flux site using a 24-channel automated chamber system, a 4-channel automated chamber system, LI-6400-09 portable chamber system, a portable automated two chamber system, and a dynamic chamber system (Fig. 5).

(4) New technique demonstrations: several new systems, which were installed at the Fuji-Hokuroku flux site to measure trace gases (e.g., CO_2 and CH_4), were introduced. These system include relative eddy accumulation (REA) (Fig. 6) and biogenic volatile organic compounds (BVOC) methods.

Field Campaign Program

Field Campaign 2008 was conducted for five days: each day, two invited scientists gave lectures in the morning session, and in the afternoon session, the participants moved to the Fuji-Hokuroku site for hands-on experiences of and practical discussions on measurement

Table 1. Schedule of the Field Campaign, 2008.

Date			AM (8:30)	AM (9:30)	Lunch (12:00)	PM (13:00)	PM (15:00)	Dinner (17:00)	Evening (19:00)
7/6 SUN	DAY 0					Arrival		Reception	
7/7 MON	DAY 1		General introduction (N. Liang) Open-path EC theory (A. Miyata) Site introduction (N. Liang)	Field Work (N. Saigusa)		Field Work (N. Saigusa)	Program comparison (R. Hirata, H. Kwon, X. Wen)		Research Introduction (Ueyama, Wang, Yoo, Hamotani)
7/8 TUE	DAY 2		REA (Y. Takahashi) BVOC (A. Tani)	Field Work (Y. Takahashi)		Field Work (Y. Takahashi)	Research Introduction (Nagai, Miyama, Tamai)	Banquet	
7/9 WED	DAY 3		LAI (T. Takeda) Biometrics (N. Liang)	Field Work (T. Takeda)		Field Work (T. Takeda)	Research Introduction (Park, Hong, Tamai)		Research Introduction (Zhang, Thakuri, Liu)
7/10 THU	DAY 4		Soil Respiration 1 (J. Lee) Soil respiation 2 (K. Tamai)	Field Work (N. Liang)		Field Work (N. Liang)	Research Introduction (Yan, Lee, Fang)		Research Introduction (Kang, Takagi)
7/11 FRI	DAY 5		JapanFlux synthesis (N. Saigusa) KoFlux synthesis (H. Kwon) ChinaFlux synthesis (X. Sun)			Vegetation Survey (Mt. Fuji)		Farewell Dinner	
7/12 SAT	DAY 6		Departure						

Lecture & Discussion in classroom (blue) / Field Work (yellow) / Recess & Meal (orange)

techniques. All participants exploited this chance as valuable as possible for exchanging ideas about their studies, and thus we came back to the lecture room located in Fuji Calm later hours than we were supposed to be back. After dinner, moreover, we had another exciting two hour seminar with Japanese draft beer (Table 1).

Below is the concise summary of each day's program.

On the 1st day (July 7), Naishen Liang gave a brief opening talk about this event and Akira Miyata synthesized the theory and technique of the open-path eddy covariance system. Before we went to the Fuji-Hokuroku site, N. Liang gave a very detailed introduction about the flux observation at the site. In the field, Nobuko Saigusa guided the participants to introduce the open- and closed-path eddy covariance systems and the relevant tower-based measurement equipment (Fig. 7). In the afternoon and evening sessions, Takashi Hirano introduced the activities of JapanFlux, then Kentaro Takagi, Ryuichi Hirata, Hyojung Kwon, and Xuefa Wen led the discussion on the analysis of CO_2 flux data from Tomakomai, mainly focusing on the flux data processes, and corrections. .

On the 2nd day (July 8), Yoshiyuki Takahashi introduced the theory and technique of a modified REA system for continuous measurements of fluxes of CO_2 and non-CO_2 gaseous components, followed by Akira Tani's presentation on the characteristics of BVOC flux measurement in East Asian forest ecosystems. During the field experiment, Takahashi introduced the operation of a REA system developed by Ken Hamotani (Osaka

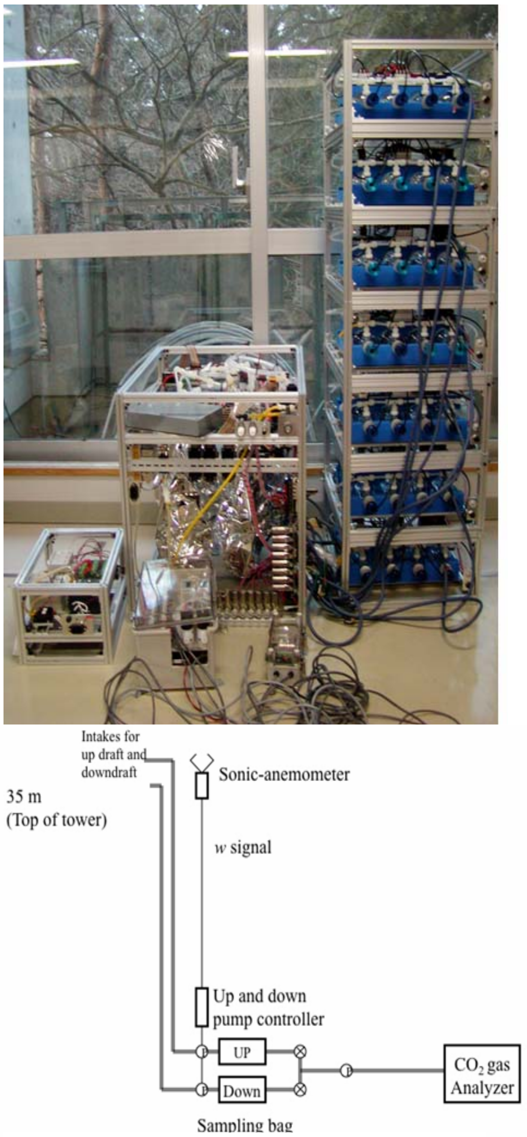


Fig. 6

Prefecture University) at the site (Fig. 8). Tani also gave a demonstration of a VOC sampling system.

