AsiaFlux Workshop 2007

International Workshop on Advanced Flux Network and Flux Evaluation

PROCEEDINGS

19-22 October 2007

Aspire Park, Taoyuan, Taiwan

Organizing Committees

AsiaFlux Workshop 2007 Organizing Committee

INUKAI, Koh (National Institute for Environmental Studies, Japan)

MIZOGUCHI, Yasuko (Forestry and Forest Products Research Institute, Japan)

TAKAHASHI, Yoshiyuki (National Institute for Environmental Studies, Japan)

TAKANASHI, Satoru (Forestry and Forest Products Research Institute, Japan)

AsiaFlux Workshop 2007 Local Organizing Committee

CHANG, Shih-Chieh, (National Dong Hwa University, Taiwan)

HSIA, Yue-Joe (National Dong Hwa University, Taiwan)

HSIEH, Cheng-I, (National Taiwan University, Taiwan)

LAI, Cheng-Wei, (National Dong Hwa University, Taiwan)

LI, Ming-Hsu, (National Central University, Taiwan)

LIU, Ching-Hwang, (Chinese Culture University, Taiwan)

SHEN Yuan (National Chung Hsing University, Taiwan)

SUN, Wen-Yih, (National Center for High-Performance Computing, Taiwan)

TSUANG, Ben-Jei, (National Chung Hsing University, Taiwan)

YU, Jia-Yuh, (Chinese Culture University, Taiwan)

Sponsors

Ministry of Education, Culture, Sports, Science and Technology, Japan

Society of Subtropical Ecology, Taiwan

Jauntering International Corporation, Taiwan

Environmental Science & Eng'n Corp., Taiwan

VAISALA Oyj., Finland

AsiaFlux Workshop 2007 is also supported by

National Institute for Environmental Studies, Japan

Forestry and Forest Products Research Institute, Japan

AsiaFlux Steering Committee

FUJINUMA, Yasumi (National Institute for Environmental Studies, Japan)
FUKUSHIMA, Yoshihiro (Research Institute for Humanity and Nature, Japan)
HARAZONO, Yoshinobu (Osaka Prefecture University, Japan)
HIRANO, Takashi (Hokkaido University, Japan)
INOUE, Gen (Nagoya University, Japan)
KIM, Joon (Vice-chair, Yonsei University, Korea)
KOIZUMI, Hiroshi (Gifu University, Japan)
LEE, Byonglyol (Meteorological Research Institute, Korea)
LEE, Dongho (Yonsei University, Korea)
MIYATA, Akira (National Institute for Agro-Environmental Sciences, Japan)
OHTANI, Yoshikazu (Chair, Forestry and Forest Products Research Institute, Japan)
OIKAWA, Takehisa (University of Tsukuba, Japan)
TANI, Makoto (Kyoto University, Japan)
YAMAMOTO, Susumu (Okayama University, Japan)

AsiaFlux Secretariat

Centre for Global Environmental Research
National Institute for Environmental Studies
16-2 Onogawa, Tsukuba, Ibaraki 305-8506, JAPAN
Ph: +81-29-850-2971 Fax: +81-29-858-2645
Emal: secretary@asiaflux.net
URL: www.asiaflux.net

Contents

Opening Session: Activities of Flux Network

Oral Session I: Measurement, Methodology, Technical Development

Special Session: Fluxes and Biogeochemical Cycles under the Humid Climate in Asia

Oral Session II: Remote Sensing

Oral Session III: Biochemical Processes

Oral Session IV: Modeling

Oral Session V: Flux Data Analysis

Poster Session

Oral Session

R01

PRESENT SITUATION AND CHALLENGES OF ASIAFLUX - TOWARD THE NEXT STEP -

Y. Ohtani [1], J. Kim [2], Y. Fujinuma [3], T. Hirano [4], D. Lee [2], A. Miyata [5], N. Saigusa [6] and M. Tani [7]

[1] Forestry and Forest Products Research Institute, Tsukuba, Japan
[2] Yonsei University, Seoul, Korea
[3] National Institute for Environmental Studies, Tsukuba, Japan
[4] Hokkaido University, Sapporo, Japan
[5] National Institute of Agro-Environmental Sciences, Tsukuba, Japan
[6] National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan
[7] Kyoto University, Kyoto, Japan

In this report, we summarize the AsiaFlux activities since the AsiaFlux Workshop 2006 and discuss about our future direction with suggestions. The AsiaFlux marks eight years since its establishment in 2000. In recent three years, our activities have been enhanced by the financial support from the projects "Initiation of the next-generation AsiaFlux (MEXT)" and "Standardization and Systematization of Carbon-Budget Observation in Asian Terrestrial Ecosystems Based on AsiaFlux Framework (APN)". During this period, the AsiaFlux activities have been promoted by the following AsiaFlux sub-workgroups according to the MEXT project framework. The sub-workgroup activities in this year are: 1) amendment of the AsiaFlux policy and membership, and renewal of the AsiaFlux web pages (*Network Management Sub-workgroup*), 2) issue of four regular and one special volumes of the AsiaFlux newsletters (*Editorial Sub-workgroup*), 3) preparation for the 6th AsiaFlux workshop in Taiwan (*Workshop Management Sub-workgroup*), 4) development of the portable flux measurement system for inter-comparison (*Measurement Support and Standardization Sub-workgroup*), 5) initiation of the operation of the AsiaFlux Database (*Database and Data Policy Sub-workgroup*), 6) preparation and holding of the 2nd AsiaFlux training course on micrometeorology in Seoul, Korea (*Short Training Courses Sub-workgroup*). We have intensively collected and updated the Asian flux site information, with the collaboration of both *Network Management* and *Database and Data Policy* Sub-workgroups. Some outcomes have been already reflected in the AsiaFlux website and introduced in the newsletter. The second AsiaFlux Training Course was accomplished successfully from 17 to 26 July 2007 in Seoul with 15 participants, 11 lecturers and 16 staffs and supporters.

After the AsiaFlux Workshop 2006, the JapanFlux was established by Japanese flux community as a sub-regional network of the AsiaFlux. This led to the structure change in the AsiaFlux organization that the AsiaFlux becomes an umbrella organization covering the Asian flux communities. Since this alteration might bring about further structure change in the AsiaFlux executive framework, we propose to discuss this issue primarily in the steering and executive committee meetings.

The MEXT and APN projects have concurrently supported our activities financially, but the support from APN has ended last March and MEXT will end in next March. Prof. Yu (CAS), Prof. Hirano (Hokkaido Univ.) and Prof. Kim (Yonsei Univ.) - representing ChinaFLUX, JapanFlux and KoFlux, respectively - proposed a new project for “A3 foresight program” and it has been accepted last August. The new project is titled as “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”. The future AsiaFlux activities will be promoted through closer cooperations among participating communities under the framework of “*CarboEastAsia*”.

Acknowledgements:

The AsiaFlux activities were financially supported by the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) and by the Asia-Pacific Network for Global Change Research (APN). The second AsiaFlux Training Course on Micrometeorology was co-organized by Koflux, Yonsei University, Korea and Seoul National University, Korea.

R03

Flux Projects in India: The Status and Challenges

Sandeep Tripathi

Head Biodiversity and Climate Change Division

Indian Council of Forestry Research and Education
P.O. New Forest Dehradun India email sandeeptrip@icfre.org

ABSTACT

Current international policy for CO_2 abatement necessitates quantifying the sources and sinks of CO_2 from natural ecosystems. Forests are responsible for about 20% of global CO_2 emissions and as well as have potential for low cost carbon mitigation. The biospheric CO_2 exchange observations for fluxes between atmosphere forest ecosystems are being carried out extensively through a global network of about 300 terrestrial flux sites. Establishment of a large global fluxnet community including AmeriFlux, EuroFlux, Asiaflux etc. reflects increasing concern of scientist and policy makers to develop precise understanding of fluxes of CO_2 for variety of natural terrestrial ecosystems. However, the reliable data at regional level from Asia and Africa is still lacking. The existing AsiaFlux network rely largely on data from Japan, China and Korean flux studies.

India with 1/5 of global population and about two percent of forests with a variety of natural ecosystems has a potentially significant impact on regional and global environment. However, a comprehensive environmental network of CO_2 fluxes is lacking. The estimates of Forest carbon stock in India including biomass and soil for the 1980s are in range of 8.58 to 9.57 Gt C. As per the latest estimates of FAO (2005) total Forest carbon stocks are 10.01 GtC. The GHG emission of the country is estimated to be about 1.2 million Gigagram/year being about three percent of global emission. It is pertinent to mention that as per the Indian National Communication to UNFCCC, the contribution of land use, land use change and forestry (LULUCF) sector is only 1.16%, which is one of the lowest in the world.

There is a felt need for establishment of nation wide monitoring network to assess emissions patterns and resultant ecosystems response. A CO_2 flux tower in the subtropical dipterocarp (*Shorea robusta*) forest ecosystems in north India near Dehradun is under installation by Department of Space, Government of India. Another tower is being established in mixed plantation ecosystems in collaboration with Italian Government. This tower will facilitate capacity building towards development of CDM afforestation and reforestation projects. JapanFlux has also proposed to have a collaborative flux studies in temperate broad leave evergreen forest in northern India. In the next five years Government of India has drawn a very ambitious plan of installing seven such towers in the different ecosystems of the country. Indian Space Research Organization under its geosphere Biosphere program intent to use this data -conjunctively with remote sensing data for terrestrial carbon sequestration studies in country.

There is an urgent need to establish flux towers in all the forest types representing different bio-geographic regions of the country. This would facilitate robust dataset for proper understanding of ecosystem exchange and synthesis of overall terrestrial carbon budgeting of the country.

*****

R04

R& D Activities Addressing Climate Change and Forest in Malaysia

Elizabeth Philip and Abdul Rahim Nik
Forest Research Institute Malaysia (FRIM) Kepong, 52 109 Kuala Lumpur

Abstract

Efforts into improving the scientific knowledge base on the potential of Malaysian rainforest as CO_2 sink or source is being intensified. Research activities identifying the key carbon pools of each key forest types, net ecosystem exchange and energy and evapotranspiration are being carried out. Along these lines, research programmes to address how land-use affects the changes in stocks and estimate the effects of land-use and land-use changes on the emissions and removals of CO_2 is being done.

The national green house gas inventory for forestry indicated that the forest is a sink to green house gases, removing 338, 058 Gg CO_2/yr. While the net ecosystem exchange ranged from 2.00 to 2.75 g C m^2/day. This paper will highlight the other current research activities and the findings as well.

O11

Stable Isotope Ratios of Ecosystem-Atmosphere CO_2 Exchange

Chun-Ta Lai[1] and James R. Ehleringer[2]

[1]Department of Biology, San Diego State University, 5500 Campanile Drive, San Diego, CA 92182, USA
[2]Department of Biology, University of Utah, Salt Lake City, UT 84112, USA

Stable carbon and oxygen isotope ratios are key measurements to the interpretation of ecosystem-atmosphere CO_2 fluxes. Simultaneous measurements of the concentration and stable isotope ratio of atmospheric CO_2 are useful to characterize the isotopic composition of ecosystem respiration and the contribution of ecosystem components to net exchange fluxes. We present carbon isotope ratio measurements of whole air samples from ten AmeriFlux sites, covering major biomes in the contiguous U.S.A. These weekly carbon-13 and concentration measurements have been used to understand: (1) separation of ecosystem photosynthesis and respiration, (2) ecosystem discrimination against carbon-13, (3) physiological response to environmental stresses, (4) canopy water use efficiency, (5) seasonal dominance of photosynthetic pathways, and (6) regional estimates of CO_2 fluxes and discrimination. Principles and current limitations on the stable isotope technique for biosphere-atmosphere CO_2 research will be reviewed and discussed.

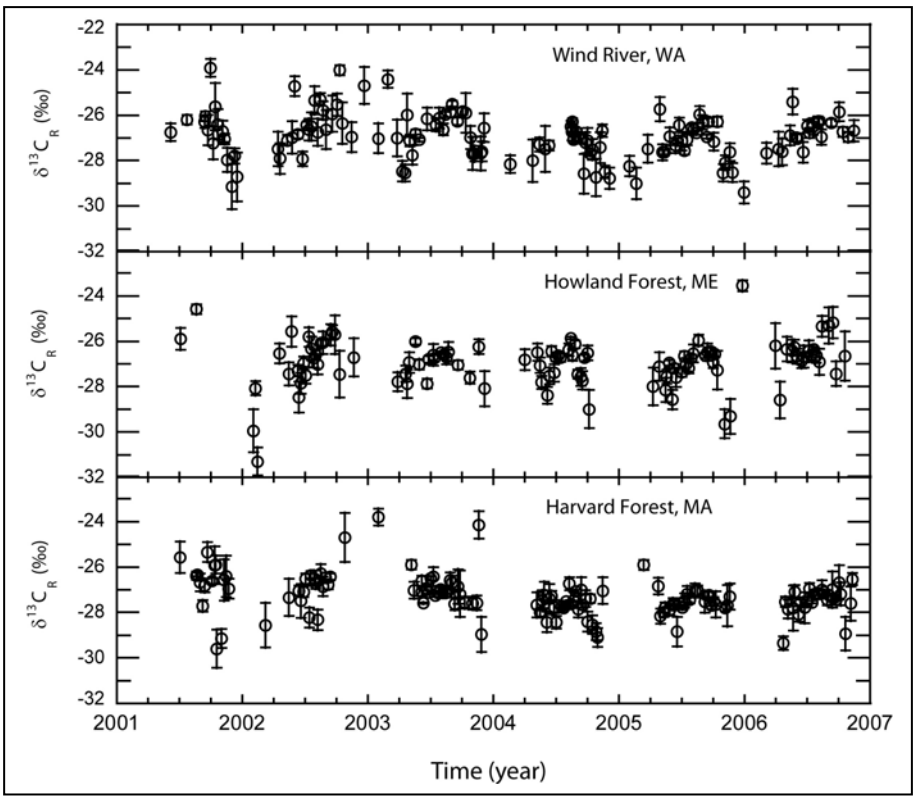


Fig 1. Weekly measurements of carbon isotope ratios of ecosystem respiration ($\delta^{13}C_R$, ± S.E.) in 3 US temperate forests. Intra-seasonal $\delta^{13}C_R$ variations are consistently observed at all 3 sites, with highest values occurring in the mid-summer. These variations were negatively correlated with ecosystem water availability. Physiological response (i.e. stomatal closure) to summer water stress likely contributes to the higher $\delta^{13}C_R$.

O12

CONSTRUCTION AND DEVELOPMENT OF CROPLAND ECOSYSTEM EDDY FLUX OBSERVATION SITES IN CHINA

Mei Xurong, Yan Changrong, Gu Fengxue, He Wenqing,

Institute of Envrionment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences, Beijing, China.

China is a large agricultural country, and the area of arable land is 1.218 $\times 10^6 km^2$ and accounts for 12.7% of total area of China. All kinds of managements in cropland, such as planting, cultivation and fertilization, etc. not only changed the chemical elements cycles, but also affected (influence)the global climate change. Therefore, it is necessary to carry out the long-term and continuous carbon, water and energy fluxes observation in typical cropland of China. Using data from eddy covariance and other relative eco-physiological measurements in typical cropland ecosystems, we are able to characterize the spatial-temporal variation of mass and energy exchange between vegetation and atmosphere, to investigate the effect of climate change and managements on cropland ecosystems and their responses, and also to calculate the potential carbon storage capacity and water use efficiency (WUE) of typical cropland ecosystems. All these measurements and analysis will provide scientific foundation for improving the production and resources use efficiency of cropland ecosystems.

The area of dryland cropping ecosystems accounts for 73.7% of total arable land in China. At present, eddy flux observation sites of the Chinese Academy of Agricultural Sciences mostly distributed in typical dryland of north China. The long-term and continuous eddy covariance observation and other eco-physiological measurements were performed in different farming pattern of different regions since 2005. In all theses observation sites, there are an open-path eddy covariance system and a regular meteorological system, and the associated soil and crop eco-physiological measurements were carried out at the same time. Using all these data from eddy covariance measurements in a typical rainfed maize ecosystem, the diurnal change of carbon and water vapor exchange and WUE in canopy scale were analyzed and also compared to the observations in leaf level. The results showed that carbon and water fluxes, WUE and their diurnal change had obvious difference between canopy and leaf level. The time of peak values of carbon and water vapor exchange in canopy scale is accordance with the time of maximum solar radiation, whereas the peak value of WUE appears in early morning and then decreases markedly, and it keeps stabilization after 8:00am.

In addition to the sites that have been established, the CAAS will build more eddy covariance observation sites in dryland of China. Along with the accumulation of eddy covariance and relative other eco-physiological measurements, we will be able to examine the seasonal and inter-annual variations of carbon, water and energy exchange between crop and atmosphere and their driving mechanisms, to investigate the effect of climate change, management and nitrogen deposition, etc. on mass and energy exchange, carbon storage and WUE in dryland cropping ecosystems and their responses, and to elucidate the forming mechanisms of production in dryland cropping ecosystems, so they will provide bases for establishing the water-saving and high efficiency farming pattern and system of typical dryland ecosystems.

Key words: dry cropland in China, eddy covariance, mass and energy exchange, WUE, construction, development

Cancelled

O13

Characteristics of Sensible Heat, Water Vapor, and CO_2 Fluxes over a Rice Paddy

Chia Ren Chu[1] and Cheng-I Hsieh[2*]

[1]Department of Civil Engineering, National Central University, Taoyuan 32001, Taiwan. [2]Department of Bioenvironmental Systems Engineering, National Taiwan University, Taipei 10617, Taiwan. *Corresponding: hsieh@ntu.edu.tw

Abstract

An eddy-correlation system consisting of a sonic anemometer and an open-gas analyzer was used for understanding the characteristics of sensible heat, water vapor, and CO_2 fluxes over a subtropical rice paddy in Taipei, Taiwan. The results showed that about 35-40% of net radiation was used for latent heat flux, 13% for sensible heat flux, and the rest (about 50%) was absorbed by the water and soil in the rice paddy. Based on the background measurements (where no rice was growing), it was found that CO_2 emission rate from the soil surface was much smaller than the CO_2 uptake by the rice. We also found that the relative turbulent transport efficiencies of heat to water and heat to carbon dioxide depended on Bowen ratio. However, in average, heat, water vapor, and carbon dioxide were transported with the same rate above this rice paddy.

Keywords: rice paddy, evapotranspiration, CO_2 flux, Bowen ratio

O14

Feedback of Ambient Air CO_2 Concentration on Soil CO_2 Efflux

D. K. McDermitt, L. Xu, R. Madsen, T. Demetriades-Shah, J. Welles, R. Garcia and M. Furtaw

LI-COR Biosciences, 4421 Superior Street, Lincoln, NE 68504, USA

Soil CO_2 flux (F_c) is driven largely, or in part, by the CO_2 concentration gradient across the soil surface. We show that under calm and warm night-time conditions, ecosystem respiration can lead to elevated ambient air CO_2 concentration (C_a) above the soil, which *suppresses* F_c, as expected from diffusion theory. We hypothesize that on warm and calm nights prolonged suppression of F_c has the effect of capping the soil, and leads to elevated soil CO_2 concentrations (C_s). When the atmosphere becomes unstable at sunrise, or when the friction velocity (U*) increases, this cap is removed by replacing air that has elevated C_a with ambient air characteristic of the well-mixed atmosphere. This can occur quite rapidly producing a large gradient between C_s and C_a, which *enhances* F_c, especially at sunrise. Elevated F_c can persist for one to two hours, apparently until the soil CO_2 concentration profile readjusts.

We conducted a series of experiments at two field sites with different soil and vegetation types, in which we investigated the impact of ambient CO_2 concentration on F_c. Nearly continuous measurements of night-time F_c from the two sites demonstrated that F_c was negatively correlated with changes in C_a, suggesting F_c was suppressed under high C_a due to the reduced CO_2 diffusion gradient. This has the effect of increasing CO_2 storage in the soil. At sunrise, increased turbulence caused a rapid drop in C_a and an increase in F_c that preceded any increase in soil temperature, and persisted for one to two hours. We used the LI-6400 to test the hypothesis that capping the soil with elevated C_a would lead to increased F_c after C_a returned to normal levels. We allowed the chamber headspace CO_2 concentration to rise to various levels above ambient, whereupon we scrubbed the chamber air quickly back to ambient and measured F_c at ambient C_a. Measured F_c increased with increasing CO_2 concentration in the headspace prior to measurement, as predicted by a diffusion-based mechanism. Wind-induced pressure pumping was not involved.

This has important implications both for chamber measurements and for ecosystem respiration. Our results suggest that respired CO_2 can accumulate in the soil profile under calm conditions. CO_2 accumulated in the soil can slowly flush out when C_a returns to the atmospheric background level as the atmosphere becomes unstable. It is likely to take much longer to flush out CO_2 accumulated in the soil profile than to exchange CO_2 accumulated in the plant canopy. This diffusion-based process might provide an explanation, in addition to U*-dependent night-time flux and pressure pumping, for the abnormally high ecosystem respiration rate at sunrise sometimes observed by the carbon flux community. Flechard, et al. (2007, *Temporal changes in soil pore space CO2 concentration and storage under permanent grassland. Agric. Forest Meterol. 142:66*) present a similar argument, although they suggest wind-induced pressure pumping as the primary mechanism moving CO_2 out of the soil and into the atmosphere.

S01

LESSONS FROM CROSS-SCALE STUDIES OF WATER AND CARBON CYCLES IN THE GWANGNEUNG FOREST CATCHMENT IN A COMPLEX LANDSCAPE OF MONSOON KOREA

Dongho Lee[1], Joon Kim[1], Su-Jin Kim[1], Sang-Ki Moon[1], Jaeseok Lee[2], Jong-Hwan Lim[3], Yowhan Son[4], Sinkyu Kang[5], Sanghyun Kim[6], Kyongha Kim[3], Namchil Woo[1], Buyong Lee[7] and Sung Kim[8]

[1]Yonsei Univ., Seoul, Korea, [2]Konkuk Univ., Seoul, Korea, [3]Korea Forest Research Institute, Seoul, Korea, [4]Korea Univ., Seoul, Korea, [5]Kangwon National Univ., Chunchon, Korea, [6]Pusan National Univ., Busan, Korea, [7]Catholic Univ. of Daegu, Kyeongbuk, Korea, [8]Korea Institute of Construction Technology (Sustainable Water Resource Research Center), Goyang, Korea

KoFlux Gwangneung Supersite comprises complex topography and diverse vegetation types (and structures), which necessitate complementary multi-disciplinary measurements to understand energy and matter exchange. Here, we report the results of this ongoing research with special focuses on carbon/water budgets in Gwangneung forest, implications of inter-dependency between water and carbon cycles, and the importance of hydrology in carbon cycling under monsoon climate. Comprehensive biometric and chamber measurements indicated the mean annual net ecosystem productivity (NEP) of this forest to be ~2.6 t C ha^{-1} y^{-1}. In conjunction with the tower flux measurement, the preliminary carbon budget suggests the Gwangneung forest to be an important sink for atmospheric CO_2. The catchment scale water budget indicated that 30~40 % of annual precipitation was apportioned to evapotranspiration (ET). The growing season average of the water use efficiency (WUE), determined from leaf carbon isotope ratios of representative tree species, was about 12 μmol CO_2 (mmol H_2O)$^{-1}$ with noticeable seasonal variations. Such information on ET and WUE can be used to constrain the catchment scale carbon uptake. Inter-annual variations in tree ring growth and soil respiration rates correlated with the magnitude and the pattern of precipitation during the growing season, which requires further investigation of the effect of a monsoon climate on the catchment carbon cycle. Additionally, we examine whether structural and functional units exist in this catchment by characterizing the spatial heterogeneity of the study site, which will provide the linkage between different spatial and temporal scale measurements.

Acknowledgment: This study is supported by a grant (Code: 1-8-3) from Sustainable Water Resources Research Center of 21st Century Frontier Research Program, the A3 Foresight Program from the Korea Science and Engineering Foundation, and the BK21 program from the Ministry of Education and Human Resource Management of Korea.

S02

BASIC CHARACTERISTICS OF WATER DISTRIBUTION WITHIN A SOIL LAYER ON HILLSLOPE

Makoto Tani

Graduate School of Agriculture, Kyoto University, Japan

Both runoff discharge and evapotranspiration are controlled by the distribution of soil water within a soil layer on hillslope. Soil physical properties and slope topography also give influences on the both processes. It can be typically supposed that evapotranspiration is smaller from the hilltop than that from the lower zone on the hillslope because of a dryer condition there and that the distribution of soil water derived from the heterogeneous evapotranspiration gives feedback to the runoff discharge. Modeling this interaction between evapotranspiration and runoff through the soil water on hillslope is strongly needed to evaluate the land-atmosphere exchanging processes in complex terrains, but this has not been sufficiently addressed. One of the reasons is derived from the fact that effects of slope properties on the water movement, which is described by behaviors of the solution of the Richards equation, are not easy to be evaluated due to the nonlinearity of the equation. This study focuses on finding the basic characteristics of soil-water distribution within a soil layer in a recession stage of runoff discharge through an approximation of the solution of the two-dimensional Richards equation.

Consider a soil layer with a constant depth, D and homogeneous hydraulic properties (the saturated hydraulic conductivity of K_s) above an underlying impermeable layer on hillslope (the horizontal length of L and the angle of ω). We can apply the two-dimensional Richards equation to the soil layer. The distribution of water table under a recession stage of the runoff is generally considered a semi-steady state, and the flow streamlines are parallel to the slope (Beven, 1981). These two approximations from the saturated zone can be extended to the unsaturated zone in the present study. For example, if the runoff discharge rate is very low, the solution of the Richards equation shows that the saturated subsurface flow (SSF) is not generated within the soil layer but that the downslope water movement is supported only by the unsaturated subsurface flow (USF). SSF is produced when the discharge rate becomes large. Although the recession stage of runoff discharge is considered, a steady state assumption needs the supply of a weak constant rainfall to produce a steady state runoff discharge from the hillslope bottom. Because the streamlines are assumed to be parallel to the slope, downslope flow can be approximately calculated by the following equation:

$$fX = \int_0^D K(\psi = \psi_b - Z\cos^2\omega)\sin\omega\cos\omega\, dZ$$

where f is the constant weak rainfall intensity fallen onto the slope, $\psi$is the pressure head, ψ_b is the pressure head at the bottom of the soil layer, K is hydraulic conductivity represented by a functional relationship to ψ, X is the horizontal axsis, and Z is the vertical axis. This indicates the two-dimensional distribution of soil water in a steady state can be inversely calculated from the steady discharge rate at each horizontal point. The point where SSF is generated is limited within the area with a positive value of ψ_b. In addition to this consideration, we further introduce a scale ($\psi_f/\cos^2\omega$) representing the vertical height of USF, whereψ_f is defined using the functional relationship of K to ψ as:

$$f = K(\psi = \psi_f)$$

This scale parameter can divide the role of USF, SSF and the area where the water movement does not contribute to the downslope flow, and is important for a new similarity analysis of the soil-water movement on hillslope. Basic characteristics of the soil-water distribution in the recession stage of runoff discharge can be simply addressed using the scale parameter.

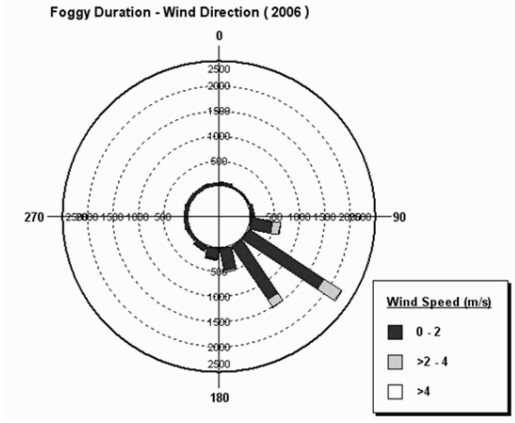
Reference

Beven, K. 1981. Kinematic subsurface flow. *Water Resour. Res.* 17: 1419-1424.

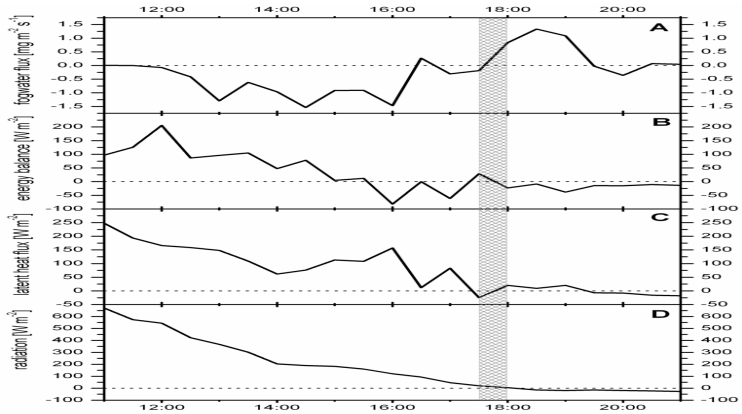
IMPACT OF FOG ON THE ENERGY BALANCE OF A CLOUD FOREST IN TAIWAN

Y.J. Hsia[1], E. Beiderwieden[2], O. Klemn, C.W. Lai[1], S.C. Chang[1]
[1] National Dong Hwa University, Hualien, Taiwan
[2] University of Münster, Münster, Germany

Mountane cloud forests cover about 25% of the land area in Taiwan and provide an important ecosystem services for the low land dense populated area. The hydrological processes of mountane cloud forest are characterized with net gain of moisture through fog water interception by the forest canopy and the reduction of evapotranspiration due to lower radiation energy flux and saturated moist air during fog events. Fluxes measurement has been carried out at the Chilan forest flux measurement site since 2004. The site is located at a steep but relative uniform slope covers densely with semi-natural regenerated yellow cypress (*Chamaecyparis obtuse* var, *formosana*). With an elevation ranging around 1650 m a.s.l. and a windward upstream valley side of the Ilan River, distinct diurnal mountain-valley wind pattern is observed at the site. Moist air uplifting by the valley wind during daytime brings dense fog/cloud almost year round (ranges from 4.7 to 11 hours/day) for the Chilan forest. Heavy fog reduced the incoming solar radiation as well as small vapor water deficient. It is thought that the lower water demanding will be the main limiting factor for the forest growth in this area since the site is also characterized with year round wet soil water condition.



Eddy fluxes of sensible, latent heat, CO2 as well as fog water were measured by 3D sonic anemometer, CO2/H2O infrared gas analyzer and fog droplet spectrometer during several experiment periods at the Chilan flux tower. Our results show that the study site has a negative energy flux during foggy condition, i.e., the forest is losing heat energy to the atmosphere. On average, the amount of solar energy during was reduced by 64% comparing with the clear sky condition. CO2 and latent heat fluxes were also reduced by 21% and 45% respectively against the clear sky conditions. However, water vapor flux (latent heat flux) was always presented despite during the fog events contradict ional to the conventional assumption that evapotranspiration was minimal due to the near saturated moist air. Concurrent measurements of sap flow also support this conclusion. As a consequence, reduced solar radiation due to the presence of fog at the Chilan site seems not the limitation growth factor for the yellow cypress. The low light requirement for the optimum growth rate from previous study on the seedling of yellow cypress might also imply that low intensity of the diffuse solar radiation could provide enough light intensity to sustain the growth of this yellow cypress cloud forest.



S04

Biometric and eddy-covariance-based estimates of net primary productivity for a warm temperate mixed forest in Japan
-Uncertainty of tower, chamber and biometric measurements-

Y. Kominami[1], M. Jomura[3], M. Dannoura[3],T. Miyama[1] K. Tamai[2],Y. Goto[4] and Y.Kanazawa[3]

[1]Kansai Research Center, Forestry & Forest Products Research Institute, Kyoto, Japan
[2]Agro-Meteorology Division, National Institute for Agro-Environmental Sciences, Tsukuba, Ibaragi
[3]Graduate School of Agricultural Science, Kobe University, Kobe, Japan
[4]Kyushu Research Center, Forestry & Forest Products Research Institute, Kumamoto, Japan
[5]Forestry & Forest Products Research Institute, Tsukuba, Japan

・ Introduction

Net ecosystem exchange or net ecosystem product of forest at warm and humid region has still much uncertainty and is controversial. Respiration activity of ecosystem at such region is high according to high temperature and humid condition and small estimation error of respiration could cause large error of NEE(NEP) estimation. Moreover, forests at such regions at Asia mostly situated on not flat terrain and estimation of nighttime respiration using tower flux has much uncertainty too. Therefore diversified evaluation of carbon budget is required. In this we estimated annual carbon storage (ΔC) of living biomass (ΔW) , soil carbon (ΔS_{litter}) and CWD (ΔS_{cwd}) in addition to chamber measurements based NEP and tower flux based NEE.

・ Materials and methods

The study was conducted in the Yamashiro Experimental Forest (temperate secondary broad-leaved forest in central Japan, 34°47'N, 135°50'E). Quercus serrata is a dominant species in the site. Annual mean air temperature was 15.5 °C and annual precipitation was 1449 mm in 2002. Tower CO2 flux have been measured from 2000.

Since the 6th century, the forests around the study site have been harvested heavily then abandoned, leaving much of the ground bare until the early 20th century. Moreover steep slope and mobile soil had prevented invading of plants. As a result, there was probably extremely little carbon accumulation in the soil during this period. In the 1900s, an extensive reforestation effort using *P. densiflora* was carried out. From the last half of the 1970s to the first half of the 1980s, most of these trees were killed by the pine wilt disease. Broadleaved species such as *Q. serrata* and evergreen species as *I. pedunculosa* that had invaded the site during the 1960s gradually became the dominant canopy species. Consequently, much CWD produced by *P. densiflora* existed in the site.

Using these especial historical conditions ,ΔS_{litter} was estimated using the RothC model(RothC-26.3). Moreover ΔS_{CWD} was estimated by subtracting respiration of CWD from the CWD input for this forest (Jomura, 2007). And combining these results with biomass estimation by DBH census held in 1994,1999 and 2004, annual change of carbon storage (ΔC) was esitimated.

		Pool (MgC ha^{-1})	Flux (MgC ha^{-1} yr^{-1})
Aboveground			
	(a) Wood	47.23	1.08
	(b) Leaves	3.78	2.58
	(c) CWD	9.30	0.61
Belowground			
	(d) Woody roots	9.86	0.23
	(e) Fine roots	1.84	0.58
	(f) NPP (a+b+c+d+e)		5.08
(g) Total soil respiration (mean)			5.81
	(h) (max.)		7.09
	(i) (min.)		4.25
(j) Heterotrophic respiration (mean)			3.66
	(k) (max.)		4.47
	(l) (min.)		2.68
Woody debris			
	(m) Logs	5.61	0.17
	(n) Snags	3.69	0.33
Soil carbon			
	(o) litter	31.00	0.31
	(p) CWD	9.30	0.11
NEP	(mean) (f-j-o-p)		0.92
	(max.) (f-l-o-p)		1.90
	(min.) (f-k-o-p)		0.11
ΔC	(a+d+o+p)		1.73
NEE	u* threshold≥0.2		1.93
	u* threshold≥0.4		1.23

・ Results and Discussion

Esimated mean annual tower flux based NEE was 1.23(u* threshold=0.4 m s$_{-1}$), chamber measurements based NEP was 0.92 and ΔC was 1.73 tC ha^{-1} y^{-1} respectively. NEE, NEP estimations highly depend on u* threshold and spatial variation of soil respiration. In estimation of ΔC, about 75% of carbon was estimated to be accumulated in living biomass. And change of annul carbon storage in soil (0.42 tC ha^{-1} y^{-1})was no less small than that reported in tropical forest (0±0.5 tC ha^{-1} y-1; Turumbore,1995).

S05

ECOSYSTEM PHOTOSYNTHESIS AND ITS ENVIRONMENTAL FACTORS IN A TROPICAL SEASONAL RAIN FOREST, SW, CHINA

SONG Qing-hai[1,3,4], ZHANG Yi-ping[1,4], YU Gui-rui[2], ZHANG Lei-ming[2], YANG Zhen[1,3,4], ZHAO Shuang-ju[1,3,4], GAO Ju-ming[1,3,4], SUN Xiao-min[2] ([1].*Xishuangbanna Tropical Botanical Garden，CAS，Kunming* 650223; [2] *Institute of Geographic Sciences and Natural Resources Research, CAS, Beijing* 100101, *China* ;[3] Graduate School of the Chinese Academy of Sciences, *Beijing* 100039, *China* ; [4] *Xishuangbanna Station for Tropical Rain Forest Ecosystem Studies，Menglun* 666303；[5] *Yunnan Building Materials Academy，Kunming 650221*)

Abstract The environmental controls on the seasonal variations of ecosystem apparent quantum yield (α), maximum photosynthesis rate ($P_{eco,opt}$) and ecosystem respiration ($R_{eco,day}$) were investigated during 2003 to 2006 in the tropical seasonal rain forest ecosystem. Interannual differences in the three parameters not apparent, indicating that the forest ecosystem was a continuum during the four years. There were seasonal differences in the three parameters. They were mainly controlled by air temperature (Ta) and vapor pressure deficit (VPD). In the rainy season, the higher ecosystem photosynthesis related to the higher precipitation and warmer air temperature. In the foggy-cool season, fog drip plays an important role in the water relations of plants, so photosynthesis capacity was still higher relatively. In the dry-hot season, ecosystem α and $P_{eco,opt}$ were lower than other seasons. The reason might be response to a hydrologic limitation. Ecosystem α decreased with increasing Ta and VPD. P_{eco} strongly depended on Ta above 20 □, as well as on VPD above 1kPa.

O21

Increasing The Spatial Resolution of MODIS Satellite Data For Mapping Net Primary Production

Abd Wahid Rasib, Ab. Latif Ibrahim, A.P. Cracknell, Mohd Azahari Fandi and Wan Hazli Wan Kadir

Department of Remote Sensing
Faculty of Geoinformation Science and Engineering
Universiti Teknologi Malaysia, 81310, Skudai, Johor, MALAYSIA
wahid@fksg.utm.my

Abstract

Spatial resolution for mapping net primary production (NPP) plays an important role to determine the good accuracy for carbon concentration in the atmosphere. Nowdays, data from Moderate Resolution Imaging radiometer (MODIS) satellite has been used widely for mapping NPP. Due to the low spatial resolution (1 km x 1 km), this satellite data is infrequent to be used for mapping NPP at local scale. Recently, the sub-pixel techniques have been developed seriously by researches to increase the existing spatial resolution particularly for highest accuracy in land information mapping. In addition, Previous researches have shown that sub-pixel techniques such as the Hopfield Neural Network have an ability to improve the spatial resolution to obtain more accurate environmental information, for example about climate change. Thus, in this present study, MODIS satellite data is attempted to be used to map the local NPP for Pasoh Forest Reserve in Malaysia. The Hopfield Neural Network technique is applied to improve the spatial resolution of MODIS satellite data appropriate to the flux measurements. Micrometeorological approach from Monteith's equation is then used to map NPP from the sub-pixel of MODIS satellite data. The NPP map produced shows the spatial distribution of estimated NPP values for Pasoh Forest Reserve.

Cancelled

O22

CALIBRATING THE GROUND REFLECTANCE FROM THE MULTI-TEMPORAL- AND LOW-SPECTRAL-RESOLUTION IMAGERY WITH NON-SYNCHRONOUS GROUND MEASUREMENTS FOR ESTIMATING CROP YIELD

Cheng-Chien Liu[1, 2], Chwen-Ming Yang[3] and Yi-Wen Wang[1]

[1] Department of Earth Sciences, National Cheng Kung University, Tainan 701 Taiwan ROC
[2] Institute of Satellite Informatics and Earth Environment, Earth Dynamic System Research Center and Sustainable Environment Research Center, National Cheng Kung University, Tainan 701 Taiwan ROC
[3] Agronomy Division, Taiwan Agricultural Research Institute, Taichung 413 Taiwan ROC

Estimating the crop yield is one of the most important and advantageous applications of space-borne remote sensing, mainly because of its synoptic view and its capability for repetitive observations. To obtain a reliable estimation, however, the vital parameters of the target crop need to be retrieved from the satellite observation in the critical timing specified by the growth model. This requires a sensor with not only the short revisiting period but also the high agility to pointing to the target area. Advance of space-borne remote sensing during the last decade has now provided imagery with much higher resolutions both in the spatial and temporal domain, such as QuickBird, IKONOS, SPOT-5 and FORMOSAT-2. Limited to their spectral-resolution, however, to correct the atmospheric interference based on the information derived from these imagery is still a big challenge for estimating the crop yield from these space-borne remote sensing imagery.

We report a new approach to calibrate the ground reflectance from the multi-temporal- and low-spectral-resolution imagery taken by FORMOSAT-2 with non-synchronous ground measurements, with the intention to monitor growth and estimate yield of rice crop from space. The field experiments were conducted at Taiwan Agricultural Research Institute Experimental Farm at Wufeng in the first and the second cropping seasons of 2006. The leaf area index (LAI), developmental stage, yield at harvest and the near ground canopy hyperspectral reflectance $R_g(\lambda)$ were collected at the interval of two to three weeks for rice plants (Oryza sativa L. cv. TNG 67) grown under seven planting densities. A total of thirty-six multispectral images of the study area taken by FORMOSAT-2 during the growing periods were processed by band-to-band coregistration, spectral preserved pan-sharpening, automatic orthorectification, multi-temporal imagery matching and radiometric normalization. Since the collections of $R_g(\lambda)$ were not synchronous with the FORMOSAT-2 observations, we applied the second order polynomial curve fitting to the time series of $R_g(\lambda)$, calculated the corresponding values of $R_g(\lambda)$ for each FORMOSAT-2 image, and then derived a linear relationship to calibrate the absolute values of ground reflectance from all FORMOSAT-2 imagery. To validate this new approach, both the satellite-derived $R_g(\lambda)$ and the ground measurement of $R_g(\lambda)$ were applied to the growth model to predict the crop yield of rice. The results show that both estimations are very close. This research demonstrates that our new approach is able to provide quite an accurate calibration of $R_g(\lambda)$ from the multi-temporal- and low-spectral-resolution imagery.

O23

MODELING AND VALIDATING GROSS PRIMARY PRODUCTIVITY FOR WINTER WHEAT – CORN ROTATION SYSTEM USING MODIS TIME SERIES AND FLUX TOWER DATA

H. Yan[1], Y. Fu[1], X. Xiao[2] and G. Yu[1]

1. *Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China*
2. *Institute for the Study of Earth, Oceans and Space, University of New Hampshire, Durham, NH, USA*

Cancelled

Accurate and spatially explicit estimation of the photosynthesis productivity dynamics of agricultural ecosystems at the global scale is of great significance to global crop condition and agricultural production assessment and is necessary for understanding the carbon cycle of the terrestrial biosphere, because agricultural land is usually described simply in most global biogeochemical models which do not accounting for crop intensity, phenology and crop types. Light use efficiency (LUE) algorithms are a potentially effective approach to monitoring global net primary production or GPP using satellite-borne sensors such as the Moderate Resolution Imaging Spectroradiometer (MODIS), and MODIS vegetation index (such as EVI, LSWI) have been proved is effective for quantifying vegetation greenness, canopy water content or crop intensity. Nevertheless, assignment of ε across all rotation season is still problematic in the case of C3 and C4 crop species rotation system (e.g., winter wheat and corn). CO_2 flux data from the tower sites provide valuable information on seasonal dynamics of GPP of crops for identifying the mechanism of LUE dynamics over different phenological stages.

In this study, our objective is: (1) to characterize seasonal dynamics of winter wheat and corn from the vegetation indices; (2) to examine biophysical performance of vegetation indices in relation to seasonal dynamics of CO_2 fluxes, and (2) to evaluate the availability of the VPM model for estimating GPP of agricultural ecosystems within winter wheat – corn rotation.

O24

Determination of Rate of Photosynthesis for Tropical Forest Using Landsat TM Data

Mohd Azahari Faidi, Ab.Latif Ibrahim and Abd.Wahid Rasib
Department of Remote Sensing
Faculty of Geoinformation Science and Engineering
Universiti Teknologi Malaysia
81310, Skudai, Johor
Email: aierezz@yahoo.com

Presenter: Mohd Azahari Bin Faidi

The tropical forest takes up and emits large amounts of carbon through the process of photosynthesis and respiration. The total rate of photosynthesis is known as the Gross Primary Productivity (GPP), the rate at which energy is captured during photosynthesis in a given period of time. Knowledge regarding total rate of GPP in any area is very important in determining the total amount of carbon that can be absorbed by forest area. Many researches have been carried out to estimate the rate of GPP using conventional techniques such as Miami Model and Thornthwaite Model. Recently remote sensing data has been widely used for estimating the rate of GPP. In this study, Landsat TM data will be utilized to estimate the annul rate of GPP of tropical forest. For this purpose, GPP for Pasoh Forest Reserve in Negeri Sembilan over ten years period (1990 – 2000) will be determine using Micro-Meteorological model. Parameters such as Radiance Use Efficiency (ε.) and Photosynthetic Active Radiation (PAR) which are required as input in Micro-Meteorological Model will be obtained using Surface Energy Balance Model. Total amount of GPP obtained using this model will be compared with the amount obtained using conventional technique.

Cancelled

O25

Upscaling of Carbon and Water Fluxes to the Regional Scale with Eco-hydrological Model in the Mountainous Forest, East Asia

Taehee Hwang1, Sinkyu Kang2, Joon Kim3, Youngil Kim4, Dowon Lee4, and Lawrence Band1

1Dept. Geography, University of North Carolina at Chapel Hill, Chapel Hill, USA
2Dept. Environmental Science, Kangwon National University, Chuncheon, Korea
3Dept. Atmospheric Sciences, Yonsei University, Seoul, Korea
4Graduate School of Environmental Studies, Seoul National University, Seoul, Korea

The objectives of this study are (1) to simulate and validate the eco-hydrological model at a small catchment scale with various field and flux measurements, (2) to scale up these carbon and water processes to a regional scale by integrating spatial information derived from high-resolution satellite data, and (3) to evaluate MODIS products temporally, which would suggest a method to extrapolate flux measurements spatially in a topographically complex terrain and a heterogeneous land cover region. In this study, a GIS-based, eco-hydrological model (RHESSys) was used as a scaling tool from a small deciduous broadleaf forest (DBF) catchment to a regional watershed scale. The primary advantage of this model is to use hydrological data from a catchment outlet to match the mass balance of water cycle. Streamflow data can be measured successively and is not affected by topographical and atmospheric conditions. RHESSys considers the spatial variances of microclimate and soil water in simulating water and carbon dynamics of forest ecosystem. Therefore, the model estimates the spatial variances of soil water and fluxes of water and carbon at a regional scale, which would be more effective especially in a complex terrain. Daily streamflow data and seasonal leaf area index (LAI) values were used to calibrate the model at both water and carbon cycles. Other field measurements and flux measurements for at least one year were used to validate model results. After this stepwise calibration strategy at a small catchment scale, the model was applied to a regional scale by employing spatial vegetation information derived from high-resolution satellite images of Landsat Enhanced Thematic Mapper plus (ETM+). Finally, regional scale model results were applied to evaluate MODIS land products (LAI and GPP/NPP).

O31

WATER USE EFFICIENCY: A GOOD PARAMETER INDICATING THE COUPLING RELATIONSHIP BETWEEN CARBON AND WATER CYCLES

F.H. Zhao [1,2], G.R. Yu[1], S.G. Li [1]

[1] *Institute of Geographic Sciences and Natural Resources Research, Beijing, China*
[2]*Graduate University of Chinese Academy of Sciences, Beijing, China*

Abstract: Carbon and water cycles are tightly coupled in the terrestrial ecosystems. Water use efficiency (WUE), the ratio of carbon and water, is a suitable parameter indicating the coupling relationship between them. Our presentation includes two parts: 1) to setup the systemic structure of WUE; 2) to report our 3 year's WUE observation in a winter-wheat ecosystem in the North China Plain. It's necessary to setup the systemic structure of WUE for there are many definitions of WUE, which usually was defined differently depending on the time and space scales of the processes and system aggregation it refers to. According to the systemic levels defined by ecosystem ecology, we setup the structure of WUE from molecular level to global level. In the second part, we discussed the coupled relations between carbon and water in a crop ecosystem, reported the general patterns of WUE and assessed the climatic effects on WUE.

Key words: water use efficiency (WUE); ecosystem; carbon flux; water flux

O32

Responses of soil respiration and ecosystem CO_2 exchange to simulated precipitation pulses in a typical steppe, Inner Mongolia

Shiping Chen, Guanghui Lin, Jianhui Huang
Key State Laboratory of Vegetation and Environmental Change, Institute of Botany, the Chinese Academy of Sciences, Beijing 100093, China

Infrequent, discrete and largely unpredictable precipitation events (rainfall pulse) have been suggested to play an important role in regulating C balance of arid and semiarid ecosystems (Huxman et al. 2004). Because of the differential rates of response of respiratory and photosynthetic processes in arid land ecosystems, generally, a rainfall pulse after periods of drought resulted in large, but short-lived, respiration increase and CO_2 efflux (Liu et al. 2002; Lee et al. 2004). Until now, it is still largely unknown how rainfall pulses influence the dynamics of ecosystem carbon exchange (Huxman 2004). However, to assess the vulnerability of arid and semiarid ecosystems to climatic changes, particularly changes in the precipitation regime, it is critical to increase our understanding of how the key ecological processes (autotrophic respiration, heterotrophic respiration and photosynthesis, etc) respond to rainfall pulses.

Cancelled

A manipulative experiment with different simulated precipitation pulse sizes treatments (0, 5, 10, 25 and 75 mm) was conducted in control (CK) and clipping (CL) plots in a typical *Stipa* steppe, Inner Mongolia, China. Our objectives are 1) to study how do soil respiration and ecosystem CO_2 exchange respond to precipitation pulses in a semi-arid steppe? 2) to test what size of precipitation pulse will be favorable for carbon sequestration of the semi-arid steppe? Our results showed that: Rapidly and substantially increases in soil and ecosystem respiration occurred several hours after pulse treatments. The responses of NEE and GEP to precipitation pulses were slower than that of respiration. The magnitude and duration of increase in respiration were depended on pulse sizes. Significantly higher proportion of heterotrophic respiration contributed to soil respiration was found in larger pulse treatment (25 and 75mm). The heterotrophic part of soil respiration showed higher sensitivity to soil moisture and temperature than autotrophic part. The precipitation pulse larger than 10mm will significantly increase NEE and be in favor of carbon sequestration in the typical *Stipa* steppe.

O33

MEASUREMENT OF METHANE FLUX OVER THE LARCH FOREST IN FUJI-HOKUROKU, JAPAN

K. Hamotani[1], W. Nisimura[1] and Y. Fujinuma[2]

[1] Graduate School of Life & Environmental Sciences, Osaka Prefecture University, Gakuencho, Sakai, Japan
[2] National Institute for Environmental Studies, Tsukuba, Japan

Atmospheric methane (CH_4) is one of the most important greenhouse gases. Since Keppler et al (2007) reported that CH_4 emissions from terrestrial plants under aerobic conditions, this topic is focusing from many researchers. However, whether forest is absorbing or emitting CH_4 is not well known.

The eddy correlation instrument for CH_4 is not well developed, and most of the flux measurements are based on slow response instruments such as gradient method. In this research, we developed a relaxed eddy accumulation (REA) measuring system and applied it to the CH_4 flux measurements over the forest.

REA method, the flux (F) is expressed as

$$F = b\sigma_w(C^+ - C^-),$$

where w is vertical wind velocity and σ_w is the standard deviation of vertical wind fluctuations. C^+ and C^- are the mean CH_4 concentration where w is positive and negative respectively. b is an empirical coefficient usually determined by applying the REA method to the temperature signal and 0.52 is used here.

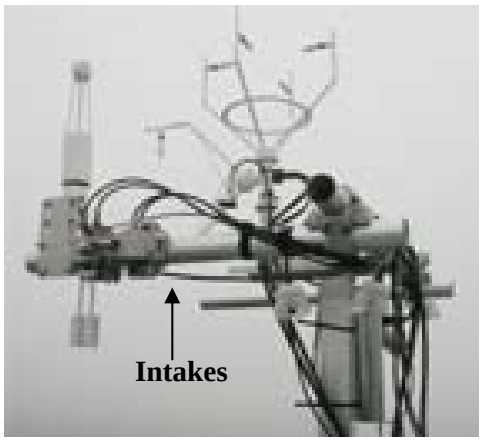


Fig 1 Intakes for measuring CH_4 flux with REA method.

Measurements were made at Fuji-Hokuroku Research site of Center for Global Environmental Research (CGER), National Institute for Environmental Studies. This site located from foot of Fuji-mountain, and the topography is fairly flat with the 3 to 4° up to the South-West. Forest type is secondary Japanese larch forest. The canopy height is 20 to 25 m and the height of 31 m aluminum tower was installed in the forest. The tower had moving mast in the top, which installed instruments and intakes (Fig 1) for flux measurements. The sampling system for measuring CH_4 flux was installed to the tower at 2007 July 18th and started measurement.

Data were continuously taken every half-hour. The ensemble average was calculated by 14 samples form 11th to 27th August except rainy days. Ensemble average of CH_4 flux and daily variation are indicated in Fig 2 and Fig 3 respectively.