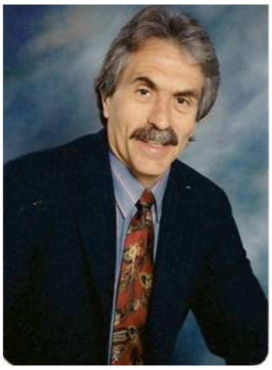
On the 3rd day (July 9), Tomomi Takeda introduced the applications of several techniques for measuring LAI, and compared the results that were obtained at the Fuji-Hokuroku site. Liang presented the importance of biometrics for estimation of forest carbon balance and its measurement procedure. In the field, Takeda showed a spectral camera installed on the top of a tower for measuring LAI. Liang introduced a root scanning method for monitoring root dynamics (growth and death; Fig. 9).

On the 4th day (July 10), Jaeseok Lee presented the application of an automated chamber system for continuous measurement of soil CO_2 efflux in Korean forest ecosystems. Koji Tamai presented his analysis of the effect of topography on spatial variations of soil CO_2 efflux in Japanese forest ecosystems. At the site, N. Liang and J. Lee conducted *in situ* comparisons of five different approaches to estimating soil CO_2 efflux in the Fuji-Hokuroku larch forest, including a 24-channel large automated chamber (90×90×50cm; L×W×H) system (CGER/NIES), a 4-channel automated chamber (30×20×10cm) system (Konkuk University), a LI-6400-09 portable soil efflux system (LI-COR), a portable automated two chamber system (CGER/NIES), and a dynamic chamber system (Forestry and Forest Products Research Institute) (Fig. 10).

On the 5th day (July 11), N. Saigusa presented the seasonal and year-to-year changes in CO_2 flux in East Asian forest ecosystems based on the database of Integrated Study for Terrestrial Carbon Management of Asia in the 21st Century Based on Scientific Advancements (S-1 Project; FY2002-FY2006) project that was funded by the Japan Ministry of the Environment. Hyojung Kwon synthesized the hydrological and carbon cycles at Gwangneung watershed, a KoFlux super site. Xiaomin Sun introduced a powerful equipment, developed by ChinaFlux for monitoring atmospheric water vapor D/H and $^{18}O/^{16}O$ isotope ratio. Finally, in the afternoon, all the participants climbed Mt. Fuji up to about 2500 m. We observed the vegetation zone on Mt. Fuji and the vertical distribution of plant communities.

Fig. 7 (top, left) / Fig. 8 (top, right) / Fig. 9 (bottom, left) / Fig. 10 (bottom, right)

In Memory of Bertrand D. Tanner…



We Meteorologist are global citizens. Atmosphere does not recognize any political boundaries. I am equally saddened by the sudden demise of Prof Bertrand and offer my heart felt condolence to the bereaved family.

G.R.Chinthalu

I remember him as a nice guy who was easy to get along, a dynamic personality with a good sense of humor and fun to be around. My prayers go out to his family. The science community will miss him.

Robert S. Evans

Bless Bertrand D. Tanner, and his image will be always in my mind.

Xia Song

"The news of Mr. Tanner's departure herald a double loss for us—not only have we lost a truly brilliant scientist but also a wonderful human being. His memories will be etched in our hearts for as long as we live".

Mohammed Mozammel Huq

Bert, I cannot forget your hospitality when I first visited Logan in October 1997. Next summer, you kindly visited our study site in Kushiro, and since then, you talked to me every time with encouraging words. Thanks, and I pray for your peaceful sleep.

Akira Miyata

I cherish the memory of seventy eight e-mail messages that we exchanged, one trip that we met each other, almost three weeks that we worked face to face, and three years and nine months that we have known each other. For the rest of my life, I'll remember all you did to me that made my life better.

Dongho Lee

Bert had been my good mentor and friend for about six years. He impressed me with his devotion spirit to his work and his career. It was such a sweet memory that he called me his Chinese daughter and gave me a warm hug when we met. His sincerity and friendliness always touched my hear softly. I wish he found his peach and happiness now.

Yuling Fu

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Editor's Note

It has been a great pleasure and privilege to serve AsiaFlux as an editor of AsiaFlux Newsletter. I give sincere thanks to those who submitted their articles. I hope the newsletter will be an open agora to share information and to discuss pivotal scientific issues for AsiaFlux

The editor of AsiaFlux Newsletter No.26:
Hyojung KWON
(Yonsei University, Korea)

The editor of AsiaFlux Newsletter No.27 will be Dr. Zhongmin Hu (Chinese Academy of Sciences, China).