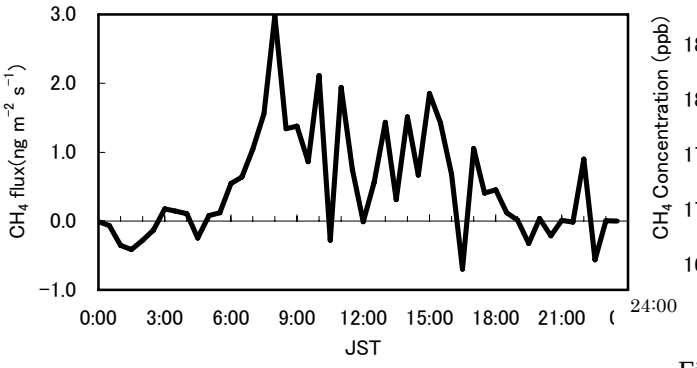


Fig 2 Daily variation of CH_4 flux.

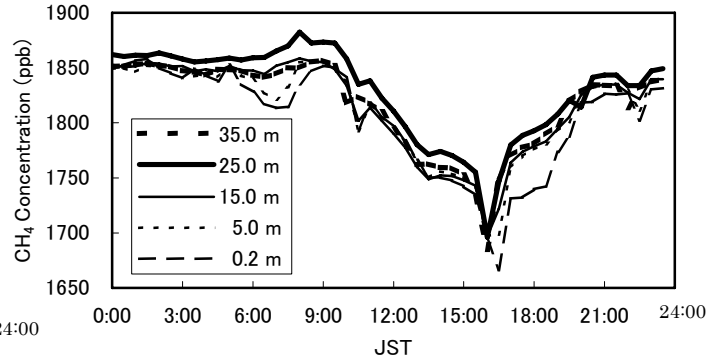


Fig 3 Daily variation of CH_4 concentration (inside; 0.2, 5.0, 15 m and above; 25, 35 m the forest).

O41

MODELING DIURNAL VARIATION OF CO_2 AND LATENT FLUXES IN NORTHEAST CHINA BASED ON STOMATAL BEHAVIOR

H. Huang[1,2], G.R. Yu[1], L.M. Zhang[1]

[1] *Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China*

[2] *Graduate School of the Chinese Academy of Sciences, Beijing, China*

Stomata controls the exchange of canopy water, carbon and energy between vegetation and atmosphere. Canopy conductance is an important index quantifying this control, which is also an important determinant of plant water use and photosynthesis. In this study, a leaf level combination model (Yu *et al.*, 1998) was scaled up to estimate canopy conductance. As a development of Jarvis-type model (Jarvis, 1976), the combination model is convenient to use, requiring parameters at the canopy level that can be measured directly. The combination model consisted of the potential canopy conductance (*PSC*) and the relative degree of stomatal opening (*RDO*), expressed as functions of inter-day and intra-day environmental variables. Canopy latent heat flux was estimated by coupling the combination model with the analogy of Ohm's law in electrics. A photosynthesis model was also founded based on combination model, which describes that the net assimilation rate depends on both 'supply' and 'demand' functions. Consequently, a canopy photosynthesis-transpiration model based on stomatal multiscale responses (CPTM-SMR) was established.

CPTM-SMR was applied to Changbai Mountains temperate broad-leaved Korean pine mixed forest (CBS, 42°24′N, 128°28′E) to simulate canopy latent heat flux and net ecosystem productivity (NEP) in 2003~2005. Simulated canopy latent heat flux and CO_2 flux were compared with the observation by the eddy covariance system. The results showed that the output of CPTM-SMR agreed well with the measurement fluxes in diurnal variations under various weather conditions. The root mean square errors (RMSE) of CO_2 flux between simulation and measurements was about 0.32 mg CO_2 $m^{-2}s^{-1}$, and 62.10 W m^{-2} of latent heat flux. The responses of canopy conductance to environmental variables varied at different time scales, which we named.as "stomatal multiscale responses". Analysis suggested that temperature is the main factor that affects canopy conductance both at inter-day and intra-day time level at CBS and the hypo-factor is Q_p.

O42

SURFACE ROUGHNESS LENGTH DYNAMIC AND ITS EFFECTS ON FLUXES MODELING OVER SEVERAL DIFFERENT FLUX STATIONS

Y.L. Zhou[1,2], X.M. Sun[1,], Z.L. Zhu [1]and X.F. Wen[1]

1 Chinese Ecosystem Research Network Synthesis Research Center, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China

[2] Graduate University of the Chinese Academy of Sciences, Beijing100049, China

Surface roughness length (z_0) is a very important parameter in micrometeorological and microclimatic research fields. Many contemporary model parameterizations of land-atmosphere fluxes, including momentum, sensible heat and latent heat, require knowledge of aerodynamic z_0. Over heterogeneous surfaces, z_0 is virtually time-variant with change of wind direction and other factors. While in fluxes models z_0 is usually considered invariant, which would result in fluxes modeling error. So it is necessary to obtain z_0 dynamic and its effects on fluxes simulation.

Surface z_0 was calculated with traditional least-square method using wind speed and temperature in four levels above canopy over three typical flux measurement stations. The three stations stand for complex and undulant surfaces, forest surfaces, and crop covered surface respectively. Results indicate that z_0 is varying with the change of wind speed, wind direction (terrain), leaf area index, and atmospheric stability. As for complex and undulant surfaces, z_0 is varying greatly with wind directions, while as for heterogeneous surface, z_0 changes little with wind directions. z_0 increases firstly to a peak value and then decreases with increasing LAI. With the increase of wind speed, z_0 changes diversely over the three stations. Particularly, z_0 represents distinct daily variation result in the change of atmospheric stability. z_0 is much lower in daytime than nighttime. Based on dynamic characteristic of z_0, we did a sensitivity analysis of aerodynamic resistance simulation and studied its effects on aerodynamic fluxes simulation by using several common models. The results indicated that 10% change in z_0 would lead to an error of 6.4% in aerodynamic resistance simulation utmost. And z_0 dynamic can result in an error of 33.802% in the heterogeneous surface by SEBS model.

O43

MODELING CARBON EXCHANGE IN FOREST ECOSYSTEMS: DESCRIPTION AND EVALUATION OF CEVSA2 MODEL

Gu Fengxue[1], Yu Guirui[2], Tao Bo[2], Wen Xuefa[2], Zhang Leiming[2], Li Kerang[2]

[1] Institute of Environment and Sustainable Developmen in Agriculuret, Chinese Academy of Agricultural Sciences, Beijing, China

[2] Key Laboratory of Ecosystem Network Observation and Modeling, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China

A new version of CEVSA model –CEVSA2 is developed to simulate the water and carbon exchange between soil-vegetation-atmosphere day by day. The revised CEVSA2 model incorporates several significant improvements over the CEVSA. The improvements can be summarized as follows: (1) developing a new leaf phenology parameterization submodel; (2) exploring a new allocation scheme that estimates allocation of photosynthesis products among leaves, stems, and roots depending on resource availability; (3) calculating the LAI according to carbon balance of leaves; (4) describing the temperature response of V_{cmax} by using a Arrhenius function, and temperature response of J_{max} by using a peaked function, and the optimal temperature for J_{max} is decided by mean temperature of 10 days ago; (5) modification of the biophysical submodel calculating evapotranspiration and soil moisture; (6) the model runs on a daily time step instead 10-day time step. Using data from eddy covariance measurements in three different forest ecosystems, which represent the temperate mixed forest, temperate deciduous forest and sub-tropical coniferous plantation, respectively, we tested and evaluated the revised CEVSA2 model. A sensitivity analysis is carried out to decide the key parameters that affect on the simulated NEP significantly. The results show that parameters for stomotal conductance, soil moisture and total soil carbon pool, composition etc. are the key parameters affected the simulated NEP. An uncertainty analysis is then carried out to evaluate the uncertainty on the annual and daily NEP outputs caused by these key input parameters and their relative contribution to the total uncertainty of simulated NEP. The real uncertainties of key parameters and driving variables make the simulation change in a large range. Initial soil carbon pool and parameters for stomotal conductance contribute to the uncertainty of NEP output mostly.

Cancelled

***Key words*:** CEVSA2 model, forest ecosystems, carbon exchange, eddy covariance, sensitivity analysis, uncertainty analysis

O44

MODELING SEASONAL TO ANNUAL NET ECOSYSTEM CO_2 EXCHANGE OF MARSH IN THE SANJIANG PLAIN, NORTHEAST CHINA

Zhijun Jia and Yao Huang

LAPC, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China

Cancelled

Freshwater marshes accumulate enormous quantities of organic carbon in the soil because of slower decomposition rates and relatively higher production, thus playing a significant role in the global carbon balance. A process-oriented model is developed to simulate the net ecosystem CO_2 exchange of freshwater marsh which is characterized by long-term inundated soil. The model has a daily time step and its components include (1) the photosynthesis and respiration of *Carex*, typical marsh plants; (2) net aboveground and belowground production, and litterfall; (3) anaerobic decomposition of soil organic matter down the soil profile with the variation of water level. The model requires air temperatures, incoming radiation, water table depth and precipitation as drivers. Simulations predict the net ecosystem CO_2 exchange of marsh over season to several years. A 3-year simulation from 1994 to 1996 was conducted for marshland in the Sanjiang Plain, northeastern China, and results were compared with eddy covariance tower CO_2 flux at the corresponding period from the site. The comparative results show that the seasonal patterns and the general magnitude of net ecosystem exchange of CO_2 were similar between the model and the tower data. In addition, the strong effects of hydrological condition on the wetland carbon dioxide cycle was verified and explained how to work.

O51

THE FLUXNET SYNTHESIS ACTIVITY TO BETTER UNDERSTAND AND QUANTIFY THE GLOBAL CARBON CYCLE USING EDDY COVARIANCE DATA

D. Papale

DISAFRI, University f Tuscia, Viterbo, Italy

FLUXNET is a global network of eddy covariance sites that started more that 10 years ago with the aim to put in contact the different regional networks, find and propose standard methods for data collection and processing and promote synthesis activities.

There are today more then 10 regional networks of eddy covariance sites in the world covering Europe (CarboeuropeIP, Carboitaly, NECC), North America (Ameriflux and Fluxnet-Canada), Central and South America (LBA), Oceania (OzFlux), Africa (CarboAfrica and Afriflux) and Asia (Asiaflux, Chinaflux, USCCC, KoFlux, TCOS-Siberia) plus a number of sites that are not officially part of any network. In total our estimates are that there are globally between 300 and 400 eddy covariance sites active and about 40 of these with at least 5 years of data.

In February 2007 a new global synthesis activity has been proposed sponsored by Fluxnet and GTOS-TCO with the aim to involve all the regional networks in a common effort, putting together all the datasets available, processing the data following a standard protocol and finally using this dataset for a number of synthesis studies at global scale. We received data from more than 180 sites and more than 900 sites/years of data that have been quality checked, gapfilled and partitioned in the two component GPP and Reco and are now available to the scientific community. A workshop has been organized in LaThuile, Italy, where colleagues coming from all the regional networks involved had the opportunity to meet each other and, we hope, put the basis for a more stable and active collaboration,

In this contribution the Fluxnet initiative, the methods and rules to access and use the Fluxnet dataset, the data processing applied and the first preliminary results from some of the activities will be presented.

O52

SPATIAL DISTRIBUTION OF CARBON BALANCE IN FOREST ECOSYSTEMS ACROSS EAST ASIA

R. Hirata[1], N. Saigusa[2], S. Yamamoto[3], Y. Ohtani[4], R. Ide[1], J. Asanuma[5], M. Gamo[2], T. Hirano[6], H. Kondo[2], Y. Kosugi[7], S.-G. Li[8], Y. Nakai[4], K. Takagi[9], M. Tani[7], and H. Wang[2]

[1]National Institute for Environmental Studies, Japan
[2]National Institute of Advanced Industrial Science and Technology, Japan
[3]Graduate School of Environmental Science, Okayama University, Japan
[4]Forestry and Forest Products Research Institute, Japan
[5]Terrestrial Environment Research Center, University of Tsukuba, Japan
[6]Graduate School of Agriculture, Hokkaido University, Japan
[7]Graduate School of Agriculture, Kyoto University, Japan
[8]Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Science, China
[9]Field Science Center for Northern Biosphere, Hokkaido University, Japan

The objective of this study is to clarify what kind of environmental factors control annual CO_2 fluxes, such as net ecosystem production (NEP), gross primary production (GPP), and ecosystem respiration (RE) in forest ecosystems across East Asia. Study sites were widely distributed and included diverse ecosystems, such as evergreen and deciduous, coniferous and broadleaf, planted and natural forests, from subarctic to tropical zones. We have measured the NEP using the eddy covariance technique at 13 forest sites in East Asia.

We have findings that GPP and RE are simply regulated by annual mean air temperature across East Asia. There is a clear linear relationship between annual GPP and annual mean air temperature because the air temperature influences both growing period length and the seasonal variation of the maximum photosynthetic capacity, which regulate the annual GPP (Fig. 1 (a)). We also found a strong exponential relationship between annual RE and annual mean air temperature on an East Asia scale (Fig. 1 (b)), which is quite similar to the relation obtained on a canopy scale. The dependency of annual RE on air temperature on the East Asia scale was similar to that of monthly RE on air temperature on an individual site scale other than temperate larch and mixed forests in northern Japan. The reason why the relation is simple is that severe stress, which effects GPP or RE, is small in East Asia. The present study suggested that RE is sensitive to environmental factors other than climate if compared with GPP, from the results that the annual RE–air temperature relationship was more scattered than the annual GPP–air temperature relationship. The NEP was small at high latitude, relatively large at mid latitude, and scattered at low latitude. As a whole, the NEP was more influenced by RE than GPP in East Asia. Compared to North America and Europe, the increase in ratio of GPP to air temperature is slightly higher in East Asia. One of the possible reasons is that GPP in East Asia was not exposed to severe environmental stresses, such as summer drought.

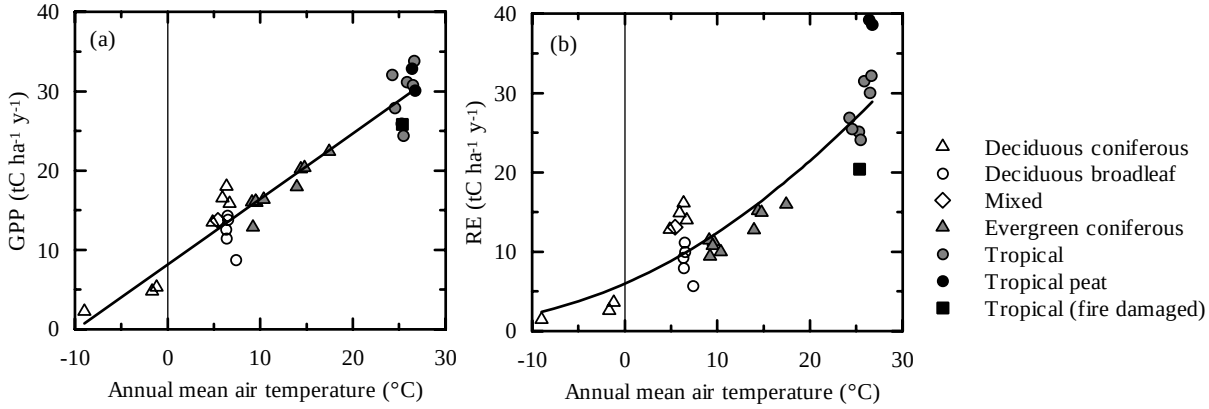


Fig. 1 Relationships between annual mean air temperature (T_a) and (a) GPP, (b) RE.

Acknowledgements: This study was supported by Japan Ministry of Environment (Integrated study for terrestrial carbon management of Asia in the 21st century based on scientific advancements). The authors would like to thank all the project investigators, their co-workers, and students for providing data.

O53

EFFECTS OF MARSHLAND CONVERSION TO CROPLAND ON WATER AND ENERGY EXCHANGE IN NORTHEASTERN CHINA

X.S. Zhao[1], Y. Huang [1], Z.J. Jia[1], H.Z. Liu[1], T. Song[1], Y.S. Wang[1], L.Q. Shi[1], C.C. Song[2], Y.Y. Wang[2]

[1] LAPC, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China
[2] Northeast Institute of Geography and Agricultural Ecology, Chinese Academy of Sciences, Jilin, China

To study the effect of land use change from marshland to cropland (rice and soybean cultivation), the energy fluxes in marshland, rice and soybean fields in northeastern China were measured by the path eddy covariance method for 2 years during the growing season (May to October in 2005 and 2006). The croplands of rice (flooded until early September) and soybean (dry land) were reclaimed from marshlands over 15 years. The annual precipitation in 2005 (480mm) was below the 1981-2004 average (564±130mm), whereas in 2006 (655mm) precipitation was significantly above average. The conversion of marshland to irrigated rice field resulted in an enhancement in latent heat flux (LE) and a decrease in sensible heat flux (H), which caused an increase in the ratio of LE and net radiation (LE/Rn) from 0.6 to 0.8 on average, and a decrease in H/Rn from 0.4 to 0.2 on average in the growing season. However, when the marshland was reclaimed as upland soybean field, the latent heat flux of the soybean field was lower in 2005 under dry condition but higher in 2006 under wet condition than that in the marshland, opposite to H. Therefore, LE/Rn in the soybean field dropped to about 0.2 in the dry month of June 2005, and rose to 0.7 in the wet month of June 2006. H/Rn for the soybean field shows opposite variation to LE/Rn for these two years. The maximum evapotranspiration (ET) in the marshland was about 4.5mm day^{-1}, and about 6~7mm day^{-1} and 5mm day^{-1} in rice and soybean fields, respectively. Rn, air temperature (Ta), vapor pressure deficit (VPD) and leaf area index (LAI) were important environmental and biological factors controlling the seasonal dynamics of LE and H at three ecosystems, which can explain about 80% of LE and 50% of H for marshland and rice field; only 30%~50% of LE and 60% of H can be explained for the soybean field. Among them, Rn was the primary variable controlling the variations of LE and H of the marshland and rice field. However, for the soybean field, VPD played a more important role on LE under dry conditions.

***Keyworks**:* Land use change; energy flux; evapotranspiration; marshland; cropland; eddy covariance

O54

COMPARISON OF CO_2 BALANCE AMONG THREE DISTURBED ECOSYSTEMS IN TROPICAL PEATLANDS

T. Hirano[1], H. Segah[2], S. Limin[2], H. Takahashi[3] and M. Osaki[1]

[1] *Hokkaido University, Sapporo, Japan*
[2] *University of Palangkaraya, Palangkaraya,Indonesia*
[3] *Hokkaido Institute of Hydro-Climate, Sapporo, Japan*

Tropical peatlands have accumulated a huge amount of carbon as organic matter in soil, and are naturally covered with swamp forests. Recently, however, the tropical peatlands are disturbed on a large scale by deforestation and drainage to produce timber and create farmlands. Such disturbance changes petland environment and should enhance the decomposition of organic carbon into CO_2. In addition, drought caused by El Niño and Southern Oscillation (ENSO) and its consequent large-scale fires accelerate CO_2 release to the atmosphere from peatland soil through decomposition and burning. These facts suggest that tropical peatlands keep vulnerable carbon stock and will be a major CO_2 source in the near future. Therefore it is important to evaluate the effects of disturbance on CO_2 balance of tropical-peatland ecosystems to globally predict the trend of atmospheric CO_2 concentration.

We have measured CO_2 flux using the eddy covariance technique above three peatland ecosystems differing in disturbance conditions near Palangkaraya, Central Kalimantan, Indonesia in 2004 and 2005, non-ENSO years. Three ecosystems are as follows: a swamp forest growing on undrained peatland in Setia Alam area (SF), a swamp forest in drained peatland on Kalangpangan area (KF) and a cutover in drained peatland in Kalangpangan area (KB). Large channels were excavated in Kalangpangan area in the 1990's. In Kalangpangan area the large portion of forest was clear-cut after the channel construction, and KB site was burned twice in the ENSO years, 1997 and 2002.

Annual sums of net ecosystem CO_2 exchange (NEE) between May 2004 and May 2005 were positive even for the undrained forest (SF) (Fig. 1), which shows that all peatland ecosystems functioned as CO_2 source for the atmosphere. The annual NEE was between 100 and 800 gC m^{-2} y^{-1} and was the largest for the cutover (KB) and the smallest for SF.

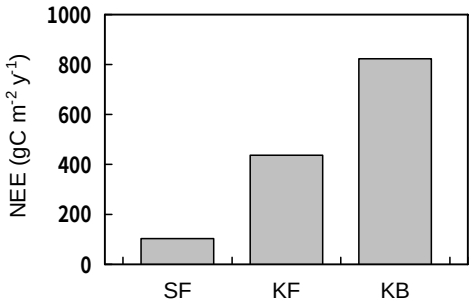


Fig. 1 Annual sums of NEE at the SF, KF and KB sites between May 2004 and May 2005.

O56

STOMATAL CONDUCTANCE RESPONSE TO ENVIRONMENTAL VARIABLES AND ITS RELATIONS TO CARBON AND WATER FLUXES OVER A SOYBEAN FIELD IN A COASTAL AREA

E. Munkhtsetseg [1, 2] and R. Kimura[1]

[1] *Arid Land Research Center, Tottori University, Japan*
[2] *Institute of Meteorology and Hydrology, Mongolia*

It is a general assumption amongst plant physiologists and ecologists that stomata have evolved to provide a means for controlling water loss from plants while adjusting itself to environmental conditions. Many water and carbon flux studies are performed over forests, grasslands, or croplands with uniform vegetation. Although, there is growing need to carry out measurements over agricultural regions characterized by specific climatic pattern, since these kinds of areas, such as Tottori sand dune etc., are currently underrepresented. The objective of the present study was to investigate response of stomatal conductance to environmental variables and its relations to both photosynthesis and evapotranspiration over a soybean field at the Tottori sand dune. The dominant climate in this area is a huge amount of precipitation resulted in the very humid atmosphere, which is overlaid the extraordinary soil type. Moreover, this type of stomatal conductance-related evapotranspiration and carbon flux analysis has not previously been investigated for Tottori sand dune.

The bowen ratio energy balance (BREB) method for a calculation of latent heat flux (*LE*), the eddy correlation technique for a computation of carbon flux were used in this study. We employed a Jarvis-type multiplicative model (Jarvis 1976; Stewart 1988), which is most frequently used for modelling stomatal conductance. It should be noted that, the function of leaf area index was introduced for the first time in the present study in order to represent the effects of a leaf aging and plant physiology on stomatal conductance.

The observational site was located in a field of the Arid Land Research Center, in Tottori, Japan (35°32'N, 134°13'E). The field size was 160m x 110m. The predominant wind direction was northeast. The upwind fetch was 120 m and enough to measure the energy fluxes according to Schmid (1997). The soil was composed of 96% pure sand in the field. The field capacity of soil water content (SWC) was 0.086 $m^3\ m^{-3}$. Some fertilizers consisted of Calcium 50kg/10acre, Nitrate 1.8kg/10acre, Phosporate 8.7kg/10acre and Kali 8.1 kg/10acre and pesticides 5kg/10acre were applied in the field before seed sown date (June 9th). The soybean field was irrigated everyday in the initial plant growth, and every night followed by sunny day during most of the observation period.

The study shows that stomata plays a crucial role in bridging net radiation (R_n) and latent heat flux (*LE*); that is an increased R_n leads to an increased gs and thus finally to an enlarged *LE*, since R_n was shown to be a major driving factor of variations in stomatal conductance (g_s) and *LE* when leaf vapor deficit was less than 2 kPa. A large net radiation (above 500W m^{-2}) associated with a high vapor deficit (above than 2.5 kPa) lead both g_s and *LE* values are limited by vapor deficits and bowen-ratio, β, respectively.

The analysis of carbon fluxes has shown a positive significant effect of stomatal conductance and photosynthetic photon flux density on carbon flux at the rapid growth period. In contrast, carbon flux was correlated to vapor deficit at the maturated period. The result showed that the relationship between carbon flux and vapor deficit in clear sky days was stronger than in cloudy days at the matured period.

In summary, the analysis of carbon flux has shown a positive significant effect of stomatal conductance on carbon flux at the rapid and peak growth periods, whereas it was shown a significant on vapor flux during whole growing season. The study shows that stomata plays a crucial role in water vapor and carbon cycling over a soybean planted sandy field in a coastal area by adjusting itself to external environmental condition and controlling other environmental variables. This would suggest an enhancement of the stomatal conductance could lead an enlargement of the photosynthesis.

Cancelled

O57

Observation and modeling on water, heat and carbon fluxes in grassland ecosystems

Guangsheng Zhou[a,b] Yuhui Wang [a],Zhenzhu Xu [a], Yunlong Wang[a], Yijun Li [a], Li Zhou[a]

[a] Key Laboratory of Vegetation and Environmental Change, Institute of Botany, the Chinese Academy of Sciences, 20 Nanxincun, Xiangshan, Haidian District, Beijing 100093, P. R. China

[b] Institute of Atmospheric Environment, China Meteorological Administration, Shenyang 110016; P. R. China

E-mail: gszhou@ibcas.ac.cn

Abstract:

Grasslands are one of the most widespread ecosystem types worldwide; they cover ca. 25% of the natural land surface and account for ca. 16% (18.9 $Gt.yr^{-1}$) of the terrestrial global net annual primary production. Thus they have a major influence on climate and the functioning of the terrestrial biosphere. Current climate change and land-use practices (e.g. overgrazing, reclamation) in recent decades have resulted in grassland degradation with impacts on surface temperatures and biogeochemistry, especially carbon cycling through changes in net primary production (NPP). It is predicted that major alterations in productivity and species composition in grasslands and rangelands will occur due to altered rainfall amounts and seasonality, and increased evapotranspiration with the corresponding climate at double atmospheric CO_2. Steppes and grasslands are very extensive in China, from the Northeast Plain towards the west, through Inner Mongolia, Loess Plateau, Qinghai-Xizang Plateau to Xingjiang, corresponding to the eastern part of the Eurasian temperate steppe. Their total area is 2 860 000 km^2. It is urgent to understand the impact and feedback of both natural climate change and increasing anthropogenic influence to grassland ecosystems.

In order to monitor and evaluate grassland surface – atmosphere interactions, lots of grassland ecosystem research stations have been founded in semi-arid grassland. This report will focus on two main issues: (1) dynamic monitoring on grassland surface – atmosphere interactions in Inner Mongolia Typical Grassland Ecosystem Field Observation Station (IMTGEFOS) founded in 1984, including flux measurement (latent heat flux, sensible heat flux, momentum flux and carbon exchanges among soil – vegetation – atmosphere continuum), ecophysiological characteristics, plant community features (Leaf area index, biomass, net primary productivity, etc.), soil physical and chemical characteristics, gradient meteorological factors, etc. (2) modeling grassland surface – atmosphere interactions. Here, we present a new grassland surface – atmosphere interaction model coupled biological, physical and chemical processes. It includes the effects of soil carbon and nitrogen on leaf photosynthesis and an environment-based carbon allocation model. It consists of land surface processes, leaf nitrogen uptake, canopy physiology, carbon allocation, vegetation phenology, terrestrial carbon balance, and vegetation dynamics. It could simulate the dynamics of grassland ecosystem much better than IBIS model does, based on a 14-year observation of aboveground net primary productivity and 2-year flux observation by eddy covariance tower in typical steppe ecosystem in Inner Mongolia.

Key words: grassland surface – atmosphere interaction, observation, modeling, latent flux, sensible heat flux, net ecosystem carbon exchange, grassland

Poster Session

P01

Continuous measurement of water vapor D/H and $^{18}O/^{16}O$ isotope ratios in the atmosphere

Xue-Fa Wen [a], Xiao-Min Sun [a], Shi-Chun Zhang [a], Gui-Rui Yu [a], Steve D. Sargent [b], Xuhui Lee [c,*]

[a] Key Laboratory of Ecosystem Network Observation and Modeling, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China
[b] Campbell Scientific, Inc., Logan, UT, USA
[c] School of Forestry and Environmental Studies, Yale University, New Haven, CT, USA

Abstract

The D/H and $^{18}O/^{16}O$ ratios in atmospheric water vapor provide rich information on the hydrological cycle and gaseous exchange processes between the terrestrial vegetation and the atmosphere. In this paper, we have demonstrated the feasibility to simultaneously measure both D/H and $^{18}O/^{16}O$ in atmospheric water vapor using a tunable diode laser absorption spectrometer. Our laboratory tests showed that the 1-h precision (one standard deviation) was 1.1‰ for D/H and 0.07‰ for $^{18}O/^{16}O$ at the dewpoint temperature of 15°C. Our atmospheric measurement captured the rapidly changing isotopic signals in both D/H and $^{18}O/^{16}O$. The measured isotope ratios were highly correlated with the water vapor mixing ratio as expected and followed very closely the Global Meteoric Water Line except during two transitional periods when the deuterium excess of atmospheric vapor deviated from the standard value. In addition, we have refined a method to provide independent, timely performance test of the in-situ system.

Keywords: Stable isotopes; Atmospheric water vapor; Hydrogen isotope; Oxygen isotope; TDLAS

P02

Use of Stable Isotope and Trace Gases as Additional Tracers in Flux Partitioning

Y. Takahashi and R. Hirata

National Institute for Environmental Studies, Tsukuba, Japan

For the purpose of determining the CO_2 uptake by terrestrial ecosystem, eddy covariance method (EC) is commonly used in the tower-flux measurements. The flux measured by this method is called ‘net ecosystem exchange (NEE)’. NEE has the meaning of difference between two component fluxes, photosynthetic uptake and respiratory release of CO_2. Magnitude of both the component fluxes is far larger than NEE. Both the component fluxes have difference in response function against changes in environmental factors, such as temperature and water. Therefore it is important to evaluate the characteristics of variations in the comporent fluxes individually in the future prediction of CO_2 uptake by terrestrial ecosystem.

Separation of NEE into the componet fluxes is usually done by using an approximate temperature expression of respiratory flux. This approximate expression is based on the assumption that the NEE observed at nighttime equals to the respiratory flux. The photosynthetic uptake of CO_2 is defined as difference between the observed NEE and “respiration” approximated as a temperature-function. Because of its technical simplicity, this approach has provided useful information about climatology of the gross CO_2 fluxes. However, the temperature expression of respiratory flux has several limitations in its application.

We are now developing a flux-partitioning method using chemical tracers (e.g. stable isotopes of CO_2 and carbonyl sulfide) as additional constraints. The flux partitioning using stable isotopes of CO_2 is based on the imbalance of net flux of the CO_2 isotopes between “respiration” and “photosynthesis”. On the other hand, because of this similarity in the control factors for uptake ratio, the net flux of carbonyl sulfide (COS) is regarded as a possible constraint for the functioning of variations in photosynthetic CO_2 uptake by terrestrial ecosystem. Field observation of fluxes of those chemical tracers by EC method is difficult due to stringent requirements for on-site measurement. Therefore, as a first step, we are planning to measure those fluxes based on an eddy accumulation technique coupled with flask sampling and high precision lab analysis. We report current progress of the development..

P03

A DRY-BATTERY-POWERED CLOSED-CHAMBER SYSTEM FOR MEASURING THE CO_2 EFFLUX FROM NUMEROUS STEMS

Tamai K.[1], Miyama T.[2], Shimizu T.[1], Kominami Y.[2], Nakai Y.[3], and Ohtani Y.

[1] *Kyushu Research Center, Forestry & Forest Products Research Institute, Kumamoto, Japan*
[2] *Kansai Research Center, Forestry & Forest Products Research Institute, Kyoto, Japan*
[3] *Forestry & Forest Products Research Institute, Tsukuba, Japan*

Recently, the CO_2 efflux from stems has been reported. Although many studies use the LI-6400 or LI-820, these sensors are very expensive and their systems are too complex for measurements at numerous points. Consequently, we developed a very light, simple, and inexpensive closed-chamber system, powered by dry batteries, for making measurements at numerous points. And compared the accuracy of the new system with the efflux measured using a dynamic chamber system using an LI-820.This document provides instructions for preparing camera-ready manuscripts for the abstract published in AsiaFlux Workshop2007 and is written in the format according to the guidelines given below.

The new system is outlined in Fig. 1. The CO_2 sensor (eSENSE, Baron DENSHI, Tokyo) is installed in an acrylic chamber with a 75-cm^2 cross-section. The sensor is powered by three 9V dry batteries and can work for 30 hours. The output data (0-10 V) are transmitted to 1/5 by a resister and recorded with a data logger (HOBO). The air temperature in the chamber can be measured and recorded. Each unit costs around $1,000 US and weighs around 800 g.

The CO_2 efflux was measured from 126 colors at 61 stems along a 200-m transect from a valley to a ridge in the Kahoku Experimental Forest, in Western Japan (Fig. 2). The height difference was around 60 m. The dominant species were *Cryptomeria japonica* and *Chamaecyparis obtusa*. Each measurement required at least 12 min, with at least a 5-min rest before measuring the next color. The 126 measurements took around 8 hours with six chambers. Measurements were made once a month beginning in February 2006.

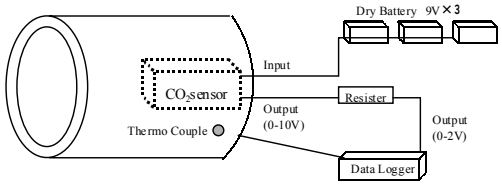


Fig 1. Outline of Dry battery powered closed chamber system

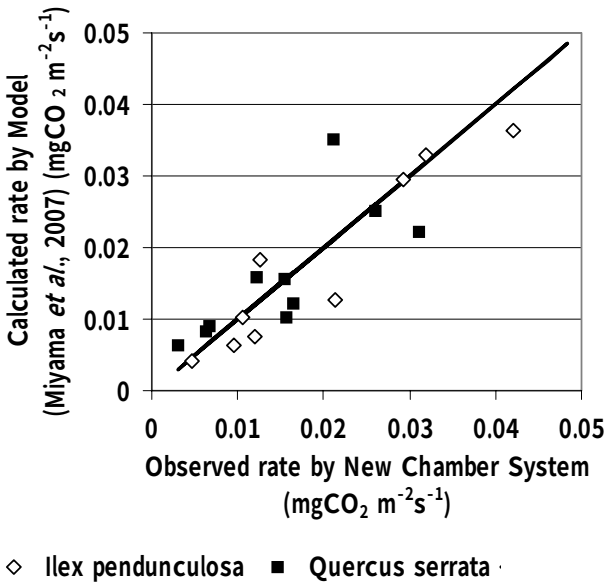


Fig 2. Verification of new chamber system and standard dynamic closed chamber system

The performance of the new system at making monthly measurements was verified from September 2006 to August 2007 in Yamashiro Experimental Forest. The CO_2 efflux from stems of *Ilex pendunculosa* and *Quercus serrata* was measured using a dynamic chamber system with a LI-820, and modeled (Miyama *et al*., 2006). The calculated root mean square error (RMSE) was only 0.004mgCO_2 $m^{-2}s^{-1}$ and we judged that the new system was useful.

References: Miyama *et al*., (2007) *Tellus* **58B**, 550-559.

P04

LONG TERM ESTIMATION OF FOREST PRODUCTION BY A TREE RING ANALYSIS IN A TEMPERATE BROAD-LEAVED SECONDARY FOREST IN JAPAN - EVALUATION BY A COMPARISON BETWEEN SUBPLOTS -

N. Misawa[1], M. Jomura[2], Y. Kanazawa[1] and Y. Kominami[3]
[1] *Graduate school of Science and Technology, Kobe University, Kobe, Japan*
[2] *National Institute of Agro-Environmental Sciences, Tsukuba, Japan*
[3] *Forestry and Forest Products Research Institute, Kansai Research Center, Kyoto, Japan*

Introduction

Influences of climate change due to increase of atmospheric CO_2 content on forest ecosystems should be evaluated. The long-term data of forest productivity is needed to evaluate the influence of climate change on net ecosystem production (Jacoby and D'Arrigo, 1997). A tree ring analysis is a useful method to estimate long-term annual aboveground production (AGP) which is a important part of a net ecosystem production's estimation (Graumlich et al, 1989).

The objective of our study is to evaluate the total AGP at our study site. We set several subplots and evaluated AGP by comparing chronologies between subplots, or overstory and understory trees.

Materials and methods

The study was conducted in the Yamashiro Experimental Forest (temperate secondary broad-leaved forest in central Japan, 34°47'N, 135°50'E). *Quercus serrata* is a dominant species in the site. The area of the site is 1.7ha. Annual mean air temperature was 15.5 °C and annual precipitation was 1449 mm in 2002. Tree census was conducted in 1994, 1999, and 2004. About 40 trees were harvested to obtain allometric relationships for biomass and production estimation in the site.

Method of this study was as follows

① We set 4 subplots (10m×10m) in the study site. And increment cores of all trees (DBH > 5cm) in the subplot were obtained from the stem at breast height and all tree ring widths were measured.

② Tree ring-width series of sample trees were cross-dated by visually among all individuals, and cross-dating was verified by COFECHA program (Holmes, 1992). The Cross-dating confirmed whether there was a synchronism among them.

③ The ring-width series of samples were transformed into tree ring-width indices using ARSTAN program (Grassio et al, 1997) to compare absolute values between sample trees.

④ The ring-indices of all samples in the subplot were averaged to obtain a chronology of each subplot. Moreover, both overstory and understory tree's ring-indices of each plot was averaged to obtain both overstory and understory tree's chronologies of each subplot.

⑤ We compared between (a) 4 chronologies obtained from all trees in the subplot (b) overstory and understory tree's chronologies within the subplot (c) overstory tree's chronologies between subplots by a simple linear regression analysis.

⑥ We estimated annual change of AGP in the site using allometric functions between DBH and biomass and tree census data.

Results and Discussion

We could basically find the positive correlation of all analysis of (a), (b), and (c). So, even if take both tree spices and location into consideration, there was a synchronism of among all trees in this site.

We can estimate the total AGP of the forest from a time series of tree ring-width of sample trees.

References

Jacoby GC and D'Arrigo RD. 1997. Tree rings, carbon dioxide, and climatic change. Proceedings of the National Academy of Sciences of the United States of America 94(16): 8350-8353.

Graumlich LJ, Brubaker LB, and Grier CC. 1989. Long-term trends in forest net primary productivity, Cascade Mountains, Washington. Ecology 70: 405-410.

P05

Field evaluation of the performance of a developed REA air sampling system for aerosol flux measurement

Masatoshi Aoki[1], Daisuke Komori[2] and Hiroyuki Nakayama[1]

[1] Institute of Symbiotic Science and Technology, Graduate School, Tokyo University of Agriculture and Technology, Fuchu, Tokyo 183-8509, JAPAN
[2] Institute of Industrial Science, University of Tokyo, Komaba, Meguro-ku, Tokyo 153-8505, JAPAN

The authors developed a REA air sampling system for aerosol flux measurement (Nagashima et. al.,2002). According to the field tests, the values of aerosol fluxes did not show good agreement with those of Bowen ratio technique. Then the present authors tried to re-evaluate the performance of the developed REA air sampling system by another field tests in which CO2 flux measurements by Bowen ratio technique (β) and eddy correlation technique(EC) were carried out for comparing with that of REA technique using with the developed air sampling system. The reason we chosen CO2 flux as our target is that CO2 flux measurement methodologies by Bowen ratio, EC and REA techniques are already clearly established. If measured CO2 flux by using the air sampling system is same with those of Bowen ratio and EC techniques, we can conclude that the developed air sampling system is applicable on aerosol flux measurement.

1. Method

The field tests were carried out in a paddy field of experimental farm of our university in Fuchu, Tokyo Japan in Sept. 2005, May 2006 and Dec. 2006. In Sept. 2005 and May 2006, the rice plants were grown, and some short weeds and rice plant stabs after harvesting were presented in the paddy field in Dec. 2006. The fetch was enough length for three techniques. As for Bowen ratio technique, the difference of CO2 concentration, air temperature and air humidity were measured between 20-30 cm above rice canopy or short rice plant stabs (the lower height) and 2.0 m above the lower height (the upper height). As for REA and EC techniques, the measurement height was in the middle of that of Bowen ratio technique.

2. Results and Discussion

The CO2 flux of REA (Frea) showed about 30% relative error comparing to those of Bowen ratio technique (Fb) and EC technique (Fec). It is found that the magnitude of the errors is related firstly with the stability of the air layer and secondary with the magnitude of temporal difference in CO2 concentration.

The analysis showed firstly that the error of CO2 flux comparing to Fb （⊿Fb=Fb－Frea） or Fec (⊿Fec=Fec－Frea) increased with increasing Monin-Obkhov length (ζ). The magnitude of ⊿Fb and ⊿Fec became larger especially in unstable condition ($\zeta > -0.2$). The secondary, it was found that the magnitude of the flux error (⊿Fb and ⊿Fec) showed correlation with the magnitude of temporal difference in CO2 concentration at the upper height (⊿C/⊿t=(Ct1－Ct2）/（t1－t2）). It implies that the results of ⊿Fb and ⊿Fec related with ζ might be caused through ⊿C/⊿t, because ⊿C/⊿t correlated with the magnitude of ζ . The above results implies that both of Bowen ratio and EC techniques need constancy for applying these techniques in the measurements while REA technique does not need constancy, then the measured value of REA technique may have more reliable and accurate than Bowen ratio and EC techniques in the stable condition.

Based on the above finding, we re-analyzed the results of Nagashima et al.(2002). The error, ⊿aFb, of aerosol flux of Nagashima et al.(2002) showed well correlated with ζ . And the magnitude of temporal difference in aerosol concentration ⊿aC/⊿t well correlated with ⊿aFb, and showed the same tendency in the case of CO2 flux. Accordingly, we conclude that the developed air sampling system is useful and applicable for aerosol flux measurement also in the stable conditions.

P06

DEVELOPMENT OF THE SYSTEM FOR SIMULTANEOUS MEASUREMENT OF ROOT RESPIRATION AND ROOT DYNAMICS IN YAMASHIRO EXPERIMENTAL FOREST, CENTRAL JAPAN

Masako Dannoura*[1], Yuji Kominami[2], Takafumi Miyama[2], Hiroyuki Oguma[3], Naoki Makita[1], Mayuko Jomura[4], and Yoichi Kanazawa[1].

[1] Graduate School of Agricultural Science, Kobe University, Kobe, Japan
[2] Kansai Research Center, Forestry and Forest Products Research Institute, Kyoto, Japan
[3]Center of Global Environment Research, National Institute for Environmental Studies, Tsukuba, Japan
[4]Agro-Meteorology Division, National Institute for Agro-Environmental Sciences, Tsukuba, Japan

1. INTRODUCTION

Root respiration (*Rr*) as a part of soil respiration (*Rs*) plays an important role in the forest carbon cycle. Moreover, root dynamics such as root production, death, and decomposition is distinctly related to the carbon dynamics. In particular, the process related to fine roots is thought to play a very important role in the circulation of carbon and nutrients in forest ecosystems (Gill and Jackson, 2000) because of the high productivity of fine roots (Satomura et al., 2001; Vogt et al., 1982) and their high respiration rate (Pregitzer et al., 1998). For example, it has been reported that in a deciduous forest in Kyoto, Japan, fine roots which constituted only about 16% of the total root biomass provided more than half of the respiration (Dannoura et al., 2006). However, the phenomena which occur under the ground are difficult to measure. In previous study, we developed a system for measuring separated *Rr* continuously. In this study, we try to measure *Rr* and fine root dynamics simultaneously.

2. FIELD SURVEY AND METHODS

The study was conducted in a mixed forest of deciduous and evergreen broad-leaved trees including some conifers at Yamashiro Experimental Forest (YMS) in Kyoto. The area consists of very thin soil layer, immature and originated from granite, located in a hilly and mountainous region in Kyoto Prefecture, Japan (34º47'N, 135º51'E). The soil is classified as a Dystric Cambisol by WRB-classification and is derived from weathered granitic parent materials.

We developed a simple method that uses a wide view optical scanner inserted into the ground. The scanner system facilitates the analysis of image data and allows continuous monitoring by automation of the capture and by fixing the position of the optical scanner. We made an acrylic cover for rain-proofing in the field and used a CCD type scanner (GT-F650, Epson, Japan) because it has a greater focal length than a CSI type scanner. The size of scanner was 210*297mm. A USB cable and power supply cable were run from a small port on the cover and a personal computer (PC) was connected in storage. Images could be obtained automatically by the controller-software. This system was buried under CO_2 flux chamber for measuring only *Rr*. In this chamber, forest soil of A layer was removed, and only living root was left. Instead of removed soil, the space was stuffed with decomposed granite soil.

3. RESULTS AND DISCUSSION

The growth and color change of roots were observed by scanner methods. A scanner has a wide area of visibility and a low risk of missing growing roots. It has the advantage of capturing the total image and the connection to the soil, mycorrhiza, etc. From the high frequent collection of picture, the growth rate was calculated and it was higher at the beginning of growth. The advantage of high frequent capture is that the process of root dynamics can analyze and facilitate investigations on root dynamics. Dannoura et al. (2006) reported that root respiration showed seasonal variations and correlation with soil temperature and soil moisture from temporal measurements. They also pointed out that during the growing period, root respiration was higher than during other periods even at the same soil temperature, perhaps due to phenological influences such as fine root dynamics. The distribution pattern and phenology of fine roots are a crucial factor in the carbon dynamics of forests. Our scanner method will help resolve many unexplained factors related to root dynamics. Because *Rr* is caused by root activity, it seems that simultaneous measurement of *Rr* and root turnover are useful for understanding belowground carbon cycle.

P07

COMPARATIVE MEASUREMENTS AMONG QUANTUM SENSORS TO IMPROVE RELIABILITY OF PAR DATA

Y. Mizoguchi[1], Y. Ohtani[1], H. Iwata[2], S. Takanashi[1], Y. Nakai[1], A. Hirakata[3], T. Aoshima[3], A. Yorisaki[4] and Y. Fujinuma[5]

[1] Forestry and Forest Products Research Institute, Tsukuba, Japan
[2] Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan
[3]EKO Instruments Co., Ltd., Tokyo, Japan
[4] Climatec Inc. Tokyo, Japan
[5] National Institute for Environmental Studies, Tsukuba, Japan

PAR, photosynthetically active radiation, is treated as a key meteorological parameter when CO_2 uptake in a vegetation field is estimated. Many types of quantum sensors are available now. Although we can use the quantum sensors to measure PAR, we have some doubt to the reliability of quantum sensors. One of the reasons is that there is no standard for the measurements of PAR unlike solar radiation. We conducted comparative measurements of the performance among quantum sensors to improve reliability of PAR data.

The sensors we have compared are five types in Table.1. The sensor characteristics including incident angle, azimuth, and input block in long wavelength were examined using light source of a solar simulator (ESS-80, EKO, Japan) with Xenon lamp in a laboratory prior to the field experiment. Optical glass filters (SCHOTT, Germany) were used in block test in wavelength. Field experiment has been also conducted to examine the long-term stability of sensors in Fujiyoshida site[AsiaFlux code: FJY] (35°27'N, 138°46'E, 1030m in elevation) (Photo 1).

The error was less than 10% when the incident angles from the normal axis of the sensor were less than 45°. The azimuth accuracy was up to 4% at 60° zenith angle. Filter transmittance was up to 1.5%.

Differences in sensor outputs were large in field experiment. The difference between each sensor and basic sensor was up to 17% during first 10days exposure. The field experiment has been still continuing. We will report the sensor stability at the Workshop.

Output difference among quantum sensor might be ignorable levels. We should consider these differences of quantum sensors when we use PAR data.

Table 1. Quantum sensors list

No.	Type	Manufacture
1	LI-190SL	LI-COR, USA
2	PAR-Lite	Kipp & Zonen, Netherland
3	ML-020P	EKO, Japan
4	IKS-27	KOITO, Japan
5	PAR-01	PREDE, Japan

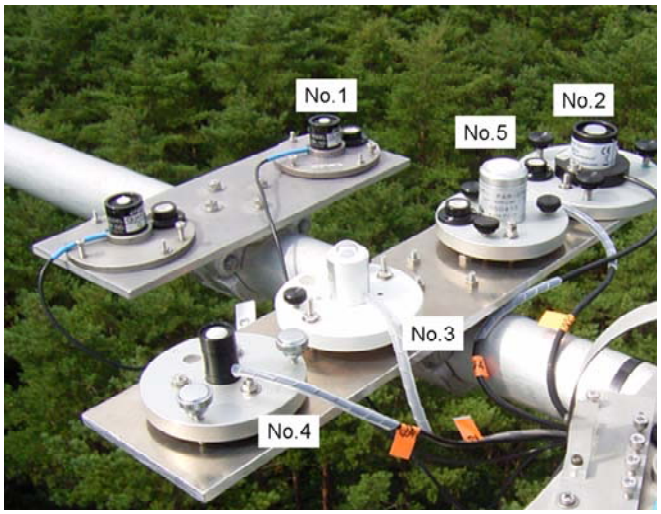


Photo 1. Comparison of quantum sensors at Fujiyosida site.

Acknowledgements
We would like to thank Mr. K. Kawabata at former EKO Co., Ltd. for providing us the opportunity to conduct this study. This study was financially supported, in part, by Ministry of Education, Culture, Sports, Science and Technology, Japan (JST project "Standardization and systematization of carbon-budget observation in Asian terrestrial ecosystem based on AsiaFlux network"), Ministry of Environment (Global environment research fund: S-1) and Forestry and Forest Products Research Institute (Long-term CO_2 flux observation project: #200303).

P08

ON THE COMPARISON OF THE TWO DIFFERENT SONIC ANEMOMETERS

S. Park, M. Kang, R. Yuan, J. Yoo, and J. Kim

Biometeorology Lab., Dept. of Atmospheric Sciences, Yonsei University, Seoul, 120-749, Korea

CSAT3 (Three dimensional sonic anemometer, Campbell Scientific Inc,. Logan, UT) has been widely used in various tower sites, including AsiaFlux. Despite its excellent performance, the cost of CSAT3 sonic anemometer may not be affordable for some researchers who have limited budget or want to have multi-level profile observations with more than one sonic anemometer. Among the several types of anemometers such as CSAT3, RMY81000, Gill etc., RMY81000 (Model 81000 Ultrasonic anemometer) may be used as an alternative, which is not only inexpensive but also omni-directional. Possibly, there is no significant difference for the performance of RMY81000 compare to that of CSAT3 (H. W. Loescher *et al*., 2005. Comparison of temperature and wind statistics in contrasting environments among different sonic anemometer-thermometers. Agricultural and Forest Meteorology, 113, 119-139; Thomas Foken. 1999. Comparison of the sonic anemometer Young Model 81000 during VOITEX-99. University of Bayreuth, Abt. Mikrometeorologie). However, some researchers reported some drawbacks for turbulence measurements.

In this study, we compared the performance of the two sonic anemometers to find out whether indeed RMY81000 can be used to replace CSAT3 in measurements of turbulent fluxes and microclimate within and above forest canopy. As a first step, we performed 'zero wind checking' to obtain information on instruments offsets for three wind velocity components by enclosing the instrument with a plastic bag. We then constructed a sound-proof box by using sound-absorbing materials, to obtain more accurate results. There were virtually no differences between these two tests. The offsets of CSAT3 were consistent within 0.02 ms^{-1}. However, the RMY81000 had sizable offset for all three components that ranges from 0.05 to 0.11 ms^{-1}. Furthermore, these offsets often showed sudden stepwise changes up to magnitude of about 0.03m^{-1}. Based on wind tunnel experiments, we will report the results of our comparison analyses on turbulent statistics of u, v, w and T from the two sonic anemometers.

Key words: Sonic anemometer, Comparison, Zero wind checking, Wind tunnel, turbulent statistics

Acknowledgement: This study was supported by a grant (code: 1-8-3) from Sustainable Water Resources Research Center of 21st Century Frontier Research Program, A3 Foresight Program of Korea Science and Engineering Foundation and Brain Korea 21 from the Ministry of Education and Human Resources Development.

P09

A PRELIMINARY STUDY OF TOPOGRAPHIC EFFECT ON FLUX MEASUREMENT AT CHI-LAN MOUNTAIN SITE

H.S. Chu, C.W. Lai, C.C. Wu and Y.J. Hsia

Graduate Institute of Natural Resources, National Dong Hwa University, Hualien, Taiwan

ChiLan Mountain site(CLM site) located in north-eastern Taiwan (24°35'N, 121°25'E, 1650m elevation, 310 ha area) is a subtropical cloud motane forest site, which is characteristics by frequent fog events and diurnal bimodal wind direction. CLM site is at a relatively homogeneous south-eastern-faced slope with an angle of 15°, mainly covered by natural regenerated 50-years-old yellow cypress (*Chamaecyparis obtuse var. formosana*).with a canopy height ranges from 11m to 14.3m (12m around tower 2).

Eddy covariance method based on ideal meteorological conditions will provide reliable ecosystem-scale flux measurements. However, as most studies indicated, there are challenges when applying the eddy covariance technique at the CLM site, namely the topographic effects at sloping terrain on flux measurements. In this paper, we discuss the questions of: (1) is there any flux divergence or convergence between measurement height and canopy top? (2) the magnitude of the storage and advection fluxes below measurement height.

Open path eddy covariance systems (OPEC) were installed at 2 heights on tower 2 at the study site(Fig 1.). Level 1 OPEC system located at 26m height (2.17 of canopy height), which consists of a Gill R3-50 sonic anemometer, a LICOR LI-7500 H_2O/CO_2 infrared gas analyzer, and a T-type thermocouple temperature sensor. Level 2 OPEC system located at 22m height (1.83 of canopy height), consists of a R.M.Young 81000 sonic anemometer, a LICOR LI-7500 H_2O/CO_2 infrared gas analyzer, and a T-type thermocouple temperature sensor. Both OPEC systems are connected to a Campbell CR5000 data logger and raw data are stored as binary file format. Data are processed with EdiRe software (University of Edinburgh). Data QA/QC, planar fit coordinate rotation, WPL correction were applied.

The preliminary result shows that fluxes measured by both OPEC systems have similar diurnal patterns. The difference between 2 levels is less than 10% (Fig 2.). The result also shows after the planar fit rotation, there are mismatch of vertical velocities between the 2 measurement heights and a more diverse diurnal course such that there are considerable effect either derived from storage below the measurement height or from advection fluxes .

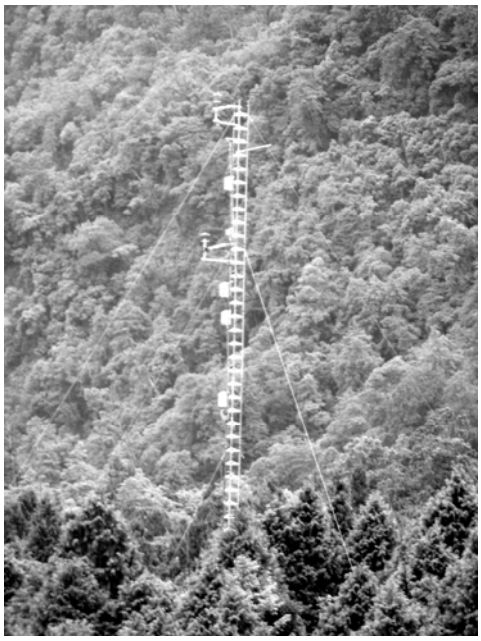


Fig 1. 2 levels OPEC systems on tower 2

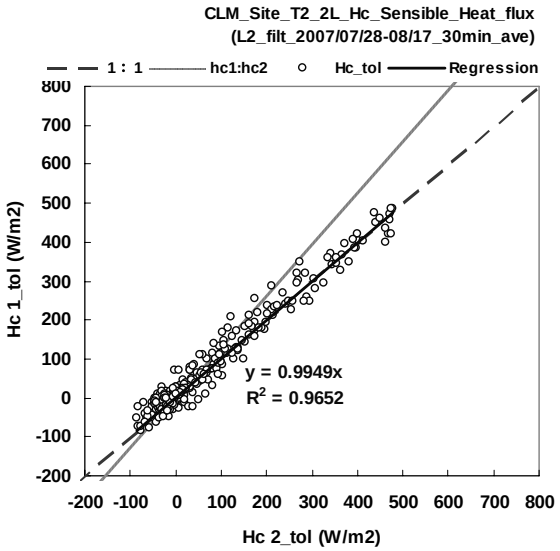


Fig 2. 2 levels Sensible Heat Flux

P10

COMPARISON OF TWO ERROR MODELS FOR PARAMETER ESTIMATION OF A COMPLEX TERRESTRIAL ECOSYSTEM MODEL USING EDDY COVARIANCE NET ECOSYSTEM EXCHANGE MEASUREMENTS

L. Zhang [1,2], Y. Luo [3], G. R. Yu [1], F. X. Gu [1], L. M.Zhang [1]

[1] Chinese Ecosystem Research Network Synthesis Research Center, Institute of Geographic Science and Natural Resources Research, Chinese Academy Sciences, Beijing, China

[2] Graduate School of the Chinese Academy of Sciences, Beijing, China

[3] Department of Botany and Microbiology, University of Oklahoma, Norman, USA

Generally the measurement error of assimilated data is assumed that follows a mean zero normal (Gaussian) error model. However, this assumption is invalid in some cases. For example, eddy covariance flux measurement error follows a double exponential distribution than a normal distribution. Based on some simple ecosystem models, it has been found that different error models with differerent optimization criteria (cost fuctions) will influence the parameter estiamtes and model preditions. In order to make clear the effect of error models on the parameter estimates and model preditions for a complex terrestrial ecosystem model, we compared two error models (normal error model and double exponential error model) for eddy covariance net ecosystem exchange measurements. The Markov Chain Monte Carlo method was used to infer the probability density functions of parameters need to be estimated of a complex terrestrial ecosystem model. The results showed the estimates of annual total ecosystem respiration using double exponential error model was lower than the prediction using normal error model. The difference was up to 144-154 g C m^{-2} y^{-1}. For modeled annual sum of net ecosystem exchange, the choice of double exponential error model led to a 98-135 g C m^{-2} y^{-1} increase compared to the estimate using normal error model. The predictions of daily net ecosystem exchange based on normal error model will underestimate the strong carbon sink during the growing sesason. We suggested that the double expontial error model may be a better choice than normal error model for assimilating eddy covariance net ecosystem exchange to a complex terrestrial ecosystem model.

P11

EFFECT OF COORDINATE ROTATION ON ESTIMATING SURFACE HEAT AND WATER VAPOR FLUXES OVER MOUNTAINOUS TERRAIN

Y. Y. Chen and M. H. Li

Institute of Hydrological Sciences, National Central University, Taoyuan, Taiwan

Coordinate rotation is often applied to transform measured turbulence data before flux calculations. Different rotation approaches may cause significant variations in estimated fluxes. For example, mountain-valley circulation furthers the requirement of selecting a proper rotation technique. This study applied three coordinate rotation approaches, including double, triple, and planar-fit rotations, for computing heat and water vapor fluxes over a mountainous terrain with the eddy covariance method.

The experiment was conducted in an experimental watershed, Lien-Hua-Chih (LHC), located in the central Taiwan. Vegetation type is a mixture of natural deciduous forest and shrubs with a canopy height of about 17 m. The observation tower was built to a height of 22 m. The site is a typical mountainous terrain with significant meso-scale circulation. Figure 1 shows the day time (left) and night time (right) wind direction and speed at the LHC site. Prevailing wind direction is NW in day time and ES in night time.

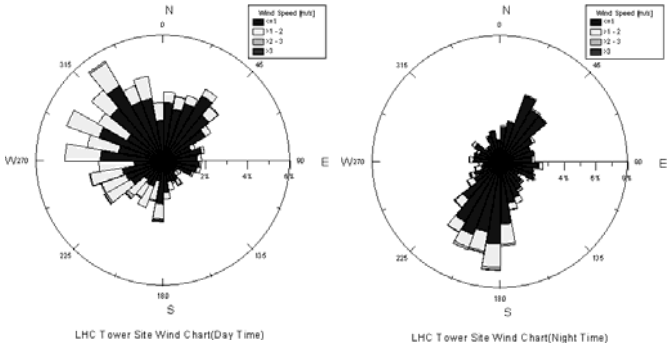


Fig. 1. Wind speed and direction at the LHC site

Turbulence data above canopy were measured with an eddy covariance system, a 3-D sonic anemometer (Young 81000) and a krypton hygrometer (Campbell KH20). Raw data sampled at 10 Hz was recorded in a data logger, CR23X, and stored by a laptop computer. More than two weeks of data were collected for fluxes comparisons between different coordinate rotation approaches. Figure 2 shows effects of wind directions on determining b1/b2 coefficients of the planar fit rotation due to tilt angle variations associated with the mountainous terrain.

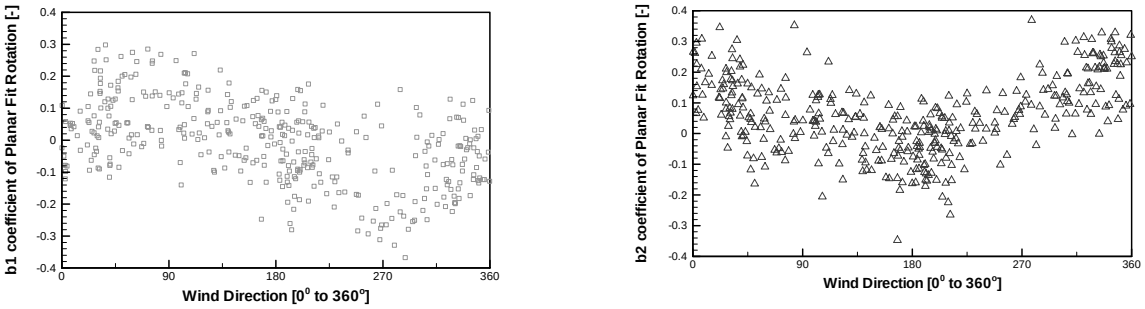


Fig. 2. Variations of coefficients in the planar fit rotation (left: b1; right: b2) affected by the wind direction

P12

THE EFFECT OF COORDINATE ROTATION ON THE EDDY COVARIANCE FLUX ESTIMATION IN A HILLY KOFLUX FOREST CATCHMENT

Renmin Yuan[1], Minseok Kang[1*], Sung-Bin Park[1], Jinkyu Hong[2], Dongho Lee[1], and Joon Kim[1]

[1]Dept. of Atmospheric Sciences, Yonsei University, Seoul, 120-749, Korea
[2] Lab for Environmental Physics, Dept. of Crop & Soil Sciences, University of Georgia, 1101 Experiment Street, Griffin, GA 30228, USA

The Gwangneung KoFlux supersite, located in a rugged mountain region, is characterized by a low wind speed due to a mountain-valley circulation and rolling terrain. Therefore, it is essential to understand the effect of coordinate rotation on flux measurements by the eddy-covariance method. In this paper, we review the properties of three orthogonal coordinate frames (i.e., double, triple, and planar fit rotations) and apply to flux data observed at the Gwangneung supersite. The mean offset of vertical wind speed of sonic anemometer was inferred from the planar fit (PF) coordinate rotation, yielding the diurnal variation of about ± 0.05 m·s^{-1}. Double rotation ($\bar{v} = \bar{w} = 0$) produced virtually the same turbulent fluxes of heat, water and CO_2 as those from the PF rotation under windy conditions. The former, however, resulted in large biases under calm conditions. The friction velocity, an important scaling parameter in the atmospheric surface layer, was more sensitive to the choice of coordinate rotation method.

Key words: KoFlux, Gwangneung supersite, Double rotation, Planar Fit, Friction velocity

Acknowledgements: This research was supported by grants (code: 1-8-3) from Sustainable Water Resources Research Center for 21st Century Frontier Research Program, the A3 Foresight Program of the Korea Science and Engineering Foundation, and BK21 Program of the Ministry of Education and Human Resources Development of Korea.

P13

Long-Term Estimation of soil heat flux using single layer time series data of soil temperature

Cheng-Wei Huang and Cheng-I Hsieh

Department of Bioenvironmental Systems Engineering, National Taiwan University, Taipei 10617, TAIWAN.
hsieh@ntu.edu.tw

Abstract

Soil heat flux may play an important role in surface energy balance. In this study, we examined the performances of two methods for predicting soil heat flux from single layer time series data of soil temperature. The first one is the traditional method, which an analytical solution of soil heat flux can be obtained by assuming the surface soil temperature varies sinusoidally. The second one is the connection between surface soil temperature and soil heat flux derived by half-order time derivative/integral, and is based on a simple model of heat transfer described by a one-dimensional diffusion equation with a constant heat diffusivity. Good agreements between measured and predicted soil heat fluxes were found for both methods. However, it was shown that the half-order derivative method has a better capability to capture flux accuracy and trend than the traditional method for long-term soil heat flux estimation.

Keywords: soil heat flux, half-order derivative method, soil temperature

P15

THE DEPENDENCY OF THE NIGHTTIME NEE ON FRICTION VELOCITY AT TWO TROPICAL SITES; SAKAERAT AND MAE KLONG, THAILAND

H. Kondo,[1] M. Gamo,[1] S. Panuthai,[2] T. Maeda,[1] and N. Saigusa[1]

[1] *National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan*
[2] *National Park, Wildlife, and Plant Conservation Department, Bangkok, Thailand*

The AIST has observed CO_2 flux at Sakaerat (SKR) and Mae Klong (MKL) (Fig.1) in Thailand since 2001. These two points are located in complex terrain; however, the data obtained these two points show significant difference that may not be explained with the difference of ecosystem around the sites. Sakaerat site is located near the top of hill and there is no higher point near the tower site. On the other hand, Mae Klong site is located on a small ridge in a basin and is surrounded higher mountains on the rim of the basin. Figure 2 shows the monthly averaged daily course of CO_2 concentration at these two sites. CO_2 is accumulated at night towards morning at Mae Klong, however, is not so much accumulated at Sakaerat. Figure 3 is wind roses of these two sites. Most of the wind direction is SW at Sakaerat and wind velocity is relatively strong for a tropical site. Nocturnal jet often appears during late March to August. On the other hand wind is weak and wind often blows along the topography at Mae Klong.

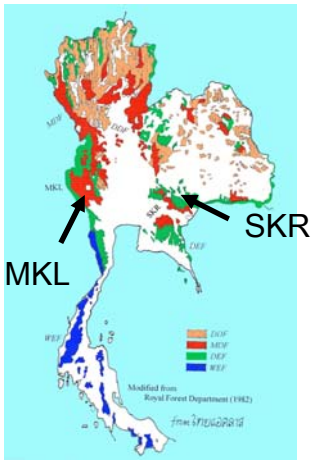


Fig.1 Map of forest type of Thailand and the location of Sakaerat (SKR) and Mae Klong (MKL).

Figure 4 shows the dependency of nighttime NEE, which is simple summation of CO_2 flux obtained with eddy covariance method (closed path with LI6262) at the top of canopy, and storage which is calculated from the time variation of CO_2 profile in the canopy, on friction velocity u*. At Sakaerat NEE increases as u* increases, however the value of nighttime NEE is not so big. On the other hand, there is a clear peak of NEE around u*=0.14ms^{-1} at Mea Klong. This u* value that gives the peak of NEE is rather small, and it may be difficult to correct NEE value with that obtained with larger value of u*.

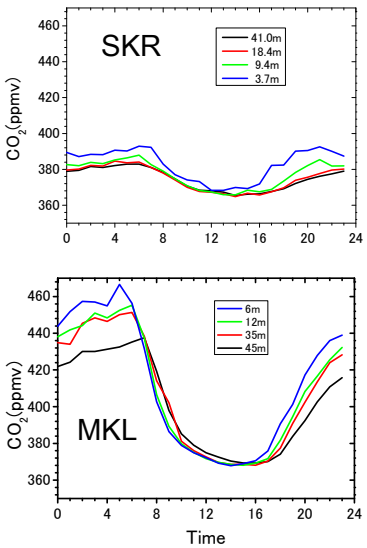


Fig.2 Monthly averaged daily course of CO_2 concentration (June, 2004).

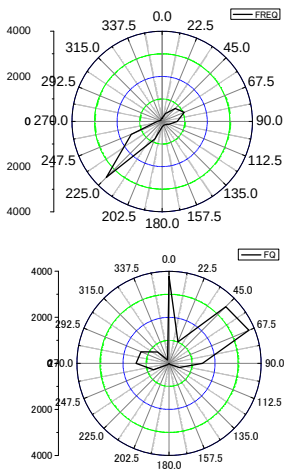


Fig.3 Wind rose at SKR (top) and MKL (bottom) in 2004.

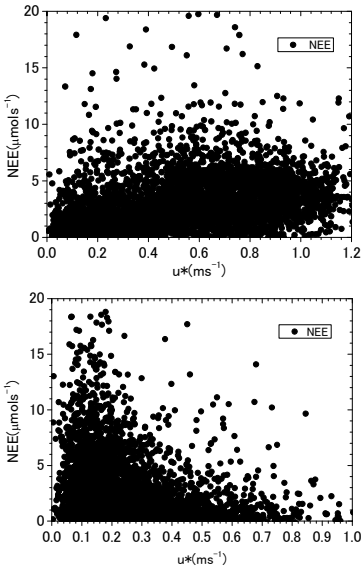


Fig.4 The relation between nighttime NEE and u* at SKR (top) and MKL (bottom) in 2004.

P16

COMPARISON OF SENSIBLE AND LATENT HEAT FLUXES ESTIMATED BY THE EDDY COVARIANCE METHOD AND THE FLUX VARIANCE METHOD

M. H. Li, K. Z. Wei, and Y. F. Yuan

Institute of Hydrological Sciences, National Central University, Taoyuan, Taiwan

Sensible heat and latent heat fluxes estimated by the Eddy Covariance Method (ECM) and the Flux Variance Method (FVM) are compared in this study. Flux measurements were conducted at an experimental site with periodically trimmed short grass at the National Central University. Turbulence data were measured by a 3-D sonic anemometer (81000, Young) and a krypton hydrometer (KH20, Campbell) at 10 Hz and stored by a data logger (CR23X, Campbell) and a laptop computer. Net radiation, soil heat flux, soil moisture, soil temperature, and air pressure were also measured and stored every 10 minutes by another data logger. A total of 5 experimental periods were performed between September 2006 and January 2007 ranging from 4 days to 21 days. Only non-rainfall raw data between 1000 and 1400 local time examined through despike, detrend, and double rotation were applied for flux calculations. Energy closure of the ECM is examined by the Energy Balance Ratio (EBR= $\sum(LH+H)/\sum(Rn-G-\Delta S)$). The EBRs of the ECM are 0.85 in 2006 and 0.83 in 2007. Latent heat fluxes computed by the FVM are consistently higher than those by the ECM. Most of sensible heat fluxes computed by the FVM are also higher than those by the ECM. The correlation of sensible heat fluxes between the ECM and the FVM is higher than that of latent heat fluxes.

P17

THE EFFECT OF FOG ON GAP FILLING AT CHILAN MOUNTAIN SITE

C.C. Wu [1] and Y.J. Hsia[1]

[1] *National Dong Hwa University, Hualien, Taiwan*

Global climate change promotes scientists to set up regional network of flux measurement sites around the world. The scientists observe carbon dioxide change between the biosphere and atmosphere with eddy covariance method. However, in the long-term research, some data will be missing and rejected in the process of the method. Hence it is urgent to establish some gap filling methods to solve the problems.

We employ open path CO_2/H_2O analyzer (OP-2 ADC) and three-dimensional sonic anemometer (Gill R3) at the ChiLan Mountain flux tower site(24°35' N, 121°E), which is located in the northeast of Taiwan. The experimental site is a cloud forest; there is distinctive diurnal mountain-valley wind pattern. During the daytime, valley wind brings heavy fog for 4.7~11.0 hour/per day. Frequent occurrence of fog deposition results in the complicity of environmental conditions. Heavy fog occurrence would cause the malfunction of eddy covariance instrument and create many data gaps. We consider that frequent occurrence of fog deposition causes environmental conditions more complex. From the point of view, we interest how difference to fill data gaps between the clear day and foggy day.

In this study, the collected data (from 2006 August 5th to September 13th) would be divided into two parts: data of clear day and foggy day. Mean diurnal variation (MDV) will be applied to replace the two dataset. The data show there are 11.6% data gaps under clear day and 33.5% data gaps during foggy day. We recommend that in order to increase the reliability of gap filling methods, the investigators should depend on environmental factors to deal with data. The environmental factors are suggested to be applied into the gap filling methods to increase the reliability.

P18

Comparison of methods for estimating evapotranspiration of a temperate mixed forest: eddy covariance, Bowen ratio energy balance, Priestley-Taylor and Penman-Monteith equation

Shi Tingting [1, 2], Guan Dexin [1], Wang Anzhi [1], Wu Jiabing [1], Jin Changjie [1], Han Shijie [1]

[1] Institute of Applied Ecology, Chinese Academy of Sciences, Shenyang, 110016, China

[2] Graduate University of Chinese Academy of Sciences, Beijing, 100049, China

Abstract

Forest evapotranspiration is one of the main components in regional water budget. A multi-year, multi-technique study was conducted to estimate latent heat flux within a temperate mixed forest of broad-leaved and coniferous trees of Changbai Mountains in northeastern China. Four different methods were used, including eddy covariance (EC), Bowen ratio energy balance (BREB) , Priestley-Taylor (PT) and Penman-Monteith combined equation (PM), during the growing seasons (May to September) of 2003–2005. These models, relying on more easily obtainable data desirable, are valuable when long-term direct measurements are not available. The objective of this study is to compare the effectivity of these models.

According to the experiments, it is concluded that:

(1) Eddy covariance measurements above the temperate mixed forest during 2003 to 2005 showed that the energy balance closure of whole day was not as good as daytime. The regression line slopes of $LE+H$ against $R_n–G_s–S$ were 0.689, 0.726 and 0.519 for the whole day and periods of day (PAR>5 mol m^{-2} s^{-1}) and nighttime (PAR≤5 mol m^{-2} s^{-1}), respectively, which ranged in middle level of that in literature reports. Diurnal cycle of latent heat flux LE was similar to that of net radiation R_n and varied seasonally. LE was smaller than sensible heat flux H in the early and late growing seasons, while in the mid growing seasons when leaves had fully grown, LE exceeded H.

(2) Each of the BREB and PM method gave different correlative latent heat flux with EC measurements when different reference levels were used. More correlative results were obtained if higher reference level(s) was employed. The phenomena could be partially explained by the hypothesis of BREB method and source area of the measurements. The assumption in BREB method of equal eddy diffusivities for heat and water vapor is not always met. In addition, the measurements of lower elevation sensors were affected by the heterogeneity of the canopy surface and less representative than those of higher elevation sensors. We suggest that elevation for measurements both for BREB and PM method is at least eight times of z_0 higher above mean canopy height.

(3) In order to estimate PT parameter, the data set was divided into two groups: (a) a calibration data set; (b) a validation data set. A constant PT parameter (α=1.18), estimated with the calibration data set, was applied to estimated evapotranspiration of validation data set.

(4) Latent heat fluxes estimated with four methods were approximately coincident with each other during the most days of three growing seasons. Considering simple linear regression between measured and modeled evapotranspiration, PT method was superior to BREB and PM methods. The regression line slope of PT-EC half-hourly evapotranspiration (=1.07) was closer to one than those of BREB-EC (=0.081) and PM-EC (=1.22) methods. The intercept of PT method (2.17 W m^{-2}) was closer to zero than those of BREB (=18.5 W m^{-2}) and PM (51.2 W m^{-2}) methods.

PT method, based on the assumption that the effect of turbulence is small compared to the effect of radiation, is the simplest and most effective approach to estimate evapotranspiration, while it is site-dependent. The uncertainty of BREB method lies in the assumption of equal eddy diffusivities for heat and water vapor, conditions which are not always met, and different levels of probes with different footprints (source area), including those of temperature/humidity and net radiation. The inaccuracy of PM method was due to the assumption that all the energy for evaporation is accessible by the plant canopy, and that water first has to diffuse through leaves against a surface resistance before diffusing into the atmosphere against an aerodynamic resistance.

Key words: Evapotranspiration; Eddy covariance; Bowen ratio; Priestley-Taylor; Penman-Monteith

Cancelled

P19

IMPORTANCE OF LEAF TEMPERATURE MEASUREMENT IN ESTIMATING WATER USE EFFICIENCY FROM LEAF CARBON ISOTOPE COMPOSITION

Jaeil Yoo[1], Namyi Chae[1,2], Dongho Lee[1] and Joon Kim[1]

[1] *Yonsei University, Seoul, Korea*
[2] *Korea Polar Research Institute, Incheon, Korea*

Water use efficiency (*WUE*) is a useful indicator for ecosystem carbon and water exchanges. Carbon isotope discrimination during photosynthesis is primarily affected by the ratio between ambient (C_a) and internal (C_i) CO_2 concentration and accordingly enables quantitative estimation of the leaf level instantaneous *WUE* (*A*/*E*) (Farquhar *et al*., 1982; Farquhar *et al*., 1989). In order to calculate *WUE*, we need to measure C_a, carbon isotope discrimination (Δ), vapor pressure deficit (*D*), and temperature difference between air (T_a) and the leaf (T_s).

$$WUE = C_a \cdot (b - \Delta) / \{1.6 \cdot (b - a) \cdot [D + s(T_s - T_a)]\}$$

where *a* is the carbon isotope fractionation associated with diffusion of CO_2 in the air, *b* is the fractionation during carboxylation including dissolution of CO_2, and *s* is the slope of vapor pressure change with temperature.

Our sensitivity test indicated that the calculated *WUE* is most significantly affected by *D* and $T_s - T_a$. *WUE* changes exponentially with *D* and $T_s - T_a$ while changes in C_a, Δ and *b* have comparatively little effect. Δ of all species that we have investigated in *Gwangneung* forest, showed seasonal and annual variation of ~1‰, which has negligible effect in calculating *WUE*. In the field conditions, T_s is difficult to measure reliably and continuously and therefore, often T_s is assumed to be the same as T_a. Without doubt, to calculate more accurate *WUE*, it is necessary to take the leaf temperature into account.

Therefore, as an effort to measure leaf temperature, we installed eight copper-constantan thermocouple temperature sensors in leaves of *Quercus serrata* grown in *Gwangneung* Supersite. The tree is the same specimen that is used for leaf carbon isotope analysis. To consider the effect of different microclimate environment, we have chosen leaves at two levels: the shaded leaves at 15m height and the sunlit leaves at the canopy top (about 20m). At each level, one thermocouple was used to measure air temperature and the other three to measure surface temperature of three different leaves. The temperature is being recorded in 1 minute interval by a CR1000 datalogger (Campbell Sci. Inc., USA). Also, we measured the leaf surface temperature by infrared thermometer for comparison.

The leaf temperature data (and vapor pressure deficit) will be interpreted in relation to air temperature and relative humidity profiles in that forest, in addition to other microclimatic parameters such as wind speed, leaf wetness, radiation, and relevant physiological parameters. The derived relationship between leaf temperature (and vapor pressure deficit) and environmental conditions will be used to calculate reliable *WUE*.

Acknowledgements: This study is supported by a grant (Code: 1-8-3) from Sustainable Water Resources Research Center of 21st Century Frontier Research Program, the A3 Foresight Program from the Korea Science and Engineering Foundation, and the BK21 program from the Ministry of Education and Human Resource Management of Korea.

References:

Farquhar, G.D., O'Leary, M.H., Berry, J.A., 1982. On the relationship between carbon isotope discrimination and the intercellular carbon dioxide concentration in leaves. Aust. J. Plant Physiol. 9, 121-137.

Farquhar G.D., Ehlerginer, J.R., Hubick, K.T, 1989. Carbon isotope discrimination and photosynthesis. Annu. Rev. Plant Mol. Biol. 40, 503-537.

P20

PARTITIONING EDDY COVARIANCE NEE AT PADDY FIELD INTO GPP, AUTOTROPHIC AND HETEROTROPHIC RESPIRATION

M. Mano[1], A. Miyata[1], H. Nagai[1], T. Yamada[1], G.H. Han[1] and K. Ono[1]

[1] *National Institute for Agro-Environmental Sciences, Tsukuba, Japan*

At present the eddy covariance (EC) method is the only direct way to measure net ecosystem CO_2 exchange (NEE) on an ecosystem scale and therefore widely used all over the world. However, the EC method has a weak point in evaluating carbon budget components (gross primary production; GPP, autotrophic respiration; RA, and heterotrophic respiration; RH). To overcome this weak point, supplementary methods such as soil chamber measurements and isotope analyses have sometimes been combined with the EC flux measurement. However, such big experiments can be conducted only at "super sites" because the supplementary methods require additional instruments, efforts or skills. Simple approaches that can generally be applied to flux sites are desired. In this study, we propose a method to partition observed NEE into carbon budget components using basic meteorological data only.

The study site is a paddy field located in the central part of Japan (36°03´ N, 140°01´ E, 15 m above sea level). Rice (*Oryza sativa* subsp. *japonica* var. *koshihikari*) is cultivated in the customary way. Half-hourly NEE was measured by the open-path EC method. Rice was transplanted in early May, and was harvested in middle September. In the remaining period, no crops were cultivated. Nighttime RH and RA throughout the growing season was determined by the following procedure with assumption (A) that RH is affected by soil temperature (TS) only, and (B) that a fraction of RA to RE (RA/RE) changes linearly with time in a short period (< 10 days).

1) Select a pre-transplanting day (DOY = i) and calculate its nighttime average RE (RE_i) and TS (TS_i). RE_i is equal to RH_i because no crops were found in the field before the transplanting.
2) Select another day (DOY = j) from post-transplanting days, where j is < i + 10 and has nighttime average TS (TS_j) close to TS_i.
3) RH_j is approximately equal to RH_i because TS_i and TS_j are close to each other (Assumption A). Thus, RA_j can be evaluated as RA_j = observed RE_j - RH_i, and consequently $(RA/RE)_j$ is obtained.
4) Since $(RA/RE)_i$ is zero, (RA/RE) from DOY = i + 1 to j - 1 are determined by linear interpolation (Assumption B). RA and RH from DOY= i + 1 to j - 1 are calculated using (RA/RE) determined above and observed RE.
5) By surveying nighttime average TS, select a day (DOY = k, $i < k < j$) and another day (DOY = l, $j < l$), where j is < k + 10, and the selected two days have almost the same TS.
6) RH_l can be approximated by already known RH_k ($TS_k = TS_l$). Hence, RA_l and $(RA/RE)_l$ are calculated from RH_l and the observed RE_l.
7) Again, using Assumption B, (RA/RE) from DOY= k + 1 to l - 1 are determined, and RH and RA for the period are also calculated.
8) By repeating above procedure to the harvest, partitioning RE into RH and RA in nighttime is completed.

Nighttime RH and RA are formulated as exponential functions of soil and air temperature, respectively. Daytime RH and RA are calculated by the exponential functions, and those are used to evaluate GPP (GPP = - NEE + RH + RA).

To validate the NEE partitioning by this method, flux-based net primary production (NPP_f = - NEE + RH, where RH was estimated by the above procedure) was compared with the total biomass of rice (biometric NPP; NPP_b). As shown in Fig. 1, accumulated NPP_f is in good agreement with NPP_b.

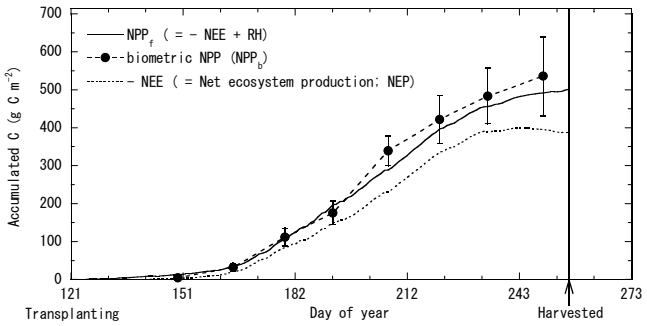


Fig. 1. Seasonal variations of accumulated NPP_f (= - NEE + RH), NEE and biometric NPP (NPP_b) in the 2005 growing season.

P21

DETECTING THE LEAF AGING EFFECT ON THE ECOSYSTEM PHOTOSYNTHESIS RATE WITH CARBON FLUX DATA

Huimin Wang[1], Nobuko Saigusa[2], Takahisa Maeda[2], Susumu Yamamoto[3], Hiroaki Kondo[2], Shohei Murayama[2], Yasumi Fujinuma[4]

[1]Institute of Geographical Sciences and Natural Resources Research, CAS, Beijing 100101, China
[2]National Institute of Advanced Industrial Science and Technology, Tsukuba 305-8569, Japan
[3]Okayama University, Okayama 700-8530, Japan
[4]National Institute for Environmental Studies, Tsukuba, Japan

Leaf aging effect on the photosynthesis rate of single leaf or a group of leaves has been confirmed in many studies. However, at an ecosystem scale, it is still a blank area even though the carbon fluxes are measured world widely using eddy covariance method; the most important reason lies on the difficulty in eliminating the environmental effects from the flux data, which are synthetic results of many biotic and abiotic factors. While it is very important to separate the environmental and biotic contribution to the carbon fluxes in precisely evaluating the carbon budget of an ecosystem and also its response to the environmental variation. In this study, we tried to extract the leaf aging effect on the photosynthesis rate (LAE) of a larch forest ecosystem from the eddy flux data using an environment control method. Our results indicated that the ecosystem photosynthesis rate decreased with the increasing canopy leaf age. However, the LAE were quite different under different environmental conditions. The LAE was much lower under dry environmental condition than that under humid condition because the drought stress diminished the LAE. Under the conditions of humid environment and sufficient radiation, the LAE tended to vary conversely with air temperature. While under humid and warm environmental conditions, the LAE declined with the decreasing radiation because of the gradually increasing limitation from radiation on the ecosystem photosynthesis.

Key words: Carbon flux, ecosystem photosynthesis rate, larch forest, leaf aging

CONTRIBUTION OF THE SOIL RESPIRATION TO ECOSYSTEM RESPIRATION DURING A SERIES OF FORESTRY ACTIVITIES IN NORTHERNMOST JAPAN

K. Takagi [1], K. Fukuzawa[1], N. Liang[2], M. Kayama[1], M. Nomura[1], H. Shibata[1], K. Sasa[1], Y. Fujinuma[2], Y. Akibayashi[1], T. Koike[1], M. Mizuno[3] and T. Murayama[3]

[1]Hokkaido University, Sapporo, Japan
[2] National Institute for Environmental Studies, Tsukuba, Japan
[3] Hokkaido Electric Power Co., Inc., Ebetsu, Japan

In order to evaluate the deforestation and forestation effects on the carbon cycle, trees in an area of 13.7 ha were clear-cut in Jan.-March 2003, after 1.5 years observation in the mixed forest, then saplings of 2-year old hybrid larch (*Larix gmelinii* × *L. kaempferi*) were planted 8 month after the clear-cutting. In the series of the activities, we conducted flux observation by eddy covariance technique and soil respiration measurement by LI-6400-09 (2002-2003) or multi-channel automated chamber (MCAC) system (2003-2005).

Table 1. Carbon budget during a series of forestry activities. Net ecosystem exchange (NEE), Gross primary production (GPP) and Ecosystem respiration (RE) are annual sum (gC m^{-2} $year^{-1}$) and RE_g, Rsl, and Rsm are RE, soil respiration by LI6400, and Soil respiration by MCAC during snow-free period (gC m^{-2} $period^{-1}$), respectively.

	2002	2003	2004	2005
NEE	-44	569	495	153
GPP	1498	474	609	1029
RE	1454	1043	1104	1182
RE_g	1359	1003	1019	1111
Rsl	577	673	-	-
Rsm	-	852 (328)	1047(328)	1062(373)

In the mixed forest, there was a strong CO_2 absorption from April to June, however the NEE often turned to be positive (carbon source) from the mid summer caused by the high respiration rate enhanced by high air temperature. The yearly GPP (1498 gC m^{-2}) and the RE (1454) were almost in equilibrium and the mixed forest was a weak carbon sink (-44) (Table 1). In 2003, after the clear-cut, the decrease in yearly RE (1043 gC m^{-2}) was smaller than that in GPP (474 gC m^{-2}), and as the result, NEE was positive throughout the year and this ecosystem turned to be a large carbon source (569 gC m^{-2} $year^{-1}$). The annual NEE (495 and 153 gC m^{-2} in 2004 and 2005, respectively) was positive for the following two years, however the net emission was decreasing rapidly owing to the increase in the GPP, which is mainly caused by the undergrowth photosynthesis.

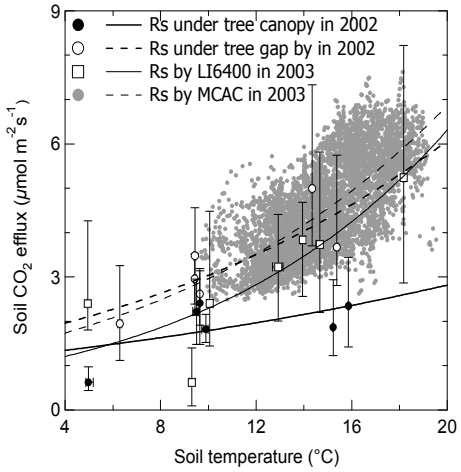


Figure 1. Soil temperature-respiration relationships in 2002 and 2003

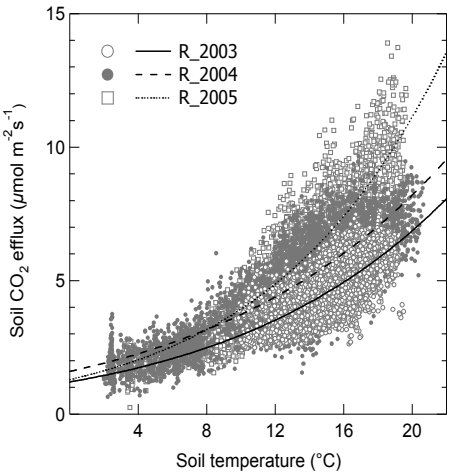


Figure 2. Soil temperature-respiration relationships from 2003 to 2005.

In 2002 in the mixed forest, the soil temperature (Ts)-respiration (Rs) relationship was different between under the tree canopy and the gap (Figure 1). The Rs at the gap was higher than that under the tree canopy at the same soil temperature. In 2003 after the clear cutting, the Ts-Rs relationship was similar to that obtained at the gap in the mixed forest, however, the relationship curves showed a year-by-year increase of the Rs during 2003-2005 (Figure 2). The increase in the Rs was attributed to the increase of the root of the undergrowth. Before the clear-cutting, the ratio of soil respiration to the ecosystem respiration during the snow-free period was 42%, however the ratio increased after the tree cutting, and was almost 100% for the last 2 years.

P24

Ecosystem respiration and its controlling factors in a coniferous and broad-leaved mixed forest in Dinghushan, China

WANG Chun-Lin[1,2,*], ZHOU Guo-Yi[1], TANG Xu-Li[1], WANG Xu[1], ZHOU Chuan-Yan[1], YU Gui-Rui[3], Tang Li-Sheng[2], Meng Ze[1] (*1.South China Botanical Garden, CAS, Guangzhou 510650, China; 2. Guangdong Climate Center. Guangzhou 510080, China; 3.Institute of Geographical Science and Natural Resources Research, CAS, Beijing 100101,China*)

.

Abstract: Accurate estimation of ecosystem respiration (Reco) in forest ecosystems is critical for validating terrestrial carbon models. Continuous eddy covariance measurements of Reco were conducted in a coniferous and broad-leaved mixed forest located in Dinghushan Nature Reserve of south China. Reco was estimated and the controlling environmental factors were analyzed based on two years data from 2003 to 2004. Major results included that: (1) Reco was affected by soil temperature, soil moisture, canopy air temperature and humidity, where soil temperature at 5cm depth was the dominant factor. (2)Exponential equations such as Van't Hoff, Arrhenius and Lyold-Talor can be used to describe the relationship between Reco and temperatures with similar statistical significance, while Lyold-Talor equation is the most sensitive for temperature index(Q_{10}); (3) The multiplicative model driven by soil temperature (*Ts*) and soil moisture (*Ms*) was more corresponsive to Reco, it explains more Reco variations than Lyold-Talor equation, both for higher and lower *Ms*. however, there was no statistical difference between the two models. (4) Annual accumulated Reco of the mixed forest in 2003 was estimated as 1100~1135.6 $gCm^{-2}a^{-1}$ using daytime data, which was 12~25% higher than Reco (921~975 $gCm^{-2}a^{-1}$) estimated by nighttime data. The results suggested that using daytime data to estimate Reco can avoid the common underestimation problem of eddy covariance methods. The study provides method basement for further study of accurate estimation of NEE in the coniferous and broad-leaved mixed forest in southern China.

Key words: Dinghushan; ecosystem respiration; eddy covariance; ChinaFLUX

Cancelled

P25

CROSS-SITE SYNTHESIS OF ANNUAL AND SEASONAL CARBON BUDGET ESTIMATED BY MICROMETEOROLOGICAL AND BIOMETRIC APPROACHES AT DIFFERENT FOREST ECOSYSTEMS IN EAST ASIA

N. Saigusa, [1] R. Hirata, [2] Y. Matsuura, [3] and S. Yamamoto [4]

[1] National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan
[2] National Institute for Environmental Studies, Tsukuba, Japan
[3] Forestry and Forest Products Research Institute, Tsukuba, Japan
[4] Okayama University, Okayama, Japan

We present a strategy and preliminary results of a cross-site synthesis of annual and seasonal carbon budget estimations by combining micrometeorological and biometric approaches in various forest ecosystems in East Asia. The study sites include a deciduous conifer forest (larch) (northern Japan), a temperate deciduous broad-leaved forest (central Japan), and a tropical seasonal forest (Thailand). The net ecosystem CO_2 exchange (NEE) was measured using the micrometeorological (eddy covariance) method, and the gross primary productivity (GPP) and total ecosystem respiration (RE) were estimated using gap-filled datasets. The major carbon pools and fluxes were also estimated at all sites by tree census, soil chambers, litter assessments, and other biometric approaches.

By combining two approaches, we estimated the seasonal patterns of several carbon budget components, such as the respiration of the above-ground biomass (R_{above}) and net primary productivity (NPP_{com}) derived by $R_{above} = RE - R_{soil}$, where R_{soil} is the soil CO_2 efflux, and by $NPP_{com} = GPP - R_{auto}$, where R_{auto} is the autotrophic respiration. Here, R_{auto} is calculated by R_{above} and the below-ground (root) respiration (R_{root}) as $R_{auto} = R_{above} + R_{root}$, where R_{root} is estimated by the ratio of the heterotrophic respiration (R_{heter}) to the total soil respiration, R_{soil}.

Figure 1 shows an example of the monthly estimation of NPP_{com} and other components. The highest NPP_{com} was estimated in June, 56 % of GPP, and decreased in mid-summer. In Fig. 2, the annual values of GPP and NPP are comparably shown for three sites in order to test the range of uncertainty in the estimation of NPP. Further investigations and interpretations are necessary to acquire a more valuable insight of the seasonal and annual components of the carbon cycle and the uncertainty of the estimations at various forest ecosystems.

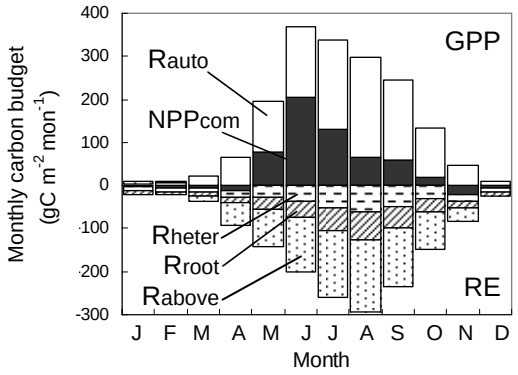


Fig. 1. Monthly values of GPP (positive bars) and RE (negative bars) with other components estimated for a deciduous conifer forest in Japan (TMK).

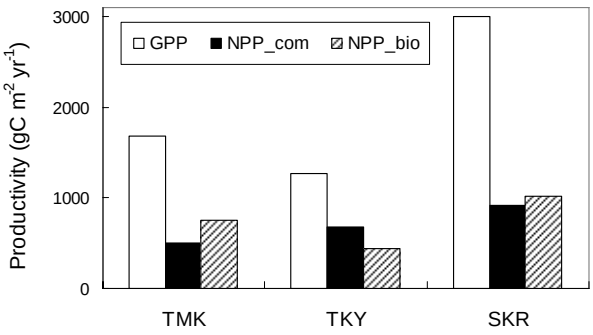


Fig. 2. Annual GPP and NPP estimated for three sites. TMK is a deciduous conifer forest, TKY is a deciduous broad-leaved forest, and SKR is a tropical seasonal forest. NPP_{bio} is NPP estimated by ordinary biometric method. NPP_{com} is obtained by the combined method described in the text.

References: Liang *et al*. (2004) and Yone *et al*. (2005, 2006) for TMK; Ohtsuka *et al*. (2007) for TKY; and Gamo (2003), Kondo *et al.* (2007), and Yamamoto *et al.* (2005) for SKR.

Acknowledgements: This study was supported by the Japan Ministry of the Environment (integrated study for the terrestrial carbon management of Asia in the 21st Century on the basis of scientific advancements). The authors would like to thank all the project investigators, their co-workers, and students for providing data.

P26

CONTRIBUTION OF SOIL MOISTURE TO SEASONAL VARIATION IN SOIL CO_2 EFFLUX IN A JAPANESE COOL-TEMPERATE OAK-BIRCH FOREST

A. (W. Mo) Kishimoto[1], S. Yonemura[1], M. -S. Lee[2], M. Yokozawa[1], M. Uchida[3], M. Kondo[2] and H. Koizumi[2]

[1] *National Institute for Agro-Environmental Sciences, Tsukuba, Japan*
[2] *Institute for Basin Ecosystem Studies, Gifu University, Gifu, Japan*
[3] *National Institute for Polar Research, Tokyo, Japan*

Soil CO_2 efflux is a key process that regulate the carbon balance in forest ecosystems, and thus long-term continuous monitoring is necessary to precisely estimate the seasonal and annual variations in soil CO_2 efflux. We improved an automatic chamber technique based on open-flow IRGA method (AOCC technique), and measured soil CO_2 efflux continuously over snow-free seasons of 2005 and 2006 in a humid cool-temperate broadleaf deciduous forest (Takayama AsiaFlux site) in central Japan. To evaluate the effect of soil moisture on production and transport of CO_2 in soil, soil CO_2 concentration profile (0, 5, 10, 20, 50 cm) was also monitored throughout 2005 and 2006 including snow-covered seasons. The aim of this study was to reveal the contribution of soil moisture to seasonal variation in soil CO_2 efflux, as well as to the estimation of annual soil respiration.

The AOCC technique was well improved to capture the effects of soil temperature and soil water content on soil CO_2 efflux in the studied humid forest (Fig. 1a). Seasonal change in soil CO_2 efflux followed the change in soil water content especially when daily mean soil surface temperature exceeded 15°C, and showing two peaks of the efflux: one was in *Bai-u* rainy season of July and another was in typhoon season of late August to early September (Fig. 1a). Soil temperature exerted principle control on the seasonal variation of efflux, and the Q_{10} function (Fig. 1b) explained 86.4% of that. Normalized soil CO_2 efflux for soil temperature (Fig. 1c) showed a significantly positive relationship to soil moisture. An empirical model that accounted for soil temperature and moisture using the relationships of Fig. 1b and 1c, explained 97.4% of seasonal variation in soil CO_2 efflux. We also developed a one-dimensional, process-based model to simulate production and transport of CO_2 in soil before and after rainfall events, to precisely analyze the contribution of soil moisture to soil CO_2 efflux in our study site.

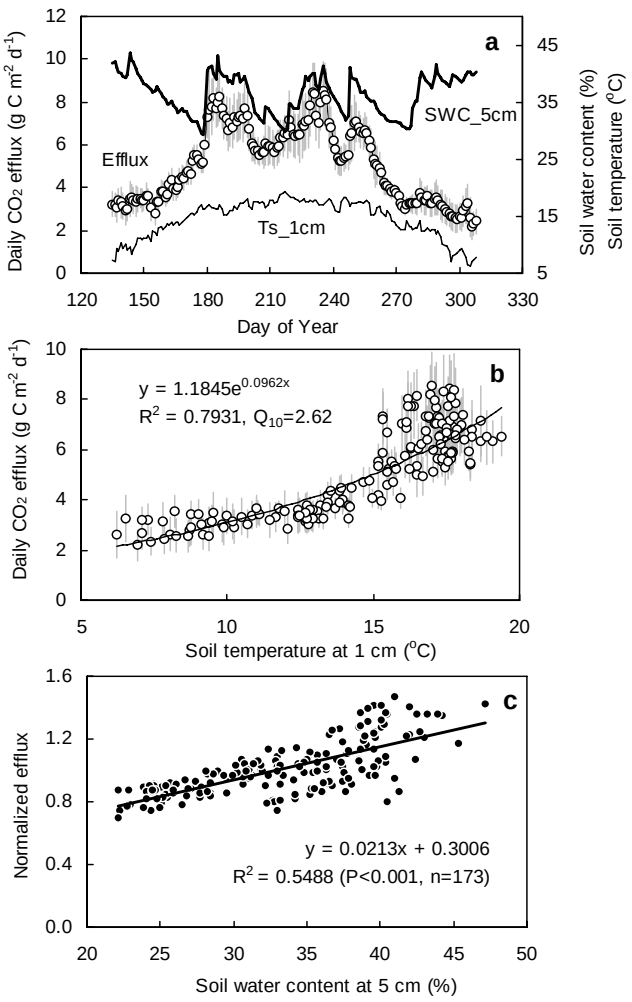


Fig. 1 Seasonal changes in soil CO_2 efflux (a) and the relationship to soil temperature (b) and soil moisture (c) during snow-free season of 2005 in Takayama site. Soil CO_2 efflux was daily carbon emission rate according to AOCC technique. Error bars represent the standard deviation of 4 chambers. In (c) soil CO_2 efflux was normalized for temperature (measured efflux in (a) was divided by efflux predicted from the soil temperature using Q_{10} function in (b) and plotted vs. soil water content (SWC) at 5 cm.

P27

LONG-TERM CO2/H20 FLUXES MEASUREMENTS IN AN TEMPERATE OLD-GROWTH MIXED FOREST: DYNAMICS AND INTERACTION

J. Zhang[1*], S. Song[1], S. Han[1], G. Yu[2]

[1]Institute of Applied Ecology, Chinese Academy of Sciences, Shenyang, China
[2]Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China

Cancelled

Long-term measurement of carbon/water fluxes of old-growth forests is critical to predict their behaviors and to reduce the uncertainties of carbon/water cycling under changing climate. Eddy covariance technology was applied to investigate the long-term CO2/H2O over a 200 year-old Chinese broad-leaved Korean pine mixed forest of Forest Ecosystem Open Research Station of Changbai Mountains (128° 28'E and 42° 24' N, Jilin Province, P. R. China), Chinese Academy of Sciences, since August 2002. This paper reports the result on (1) Sink/source status, phase and amplitude of ecosystem CO_2/H2O dynamics; (2) Interaction between behaviors of CO2 and H2O fluxes and its implication on the data obtained with open-path eddy covariance system and CO_2 /H2O profile measurement system from Aug. 2002 to Aug. 2007. Corrections due to storage and friction velocity were applied to the eddy carbon flux.

This old-growth forest ecosystem is carbon sink although there were significant inter-annual variations in fluxes components. ET coupled closely with GPP and showed significant seasonal and annual variation. The significant variation in WUE is due to the variations in T_A except year 2004 while the r values for WUE on the other meteorological data were low. WUE followed seasonal T_A curves more closely than these of VPD.

*Correspondence: jhzhang@iae.ac.cn

P28

HYDRO-BIOGEOCHEMICAL APPROACHES TO UNDERSTANDING OF WATER AND CARBON CYCLING IN THE GWANGNEUNG FOREST CATCHMENT

Su-Jin Kim[1], Dongho Lee[1], Joon Kim[1], and Sung Kim[2]

[1]Yonsei University, Korea
[2]Sustainable Water Resources Research Center/KICT, Goyang, Korea

The information on flowpath, storage, residence time, and interactions of water and carbon transport in a catchment is the prerequisite to the understanding and predicting of water and carbon cycling in the mountainous landscapes of Korea. In this paper, along with some up-to-date results, we present the principal methods that are currently used in HydroKorea and CarboKorea research to obtain such information. Various catchment hydrological processes have been examined on the basis of the water table fluctuations, the end-member mixing model, the cross correlation analysis, and cosmogenic radioactive isotope activity. In the Gwangneung catchment, the contribution of surface discharge was relatively large, and the changes in the amount, intensity and patterns of precipitation affected both the flowpath and the mean residence time of water. Particularly during the summer monsoon, changes in precipitation patterns and hydrological processes in the catchment influenced the carbon cycle such that the persistent precipitation increased the discharge of dissolved organic carbon (DOC) concentrated in the surface soil layer. The improved understanding of the hydrological processes presented in this report will enable a more realistic assessment of the effects of climate changes on the water resource management and on the carbon cycling in forest catchments.

Acknowledgment: This study is supported by a grant (Code: 1-8-3) from Sustainable Water Resources Research Center of 21st Century Frontier Research Program, the A3 Foresight Program from the Korea Science and Engineering Foundation, and the BK21 program from the Ministry of Education and Human Resource Management of Korea.

P29

CHARACTERISTIC OF NEE IN TROPICAL SEASONAL RAIN FOREST OF XISHUANGBANNA, SW CHINA

Yiping Zhang, Liqing Sha, Qinghai Son, Min Cao, Zhenghong Tan

Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, Kunming China

Abstract

Objectives：1. To obtain NEE pattern in a tropical seasonal rain forest in Xishuangbanna SW China; 2. To improve our understanding of processes controlling the rain forest cycle of carbon.

Location: The tropical rain forest in Xishuangbanna is an important part of Indo-Malaysian tropical rain forest and is located on the northern edge o the tropical zone in South-East Asia. A large proportion of the forest in this region is tropical seasonal rain forest and it is primarily formed in wet valleys, lowlands and on low hills below 900 m altitude. This study was conducted in a tropical seasonal rain forest (21°55'39" N, 101°15'55" E, elevation 750 m) in the Menglun Forest Reserve in Mengla County, Yunnan Province. The forest structure at the study site can be divided into three general tree layers that are represented by different species. More than 70% of all individual trees occur in tree layer C (below 16 m), which is composed of small evergreen trees and juveniles of species from the upper tree layers (above 16 m). Tree layer B, between 16-30 m, consists of a mixture of evergreen and deciduous species, such as *Barringtonia macrostachya*, *Gironniera subaequalis*, and *Sloanea cheliensis*. Tree layer A, having a canopy height of over 30 m, is dominated by *Pometia tomentosa* and *Terminalia myriocarpa*. Many species of algae, lichens, mosses and ferns comprise the epiphyte communities. The woody climbers, such as *Byttneria integrifolia*, and *Gnetum montanum* are also common at the study site.

Methods:

(1) CO_2 flux: The fluxes of CO_2, water vapour and sensible heat was quantified using tower-based eddy covariance. The eddy covariance system utilized a fast response three-dimensional sonic anemometer-thermometer (CSAT3, CAMPBELL, USA) and a fast-response open-path infrared gas analyzer (LI-7500, LI-COR, Inc., Lincon, NE, USA) to measure the mean and fluctuating quantities of wind speed and temperature, and CO_2 and H_2O vapour, respectively.

(2) Soil respiration: The static opaque chamber technique was used to measure soil respiration in tropical seasonal rain forest in Xishuangbanna. Three treatments were applied with three replicates. In a square collar, litter was removed and seedlings were cleared , litter was not removed and seedlings were cleared, or neither litter nor seedlings were removed. Sampling was done on every Monday morning during 09: 00 to 11: 00 in every week.

(3) Photosynthesis: A portable photosynthesis system (Li-Cor 6400) was used to measure light response curves of dominant canopy tree species (*Pometia tomentosa*) and underground seedlings (*Pometia tomentosa*, *Barringtonia macrostachya*, *Ardisia tenera* and *Drypetes indica*) in different light intensities and CO_2 concentrations.

(4) Leaf area index: Vertical profiles of Leaf area index were measured using a LAI-2000 (Li-Cor, Lincoln, Nebraska, USA) every month.

(5) Litterfall and litter decomposition rate: Forty litter traps (caliber: 0.2 m^2) were placed randomly within the research plot. Litter was collected at monthly intervals from the traps. Litter decomposition rate was calculated by embedding 60 litterbags simultaneously on April when forest shed more leaves in this period than other months and removing five bags at one month intervals to get fresh and dry weight.

(6) Stem respiration: The stem respiration were measured using a LI-820(Li-Cor, Lincoln, Nebraska, USA) every month.

Results: Above-canopy NEE was negative in Sep.-Apr., when the forest acts as a C sink, and mainly positive in May-Aug., when the forest acts as a weak C source. Seasonal changes in daytime and nighttime averaged NEE were also significant in this forest. There was a significant correlation between above-canopy carbon flux and rate of photosynthesis of tree species. Soil respiration of the three treatments displayed a markedly seasonal dynamic; in addition, above-canopy carbon fluxes correlate well with soil respiration, litterfall production, litterfall decomposition rate, precipitation, and soil moisture and temperature.The mean stem respiration rates for 11 dominant species of tropical rain forest ranged from 0.823 to 2.727 μmol m^{-2} s^{-1}.

Conclusions: (1) The tropical rain forest in Xishuangbanna played a role of carbon sink, accumulated 2.665 t CO_2/ha/yr (727 kg C/ha/yr, mean value from 2003 to 2006).(2) Temperature and moisture controlled the seasonal pattern of NEE.(3) The factors, such as photosynthesis rate, soil & stem respiration, litter fall & its decomposition, fine root decomposition, LAI, etc., affect NEE.

Keywords: NEE, annual variation, impact factors, tropical seasonal rain forest, Xishuangbanna

P30

AN ANALYSIS OF LEAF PHENOLOGY USING FIXED VIEW CAMERA IMAGES IN A TROPICAL SEASONAL FOREST AT MAE KLONG, THAILAND - ANALYSIS BY RESPECTIVE TREE SPECIES -

T. Maeda [1], M. Gamo [1], N. Saigusa [1] and S. Panuthai [2]

[1] National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Japan
[2] National Park, Wildlife and Plants Conservation Department, Bangkok, Thailand

A simple numerical method to detect seasonal variations of phenology of forest canopies using a series of daily fixed view photographs and its applications to the tropical deciduous forest at the Mae Klong flux monitoring site in Thailand (14°34'34"N, 98°50'38"E, 150m MSL) have been examined.

The photo images were taken at noontime every day by a fish-eye digital camera fixed on the top of the tower (40m high) to look down the surface of forest canopies 10-20m below the camera. The analyses of the photo images were done by making time series of the monochromatic intensities of respective channels of RGB normalized by the panchromatic intensity. In the previous presentation at the Asiaflux workshop 2006, a preliminary result by analyzing the average color over the whole field of view was described. The result showed that the analysis method could detect the seasonal variation of the leaf phenology in the community scale. However, the detection of the events was uncertain because there were many species of trees that have different seasonal variation of leaf phenology included in the field of view.

To solve this problem, further analyses with dividing the photo image into areas of several typical tree species were carried out in this paper. The seasonal variation of the normalized intensities *r*, *g* and *b* averaged over each area of the three typical species in the images are shown in Fig. 1. As the result, the seasonal patterns peculiar to each species were obtained clearly. The timings of changes in the leaf phenology correspond to the discontinuities in the seasonal variation of any of *r*, *g* and *b*. The foliating periods of the three species were detected as about 11 months for *Xylia xylocarpa* and *Shorea siamensis*, 9 months for *Dillenia obovata* in 2005. The difference of the day of leaf flushing among the three species was 4 months at the maximum.

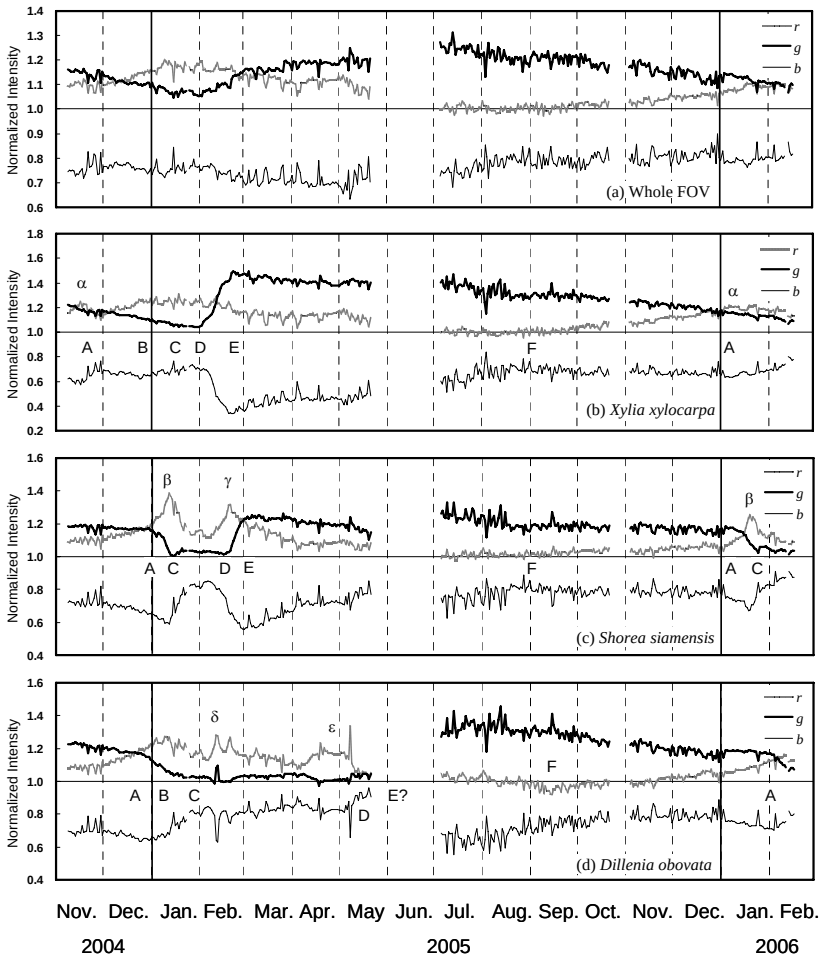


Fig.1. Time series of the normalized intensities of red (*r*), green (*g*) and blue (*b*) channels averaged over (a) the whole field of view and the part of canopies of (b) *Xylia xylocarpa*, (c) *Shorea siamensis*, and (d) *Dillenia obovata* in the daily fixed view photos taken at the mixed deciduous forest in Mae Klong, Thailand. Characters in the figures denote A: onset of defoliation, B: withered leaves, C: end of defoliation, D: onset of leaf flushing, E: end of leaf flushing, F: onset of leaf senescence, α: autumnal leaves of *Xylia xylocarpa*, β: fruits of *Shorea siamensis*, γ: leaf-bud outbreak of *Shorea siamensis*, δ: flowers of *Dillenia obovata*, and ε: fruits of *Dillenia obovata*, observed in the photos respectively.

P31

CARBON BUDGET OF A SUBTROPICAL CONIFEROUS PLANTATIONS AND ITS RESPONSE TO ENVIRONMENTAL FACTORS IN QIANYANZHOU ECOLOGICAL STATION

Yunfen Liu[1], Guirui Yu[1], Huimin Wang[1], Xuefa Wen[1], Xiaomin Sun[1], Wenqing Shen[2]

[1]Institute of Geophysical Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China

[2] Mountain-River-Lake Regional Sustainable Development of Jiangxi Province, Nanchang, 330046, China

A long-term carbon flux measurement has been conducted using eddy covariance technique since 2002 in a subtropical coniferous plantation at qianyanzhou ecological station, where *Pinus massoniana*, *Pinus elliottii Engelm*, and *Cunninghamia lanceolata* were dominated. This study analyzed the seasonal variation of net ecosystem CO_2 exchange (NEE), ecosystem respiration (RE) and gross ecosystem exchange (GEE) from 2003 to 2005; meanwhile, the impact of the environmental variables on the ecosystem carbon fluxes was discussed.

1). NEE, RE and GEE obviously showed seasonal and diurnal variation and well correlated with each other. The ecosystem switched from carbon source to sink at about 8:00 AM. The carbon assimilation ability rapidly increased since then and reached the maximum value at 11:00 or 11:30 AM; after then, the acquisition ability of the ecosystem gradually decreased and switched to carbon source again around 5:00PM. At the night, the ecosystem released CO_2 with less variation. Both the carbon assimilation at the daytime and the respiration at the nighttime were higher in summer and autumn than those in other seasons. Generally, the absolute value of GEE, RE and NEE increased from January, peaked in July and gradually decreased after then. But the decreasing slope is much more gentle than that of the increasing process.

2). Radiation, temperature and humidity conditions were the most important environmental variables in controlling the dynamic of the NEE, Re and GEE. Of which, PAR and VPD greatly affected the daytime carbon assimilation, the absolute value of NEE will be greatly decreased under the drought condition (high VPD). The nighttime ecosystem carbon flux (respiration) highly correlated with soil temperature following an exponential model. The ecosystem respiration rate was higher in the first half year than that in the second one. Under the condition of a high soil temperature, the low soil water content restricted the soil respiration. There was an exponential relationship between the soil respiration and soil temperature, whereas soil moisture had no significant effect on soil respiration.

3). The mean annual NEE, RE and GEE from 2003 to 2005 were -617.4, 1137 and 1754.8 g C m^{-2}, respectively. This result indicated that the ecosystem at the Qianyanzhou Station was a strong carbon sink.

4). The ecosystem carbon storage was estimated to be 5.212 t ha-1 using biometric method, which is lower than that estimated using eddy covariance method.

5). The ecosystem respiration (RE) consumed 63.9 to 65.9% of the total GEE, and 48.6% of the ecosystem RE was contributed from soil. Litter decomposition also contributed 38.3% of the soil respiration.

The planted forest ecosystem at Qianyanzhou Station assimilated CO_2 from the atmosphere in all the months of a year, and its carbon assimilation ability increased from year to year during the study period from 552.5 g C m^{-2} in 2003 to 608.2 g C m^{-2} in 2004 and 691.6 g C m^{-2} in 2005. These results indicated that the large area of planted forest since 1970's in the subtropical region in China may take an important role in mitigating the climate warming by assimilating atmospheric CO_2.

Abstract

Eddy Covariance (EC) system was recommended a fine instrument to measure flux of greenhouse gases and turbulence heat flux.And this study is to measure and analysis to surface fluxes over rice paddies during flooded and fallowing seasons(2006/4-2006/5 、 2006/9-2006/10 、 2006/12、2007/1) in Wu-Feng Agricultural Research Institute, Taichung, Taiwan (24°01′ N ,120°41′ E).The soil during flooded seasons is coverd by water and the soil during fallowing seasons is not.

It is found the value of latent heat fluxes are between 0 and 120 Wm^{-2}, and the value of sensible heat fluxes are between -10 and 70 Wm^{-2} during flooded seasons.The energy balance ratio is 0.88 during flooded seasons daytime(7:00 am~5:00 pm). The value of latent heat fluxes are between 0 and 120 Wm^{-2}, and the value of sensible heat fluxes are between -10 and 100 Wm^{-2} during fallowing seasons.The energy balance ratio is 0.7during fallowing seasons daytime(7:00 am~5:00 pm) The mean value of albedo during the fallowing seasons daytime period was 0.127 and the mean value of Bowen Ratio during the fallowing seasons daytime period was 0.82. The mean value of aerodynamic resistance(r_a) during the daytime period was 50 sm^{-1},and canopy resistance(r_c) was 406 s m^{-1}. The aerodynamic resistance are always higher than canopy resistance.

Keywords: surface energy closure, eddy covariance system, Bowen Ratio, photosynthesis, canopy resistance, thermal emissivity

Cancelled

P33

WATER AND HEAT FLUXES ABOVE A TROPICAL RAIN FOREST AT PASOH IN PENINSULAR MALAYSIA

S. Takanashi [1], Y. Kosugi [2], S. Ohkubo [2], N. Matsuo [3], M. Tani [2], and Abdul Rahim Nik [4]

[1] *Forestry and Forest Products Research Institute, Tsukuba, Japan*
[2] *Kyoto University, Kyoto, Japan*
[3] *Mie University, Mie, Japan*
[4] *Forest Research Institute Malaysia, Kuala Lumpur, Malaysia*

The exchange of heat and water vapour by terrestrial ecosystems, coupled with carbon dioxide, plays a role in the regulation of thermal environment of the atmosphere and water cycling on the planet scale. Tropical rain forests, in particular, play an important role in climate change because of their large plant volume and complexity. It is important to understand the heat and water exchanges of a tropical rain forest for its role in global environmental changes.

We measured the fluxes of sensible and latent heat between a tropical rain forest (a low-land dipterocarp forest) in Peninsular Malaysia and the atmosphere. No clear seasonal and inter- annual changes in latent heat flux were found from 2003 to 2005, while sensible heat flux sometimes fluctuated depending on the fluctuation of incoming radiation between wet and dry seasons. Average evapotranspiration rate was 2.77 mm day^{-1} and 3.61 mm day^{-1} using eddy covariance data with and without an energy balance correction, respectively. Average precipitation was 4.74 mm day^{-1}. Midday surface conductance decreased with atmospheric water vapour pressure deficit and thus restricted the excess water loss on sunny days in the dry season. However, the relationship between surface conductance and vapour pressure deficit did not significantly decline with volumetric soil water content even during the extremely low rainfall period.

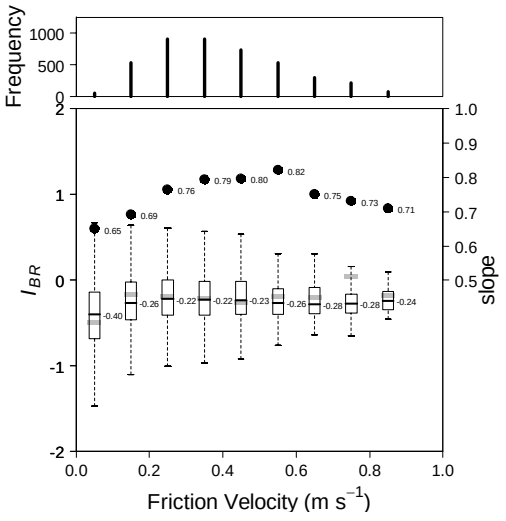


Fig.1 Effects of friction velocity ($\boldsymbol{u}_*$) on the imbalance ratios and the linear regression slopes in the daytime. Box plots of the imbalance ratios for each friction velocity class are shown. Black points represent the linear regression slopes between the available energy and the sum of sensible heat flux and latent heat flux.

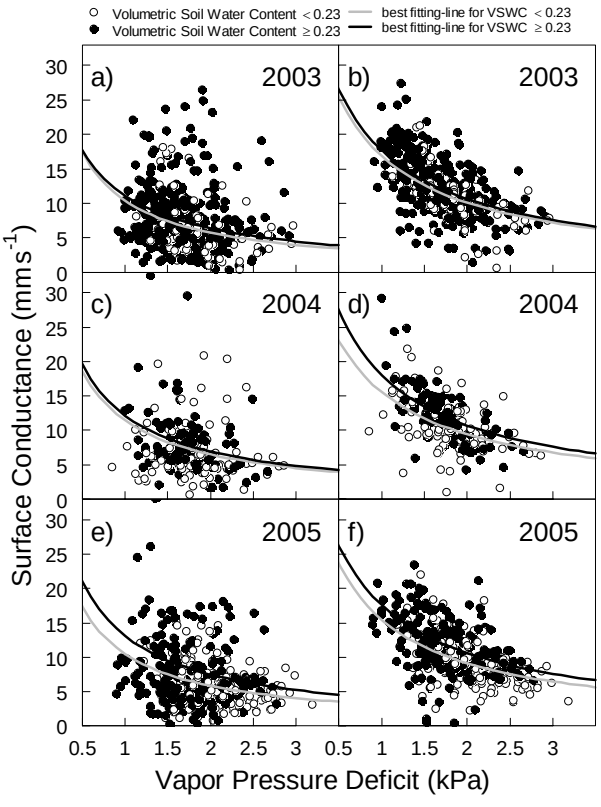


Fig.2 Relationships between vapour pressure deficit and surface conductance in the afternoon under light-saturated conditions (at a solar radiation value of >800 W m^{-2}) for two average volumetric soil water content classes. Lines represent best-fitting curves based on the Lohammar equation (Lohammar et al., 1980). Surface conductances calculated using $\boldsymbol{E}_{eddy}$ and $\boldsymbol{E}$ are shown in left panels (a,c,e) and right panels (b,d,f), respectively.

P34

SEASONAL VARIATIONS OF HEAT, WATER VAPOR AND CO_2 FLUXES ABOVE A MOUNTAIN FOREST IN TAIWAN

Chih-Yi Fang[1], Cheng-I Hsieh[1*], and Yue-Joe Hsia[2]

[1] *Department of Bioenvironmental Systems Engineering, National Taiwan University, Taipei 10617, TAIWAN.*

[2] *Institute of Natural Resources, National Dong Hwa University, Hualien 97401, Taiwan.*

[*]Corresponding: hsieh@ntu.edu.tw

Abstract

Results from 2-year measurements of sensible heat, water vapor, and CO_2 fluxes above a homogeneous mountain Cypress forest are presented. The site is located at 1650 m a.s.l. in northeastern Taiwan, close to a nature preserve. Vertical turbulent scalar fluxes are obtained by eddy-covariance method. The data were collected during the period from April 2005 to May 2007. Two gap filling strategies, including linear and nonlinear regressions between net radiation and scalar fluxes, were discussed and applied for filling the missing and rejected data. We examined the seasonal patterns of net radiation, sensible heat, latent heat, and CO_2 fluxes. The results showed that all three fluxes change seasonally, in consist with net radiation. Bowen ration variation with season and relative transport efficiencies between heat and water vapor and carbon dioxide under different atmospheric stabilities were also discussed.

***Keywords*:** seasonal variation, mountain forest, eddy-covariance, gap-filling, Bowen ratio

P35

SEASONAL VARIATION IN ENERGY PARTITIONING OVER A TROPICAL DECIDUOUS FOREST IN NORTHERN THAILAND

N. Yoshifuji[1,2], K. Tanaka[3], N. Tanaka[2], C. Tantasirin[4], M. Suzuki[2]

[1] Japan Science and Technology Agency, Saitama, Japan
[2] The University of Tokyo, Tokyo, Japan
[3] Frontier Research Center for Global Change, Kanagawa, Japan
[4] Kasetsart University, Bangkok, Thailand

Tropical forests are an important latent energy source, having a strong influence on both global and regional climate. The area of deciduous forests in the tropical region accounts for significant portion of the total area of tropical forests (Food and Agriculture Organization, 2001) and, in addition, is estimated to be larger than the area of temperate deciduous forests (Melillo et al., 1993). However, the energy exchange over tropical deciduous forests is less investigated than tropical rain forests and temperate deciduous forests.

In this presentation, we describe the preliminary results of seasonal variation in energy partitioning of a teak plantation in northern Thailand, and examine its characteristics in comparison with the energy partitioning previously reported at tropical rain forests and temperate deciduous forests. The climate of the site is influenced by Asian monsoons, which produce highly seasonal variation in precipitation. Teaks loose leaves completely in the late dry season (Fig. 1). Seasonal variation in the sensible and latent heat flux over the canopy measured by eddy covariance method and soil heat flux is described and compared with seasonal variation in meteorological factors, leaf area index, and sap flux of canopy trees.

Net radiation of the site remained large throughout the year compared to higher latitudes, and the partitioning of net radiation into sensible and latent heat changed seasonally and drastically. Latent heat flux increased in the beginning of rainy season, then decreased in the dry season corresponding to the decline in the transpiration of canopy trees but earlier than the leaf-fall. On the other hand, sensible heat flux decreased in the beginning of rainy season and increased from the end of rainy season to the dry season. Net radiation was partitioned far more into latent heat in the rainy season and far more into sensible heat in the dry season. This contrasts with the energy partitioning reported at tropical rain forests in Southeast Asia (e.g., Takanashi et al., 2005) and Amazon (e.g., da Rocha et al., 2004), at which latent heat was larger than sensible heat throughout the year. This also different from the energy partitioning reported at a transitional forest between tropical rain forest and savanna in Amazon, at which more than 40% of net radiation was partitioned into latent heat even in the dry season (Vourlitis et al., 2002). The inter-annual variation in the growing season length of this site was large (Yoshifuji et al., 2006). As the ratio of sensible and latent heat fluxes was quite different between the growing and dormant season, it is possible that year-to-year variation in the growing season length causes considerable changes in annual sensible and latent heat fluxes. The impact of changes in the growing season length on annual sensible and latent heat fluxes through the modification in the energy partitioning might be more significant in this site than in temperate deciduous forests, because net radiation is large throughout the year in this site, whereas net radiation becomes small from fall to spring due to low solar elevation in temperate deciduous forests.

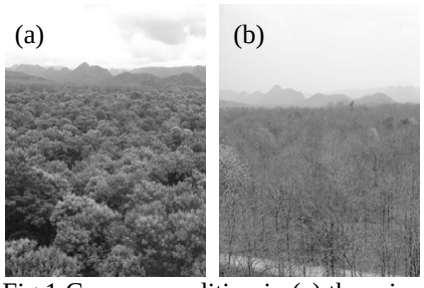


Fig.1 Canopy condition in (a) the rainy season and (b) the late dry season.

References

Takanashi S., et al., 2005. Characteristics of the Gas Exchange of a Tropical Rain Forest in Peninsular Malaysia. Phyton 45, 61-66.

da Rocha H.R., et al., 2004. Seasonality of water and heat fluxes over a tropical forest in eastern Amazonia. Ecol. Appl. 14 (4), S22-S32.

Vourlitis G.L., et al., 2002. Seasonal variations in the evapotranspiration of a transitional tropical forest of Mato Grosso, Brazil. Water Resour. Res. 38 (6), 1094.

Yoshifuji N., et al., 2006. Inter-annual variation in growing season length of a tropical seasonal forest in northern Thailand. For. Ecol. Manage. 229(1-3), 333-339.

Food and Agriculture Organization, 2001. Global Forest Resources Assessment 2000 – main report. FAO Forestry Paper 140, Rome.

Melillo J.M., et al., 1993. Global climate change and terrestrial net primary production. Nature 363, 234-240.

P36

C02 and water fluxes over a rubber tree ecosystem

Philippe Thaler[1], Pongpan Siripornpakdeekul[2], Poonpipope Kasemsap[2], Summit Kunjet[3], Naruenat Chairungsee[2], Boonthida Kositsup[2], Olivier Roupsard[1], Arak Chantuma[3] and Jean-Marc Bonnefond[4]

Abstract :

In Thailand, rubber is the major tree crop covering more than 2 millions hectares. Its impact on environment, and particularly CO_2 balance and water use, is a major issue.
A complete flux-measuring system has been installed in a 13 years old rubber plantation (clone RRIM 600) in eastern Thailand (Chachoengsao Rubber Research Center, RRIT-DOA) in 2006. Carbon fluxes of rubber plantation ecosystem are continuously measured by eddy-covariance method (CO_2 exchanges between the ecosystem and the atmosphere). Evapo-transpiration (ET) are measured by eddy-covariance and water balance together and partitioned between tree transpiration and soil evaporation. Sapflow is measured by heat dissipation method (Granier 1985, 1987) using home-made 20 mm-long radial probes, continuously heated (0.2 W). Meanwhile, amounts of C stored in the trees are evaluated by measuring biomass increment along the life cycle of the plantation, in combination with estimations of the carbon content of the different compartments. These measurements will provide the annual balance of C within plantations at different ages.
Results obtained at ecosystem scale by these methods will be compared to gas exchanges measured at the level of the different compartments (canopy, trunk, root system, soil…). Particularly, Farquhar's photosynthesis model (Farquhar et al. 1980) is parameterized across the canopy. Leaf water potential, sapflow and canopy transpiration are computed to calculate canopy conductivity.
Thereby, validated CO2 and H2O fluxes will be used to model gas exchanges of rubber plantation ecosystem according to climate and other environmental parameters as well as crop management.

1 Cirad, UR Plantation Ecosystems, Montpellier France / DORAS Center, Kasetsart University, 10900 Bangkok, Thailand
2 Faculty of Agriculture, Kasetsart University, 10900 Bangkok, Thailand.
3 Chachoengsao Rubber Research Center, RRIT-DOA, Sanam Chai Ket, Thailand
4 INRA, UR EPHYSE, Bordeaux, France.

P37

COMPARISION OF CO_2 FLUX AND SURFACE ENERGY COMPONENTS DURING RICE PADDY GROWING SEASON AND FALLOW PERIOD

A. Alagesan, Ben-Jei Tsuang and Chao -Wei Wu

Department of Environmental Engineering
National Chung Hsing University, Taichung, Taiwan

This paper aims to compare the variations in CO_2 flux and partitioning of surface energy components during rice-paddy growing season and the subsequent fallow period.

The observational site is located at Taiwan Agricultural Research Institute (120°41'E, 24°01'N and 50 m above mean sea level). The observation period during rice paddy was between 7th April to 19th May 2006, which corresponds to maximum tillering to maturity stage of the rice crop. After the harvest of the rice paddy, the land was plowed and left as fallow. The land was kept dry without any irrigation during the period of observation; 21st December 2006 to 29th January 2007. The only source of moisture to the fallow land during the periods of investigation was through rainfall.

CO_2, sensible heat (*H*) and latent heat (*LE*) flux were measured through an EC system consist of sonic anemometer (Model: CSAT3 during rice paddy and YOUNG 81000 during fallow) and an open-path CO_2/H_2O fast response infrared gas analyzer (LI 7500; Licor, inc). All the samples were measured at 20 Hz and averaged over 10 minutes period. A Solar Infrared Radiation Station (SIRS) system was used to measure each component of the radiation balance. Necessary coordinate rotation and webb *et al*, term correction were applied to the observed data as a post processing measure.

The analyzed data using 24 hours hourly composites results that the fluxes of CO_2 (mg m^{-2} s^{-1}) exhibited a clear diurnal variation during growing and fallow period. The degree of magnitude during rice paddy was very high than fallow period, where the diurnal variation of hourly composite ranged from a minimum value of -0.71 during day and a maximum value of 0.16 during night. The daily average flux accounts for about -0.14 which depicts the rice paddy as net CO_2 sink. However, during fallow period, the flux of CO_2 is always positive with a minimum value of 0.06 during day and a maximum value of 0.14 during night with average daily flux of 0.1 and with a standard deviation of 0.3 which serve as a CO_2 source to the atmosphere.

With regards to surface energy characters, during rice paddy the observed net radiation (W m^{-2}) ; the maximum, minimum and average values are 583.36, -54.0 9 and 121.49 with a standard deviation of 226.22. During fallow period the the corresponding values are 439.24, -33.05, and 95.68 with a standard deviation of 162.02. With regards to partitioning of available energy into turbulent heat fluxes, during growing period, the maximum, minimum and average flux (W m^{-2}) of *H* are 63.59, -5.99 and 13.29. The corresponding values for fallow periods were 99.94, -14.11 and 30.14. The maximum, minimum and average flux (W m^{-2}) of *LE* during the respective periods are 335.58, 4.33 and 89.57; and 136.83, 2.96 and 39.14. During both the observation periods, the *LE* dominates over *H* , However, during growing period, the difference between *LE* and *H* was wider during day time, whereas, under fallow period the difference is very narrow. This is because of the presence of rice canopy and flood water during rice paddy and dry field without significant vegetation during fallow. The corresponding maximum , minimum and average Bowen ratio during the rice paddy and fallow periods were found to be 0.69, -0.43 and 0.03; -2.87, -2.46 and 0.49 respectively.

P38

VARIABILITY IN SEASONAL VARIATION OF CARBON DIOXIDE EXCHANGE IN PADDY FIELDS IN MONSOON ASIA

A. Miyata[1], A. Mano[1], Md. A. Baten[2], T. Iwata[3], J. Zhu[4] and K. Kobayashi[5]

[1] National Institute for Agro-Environmental Sciences, Tsukuba, Japan
[2] Bangladesh Agricultural University, Mymensingh, Bangladesh
[3] Okayama University, Okayama, Japan
[4] Institute of Soil Science, Chinese Academy of Sciences, Nanjing, China
[5] The University of Tokyo, Tokyo, Japan

Paddy fields are one of the ecosystem types characterizing agricultural land use in monsoon Asia. Although paddy fields are distributed widely from Northeast Asia to Southeast and South Asia, cropping pattern in paddy fields is not uniform across the region. In tropical and subtropical area with sufficient water supplies, multiple (double or triple) cropping of rice is common. In mid-latitudes with humid summer and dry winter, double cropping of rice and wheat (or rice and barley) or single cropping of rice is generally practiced. Seasonality in carbon dioxide (CO_2) exchange at paddy fields would change with the cropping patterns and related cultivation practices and field management. To investigate variability in seasonal variation of CO_2 exchange and annual carbon budget of paddy fields in Asia, multiple-year experiments are conducted in parallel at four paddy flux sites shown in Fig. 1: MSE in central Japan (single rice), OKY in western Japan (rice-barley), JND in Jiangsu Province, China (rice-wheat), and MYM in northern Bangladesh (rice-rice). At all of the four sites, open-path eddy covariance system is employed to measure net ecosystem CO_2 exchange. Micrometeorological variables and biometric parameters are also monitored.

From results of the first year experiments, following features were found. 1) Annual courses of NEE showed single or double peaks of net CO_2 uptake in accordance with the number of crops at respective sites. The peak values of net CO_2 uptake in rice growing season were similar, about 10 g C m^{-2} d^{-1}, while those in barley growing season at OKY and wheat growing season at JND were a little smaller. 2) The number of days from planting to the maximum uptake was the smallest, less than two months, in dry rice growing season at MYM and in rice growing season at OKY. It was longer in wheat (JND) and barley (OKY) growing season. 3) In inter-cropping season, net CO_2 release from the paddy fields was observed at MSE, OKY, JND and MYM in winter. At MSE, OKY for barley growing season and JND for wheat growing season, NEE turned positive a few weeks before harvest. At MYM, net CO_2 release after harvest of dry season rice was not apparent because the field was flooded even after the harvest due to precipitation in monsoon season.

Acknowledgements: This study is partially supported by the following funds: Special Coordination Funds for the Promotion of Science and Technology by MEXT, Environment Research Fund by MAFF, JSPS-UGC Joint Research Program by JSPS, and Global Environment Research Fund S-1 and C-062 by ME.

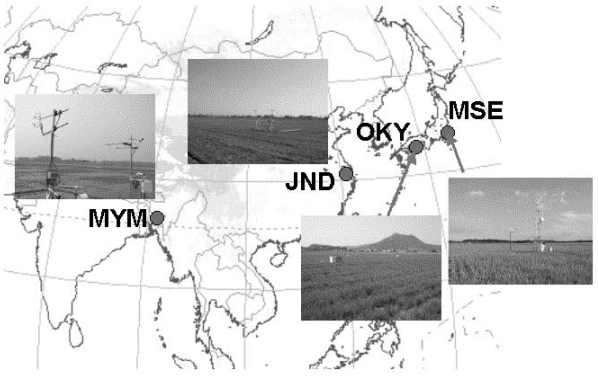


Fig.1 Location of paddy flux sites

P39

CHARACTERISTICS AND CONTROLLING FACTORS OF CO_2 FLUX OVER A REED (*Phragmites Australis*) WETLAND IN NORTHEAST CHINA

L. Zhou[1] and G. S. Zhou[1,2]

[1] *Key Laboratory of Vegetation and Environmental change, Institute of Botany, Chinese Academy of Sciences, Beijing, China*

[2] *Institute of Atmospheric Environment, China Meteorological Administration, Shenyang, China*

Terrestrial ecosystem, Ocean ecosystem and wetland ecosystem are three largest ecosystems in the earth. Reed is one of the most widespread and productive plant species in the wetland ecosystem. In order to understand how the large area of reed wetlands will contribute to global carbon budget, the characteristics of the diurnal and seasonal variations of NEE and its controlling factors were analyzed based on long term observation data from eddy covariance (EC) measurements of a reed (*Phragmites australis*) wetland ecosystem in northeast China. The results indicated that the diurnal pattern in NEE was almost absent mostly during the non-growing season (from January to March and from November to December), and showed a converse campanulate curve during the growing season from May to October. Reed wetland behaved as a sink of CO_2 during the growing season, and as a source in the non-growing season. The monthly cumulated NEE, ranged from -114.82 g C m^{-2} $month^{-1}$ in July to 74.78 g C m^{-2} $month^{-1}$ in November of 2005. The annual carbon budget for the reed wetland ecosystem was -65 g C m^{-2} in 2005, similar to the Scottish peatland ecosystem (-41 g C m^{-2} y^{-1}) and the northern bog (-76 g C m^{-2} y^{-1}). Daytime NEE has a close relationship with PAR, and NEE-PAR response curve depends on temperature conditions; and nighttime CO_2 flux has a significant exponential relationship with soil temperature at 5cm ($T_{s,5}$), and Q_{10} was 1.568.

Key words: net ecosystem CO_2 exchange; eddy covariance; reed; wetland

P40

Characteristics and Controlling Factors of Latent Heat Flux of *Phragmites Australis* from Leaf to Canopy in Panjin Wetland

YU Wenying, ZHOU guangsheng

Institute of Atmospheric Environment, China Meteorological Administration, Shenyang 110016

Email: wuying0636@sina.com.cn

Abstract: Based on the data of the whole year in 2005, including the microclimate gradient observation data, eddy covariance observation data, and ecophysiological observation data in Panjin Wetland Ecosystem Research Station, Institute of Atmospheric Environment, China Meteorological Administration, the latent heat flux variation and its controlling factors of *phragmites australis* were analyzed. The results showed that the latent heat flux variation in different months could be expresses as a single peak curve that was lower in the morning and evening and higher around noon. Meteorological factors and biological factors would affect the latent heat flux. According to the correlative analysis, the latent heat flux variation of *phragmites australis* wetland has good responding to the environmental factor such as radiation, air temperature, surface temperature, relative humidity, wind speed, and soil moisture. Regression analysis indicates, the major factors in growing season are: radiation, soil moisture, relative humidity, air temperature and surface temperature; the factors in non-growing season are: radiation, surface temperature and wind speed. At the same time, vegetation growth situation and biological characteristic had significant effects on the latent heat flux of *phragmites australis*, especially, leaf area index, leaf transpiration rate and leaf conductance.

Key words: *Phragamites Australis*; Wetland；Latent heat flux；Dynamic changes

P41

Seasonal and interannual variations of net ecosystem carbon exchange in a temperate *Stipa krylovii* steppe during three dry years

Yunlong Wang[a,b], Guangsheng Zhou[a,c], Yuhui Wang[a]

[a] Key Laboratory of Vegetation and Environmental Change, Institute of Botany, the Chinese Academy of Sciences, 20 Nanxincun, Xiangshan, Haidian District, Beijing 100093, P. R. China

[b] Graduate School of the Chinese Academy of Sciences, Beijing 100039, P. R. China

[c] Institute of Atmospheric Environment; China Meteorological Administration; Shenyang 110016, P. R. China

Abstract:

Net ecosystem carbon exchange (NEE) between the atmosphere and a native *Stipa krylovii* steppe ecosystem was measured in northeast Xilinhot during three consecutive years of extreme drought using eddy covariance techniques. The annual precipitation in 2004, 2005 and 2006 was 291.0 mm, 173.6 mm and 215.3 mm, respectively, whereas the long-term average annual precipitation from 1971 to 2003 was 290 ± 79.3 mm (± SD). Our results indicate that native *Stipa krylovii* steppe produced a small amount of carbon under extreme drought conditions. The NEE was the highest in the driest year of 2005 (67.5 g C m^{-2} y^{-1}; a positive value means carbon release from vegetation to the atmosphere). In 2006, precipitation levels were also below average and the annual carbon release was 34.9 g C m^{-2} y^{-1}. Precipitation in 2004 was slightly higher than average, but most rain events fell after July, and carbon release also occurred with a value of 48.9 g C m^{-2} y^{-1}.

The maximum daytime NEE ($NEE_{daytime\ max}$) and the maximum daily NEE ($NEE_{daily\ max}$) of *S. krylovii* steppe were low compared with other temperate grasslands, varied widely in magnitude and timing over the year. $NEE_{daytime\ max}$ (-8.0 μmol C m^{-2} s^{-1}) and $NEE_{daily\ max}$ (2.1 g C m^{-2} d^{-1}, DOY 260) occurred at the end of the growing season in 2004, but in early June in 2005 (-5.0 μmol C m^{-2} s^{-1}; 0.91 g C m^{-2} d^{-1}, DOY 154). In 2006, values of $NEE_{daytime\ max}$ (-7.0 μmol C m^{-2} s^{-1}) and $NEE_{daily\ max}$ (2.0 g C m^{-2} d^{-1}, DOY 194) were similar to 2004, but occurred in the peak growing time.

Key words: Net ecosystem carbon exchange, *Stipa krylovii* steppe, drought, Interannual variations

SEASONAL VARIATION OF CO_2 FLUX OVER A BARLEY-FIELD IN WESTERN JAPAN

T. Takimoto[1], Y. Hanaoka[1], S. Kikkawa[1], Y. Tsukamoto[1], T. Iwata[1], S. Yamamoto[1], T. Miura[1], M. Mano[2] and A. Miyata[2]

[1] Graduate School of Environmental Science, Okayama University, Okayama, Japan
[2] National Institute for Agro-Environmental Sciences, Tsukuba, Japan

Rice-based cropping systems have dominated over the agricultural land use in East and Southeast Asia, which takes an important role in CO_2 uptake. We have been conducting a long-term observation of CO_2, H_2O and heat flux using eddy covariance method since January 2007 over a barley field in Japan. The objectives in our study are: (a) to quantify the seasonal variation of Net Ecosystem Exchange (NEE) over barley and irrigated rice field, and (b) to examine how environmental factors control carbon exchange processes.

The site is located at the reclaimed land in west Japan (34°32′N, 133°55′E, 2m a.s.l.). The barley was sowed on the bare soil at the late December 2006 and harvested at the late May 2007. CO_2 flux was measured with the eddy covariance system, which consisted of a sonic anemometer (DA-600, Kaijo) and an open-path infrared gas analyzer (LI-7500, LI-COR). The system was installed 1.8m above ground and sensors of the meteorological variables such as air temperature, photosynthetically active radiation were also installed. Sensible heat, latent heat and CO_2 fluxes were calculated half-hourly. Quality tests were applied in order to check the validity of the data and to eliminate wrong data. Missing and rejected fluxes caused by system failure or the quality check were filled with fluxes estimated by non-linear regression method. Gross Primary Production (GPP) and Ecosystem Respiration (RE) were estimated from absorbed photosynthetically active radiation and air temperature, respectively.

Figure 1 shows the seasonal change of GPP, RE, NEE at the site. The daily GPP increased with the growth of barley, and reached a maximum ($38gCO_2/m^2/d$) on 20 April, at the same time that LAI reached a maximum ($3.5m^2/m^2$). After the peak, GPP showed a steep decrease in the maturing stage. The daily RE increased gradually until the harvest, and reached $21gCO_2/m^2/d$ (27 May). The field was source of CO_2 for the first 20days of the growing period. The daily NEE turned negative (uptake) on 25 February, and then increased gradually until 12 April, when it reached the maximum CO_2 uptake of about $26gCO_2/m^2/d$. After that, NEE declined rapidly from its maximum due to decreased GPP and high level of RE, and the field returned to a source of CO_2 on 23 May, 7days prior to the harvest.

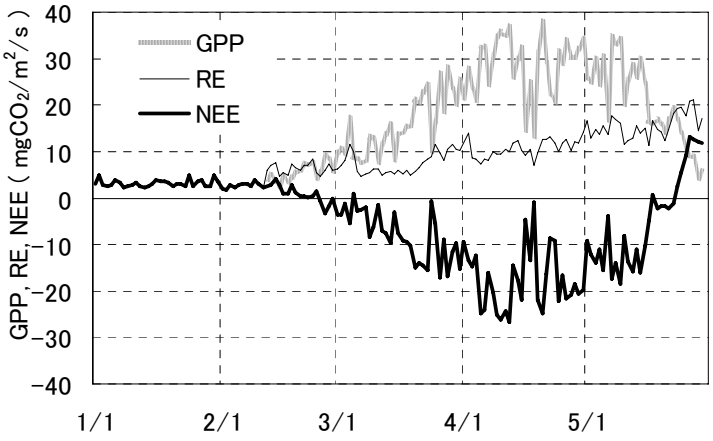


Fig.1. Seasonal changes of GPP, RE and NEE over a barley-field in western Japan

P43

INTERANNUAL VARIATION AND ENVIRONMENTAL REGULATION OF CO_2 FLUXES OVER GRASSLAND IN CHINA

Y. Fu [a], G. Yu [a], X. Sun [a], X. Zhao [b], P. Shi [a], Y. Hao [c], L. Zhang [a]

[a] *Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences*

[b] *Northwest Plateau Institute of Biology, Chinese Academy of Sciences*

[c] *The Graduate University of Chinese Academy of Sciences*

The Long-term measurement of CO_2, H_2O and heat fluxes across different biomes have greatly facilitated scientists to evaluate the spatio-temporal patterns of ecosystem carbon balance and to understand its response and adaptation to climate change. Based on eddy covariance flux measurements at three grassland sites from 2003 to 2005 in China, the seasonal and annual estimates of ecosystem CO_2 exchange and the mechanisms controlling CO_2 exchanges were compared among the three grasslands, with one semi-arid *Leymus chinensis* steppe in Inner Mongolia (NMG), an alpine shrub-meadow at Haibei (HB) and a steppe-meadow at Dangxiong (DX) on the Tibet Plateau.

Located in different eco-regions, there were significant differences in the climate, vegetation and soil characteristics among the three grassland sites. The net ecosystem CO_2 exchange (NEE) in the three grasslands showed large seasonal and interannual variation with the change of temperature, water availability and solar radiation. The alpine shrub-meadow and steppe-meadow on the Tibet Plateau mainly sequestrated carbon from June to September and emitted carbon during the rest period in each year; while the seasonality of NEE at NMG site showed distinct interannual variation with precipitation. The shrub-meadow at HB has larger photosynthetic production (F_{GEP}) than the alpine steppe-meadow at DX and the semi-arid steppe at NMG. With sufficient rainfall during growing season, the F_{GEP} of HB was mainly limited by temperature and radiation. The F_{GEP} at DX was limited to a relatively low level due to poor soil nutrient and vegetation growth, showing significantly positive correlation with soil and air moisture. The frequent moisture stress at NMG has strong effects on its F_{GEP} and ecosystem respiration (R_{eco}). The annual total R_{eco} followed the order in HB>NMG>DX. In semi-arid ecosystems steppe at NMG, soil moisture has significant effects on R_{eco} and its temperature sensitivity.

Comprehensive analysis shows that the *Leymus chinensis* steppe in this study were a net carbon source during the observing years, while the alpine shrub-meadow at HB are a net carbon sink. The steppe-meadow at DX was in carbon balance, turning into carbon source in dry years. The global change with global warming and changes in precipitation could have profound effects on temperate and alpine grasslands in China.

Keywords: Eddy covariance, grassland, net ecosystem CO_2 exchange, ecosystem respiration

P44

STUDY ON THE CHARACTERISTICS OF CO_2 CONTENT FROM EASTERN FOREST IN INNER MONGOLIA OF CHINA

Li-Xinghua[1] Han-fang[1] Zhang-Cunhou[1] Yang-zhongxia[2]

[1]*Inner Mongolia Ecological and Agricultural Meteorological Center Huhhot 010051, China;*

[2]*Inner Mongolia Aer Mountain Meteorological Bureau Huhhot 137800, China*

Abstract:

Using the LI-7500 opening type carbon dioxide/water analyze apparatus to investigate the law of CO_2 content from larch forest in east Inner Mongolia of China, Data analysis of three years measurement results suggested that CO_2 content had the obvious diurnal variation characteristic, the CO_2 content achieved furthest lowness around noon, the CO_2 content started to elevate gradually after the sunset, achieved to maximum the sunrise around; Seasonal variation is obvious about the CO_2 content, the summer is obviously lowest, which explained CO_2 absorbing effect was strong in east larch forest; The CO_2 content took on increasing tendency by year, and it was different to its change characteristic in the different year, there was positive correlation between seasonal CO_2 content and seasonal precipitation.

Cancelled

Key words: larch forest; CO_2 content; diurnal variation; seasonal variation;

P45

SENSIBLE HEAT FLUX OVER A SUBURBAN CANYON

Bor-Ru Chen and Cheng-I Hsieh

Department of Bioenvironmental Systems Engineering, National Taiwan University, Taipei 10617, TAIWAN.
hsieh@ntu.edu.tw

Cancelled

Abstract

Sensible heat flux is a key parameter controlling the micrometeorology of the urban and suburban areas. This study presented field measurements and estimations of the sensible heat fluxes above a suburban street canyon. The experimental site is located in a street canyon with an aspect ratio (Height/Width) of 0.9 in Taichung, Taiwan. Wind speed, sensible heat flux, surface temperature, and net radiation were measured within and above the street canyon.

By knowing the aspect ratio of the street canyon and the partition of recirculation region, a one-dimensional vertical flux model was adopted for estimating sensible heat fluxes from the urban street canyon. The estimated sensible heat fluxes were in good agreement with the measured ones while the wind speeds were above a threshold (~2.5 m/s). And the measurements showed the sensible heat fluxes within the street canyon were mostly smaller than those above the street canyon.

Keywords: urban street canyon, sensible heat flux, recirculation

P46

Air-sea flux observation at northern coast of the South China Sea

Huang Jian, Liang Jian-yin, Wan Qi-lin, Yi Yan-ming, Huang Hui-jun, Mao Wei-kang

Institute of Tropical and Marine Meteorology of Guangzhou, CMA, Guangzhou, China

Lv Wei-hua, Yang Yong-quan

Maoming Meteorology Administrative, Maoming, China

"Air-land-sea interaction field experiment at northern coast of the South China Sea" program is sponsored by Institute of Tropical and marine meteorology of Guangzhou, with support of China Meteorology Administrative(CMA), and the Ministry of Science and Technology of the People's Republic China. The scientific objective of this program include ⑴To obtain direct measurements of fluxes of momentum, heat and mass across the land-air and air-sea interface at different oceanic and synoptic conditions;⑵To improve physical understanding and forecast of coast heavy rain by identifying land-air and air-sea transfer and its influence on local land and sea circulation;⑶To improve basic physical understanding and forecasts of tropical cyclone track and intensity variations on the offshore of coast of the South China Sea;⑷To develop a new flux parameterization be suitable for numerical forecast of the South China Sea, especially for the northern coast area. A brief introduction about this experiment is presented here. Pilot experiment begins at early march and continues to the end of 2007. The program is conducted by four on shore stations along northern coast of the South China Sea. The observations include in situ investigations of ocean-atmospheric turbulence and mean flow from fixed towers, remote sensing of structure of the boundary layers, radiation flux and sea surface wave measurements. Nowadays, investigations focus on the impact of land and ocean processes on coast heavy rains. In our observation scheme, all infrastructures of this experiment are designed to provide continuous long term observations for climate studies. At the end of 2007, an air-sea interaction observation tower, about six kilometers from shore, will be situated over sea. And two air-sea flux observation stations located at north and middle of the South China Sea will be completed in 2008 to investigate offshore ocean processes.

P47

AN AUTOMATED CHAMBER NETWORK FOR LONG-TERM MEASUREMENT OF SOIL CO_2 EFFLUX

Naishen Liang[1], Seong-Deog Kim[2], Koh Shimoyama[1], Yongwon Kim[3], Takashi Hirano[4], Kentaro Takagi[4], Yasumi Fujinuma[1]

[1]CGER, National Institute for Environmental Studies, Japan; [2]Chungnam National University, Korea; [3]IARC, University of Alaska Fairbanks, USA; [4]Hokkaido University, Japan

Regional networks for measuring carbon sequestration or loss by terrestrial ecosystems on a year round basis have been in operation since the mid-1990s. However, continuous measurements of soil CO_2 efflux, the largest component of ecosystem respiration have only been reported over similar time scales at a few of the sites. Reasons include the lack of automated measurement systems that are commercially available, and the need for frequent servicing to ensure accurate measurements. We have developed a multichannel automated chamber system that can be used for continuous measuring soil CO_2 efflux during snow-free seasons. We installed the chamber systems in boreal forest in Alaska, tundra in west Siberia, cool-temperate and temperate forests in Japan and Korea, tropical seasonal forest in Thailand, and tropical rainforest in Malaysia. Annual soil CO_2 effluxes were estimated to be about 5-6 tC ha^{-1} y^{-1} in the boreal and cool-temperate forests, 10 tC ha^{-1} y^{-1} in the temperate forests, and 30 tC ha^{-1} y^{-1} in the tropical rainforests. Efflux showed significant seasonality in the boreal and temperate forest that corresponding with the seasonal soil temperature. However, the wavelike efflux rates in the tropical forests were correlated with the seasonality of soil moisture. Soil CO_2 efflux of forest ecosystems showed large spatial variation and was correlated with vegetation type and the chamber size.

P48

SOIL RESPIRATION OF PINUS DENSIFLORA WITH THREE STAND DENSITIES IN CENTRAL KOREA

N.J. Noh[1], Y. Son[1], K.W. Seo[1], S.J. Heo[1], W.K. Lee[1], S.W. Bae[2], and C.S. Kim[3]

[1] Korea University, Seoul, Korea
[2] Korea Forest Research Institute,Pochon, Korea
[3] Jinju National University, Jinju, Korea

Soil respiration of 45 to 65-year-old naturally regenerated *Pinus densiflora* growing on the similar site conditions was investigated from three different stand densities (high stand density-HD; 1,038 trees ha^{-1}, medium stand density-MD; 663 trees ha^{-1}, and low stand density-LD; 413 trees ha^{-1}) located in Gwangneung Experimental Forest near Seoul, Korea (Fig 1). Also soil temperature and soil water contents were measured from October, 2006 through July, 2007.

Fig 1. *Pinus densiflora* with different stand densities.

Soil respiration increased with soil temperature, however, there were no significant differences in mean soil respiration rates among stand densities. Mean soil water content was highest in LD (12.2%), followed by MD (10.5%) and HD (8.8%). Soil respiration rate (mg CO_2 m^{-2} hr^{-1}) showed an increasing trend during the early growing season and July had the highest soil respiration rate in all stands; 701.9 for HD, 843.4 for MD, and 933.1 for LD, respectively (Fig 2). From May through July, 2007, soil respiration for MD showed highest rates, however, there were no differences in mean soil respiration rates among stands during this period; 223.3 for HD, 314.2 for MD, and 287.3 for LD. And there were no significant differences in total soil respiration rates (t C ha^{-1} 9 $month^{-1}$) among stands during the study period; 4.5 for HD, 6.0 for MD, and 5.6 for LD.

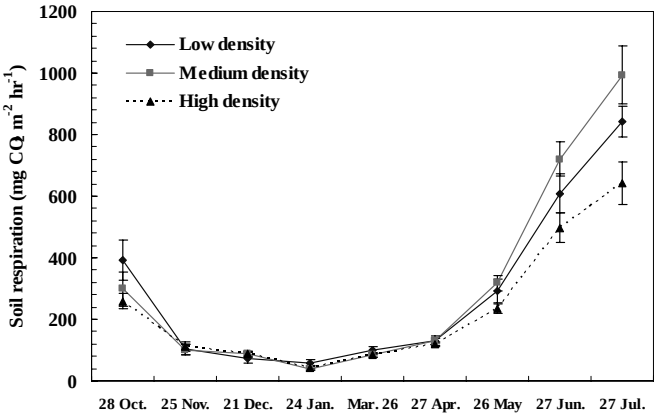


Fig 2. Soil respiration of *Pinus densiflora* with three stand densities.

P49

VARIATION IN FINE ROOT RESPIRATION WITH ROOT ARCHITECTURE

Naoki Makita*[1], Masako Dannoura[2], Yuji Kominami[3], Yasuhiro Hirano[3], Takeo Mizoguchi[3] and Yoichi Kanazawa[2].

[1] *Faculty of Agriculture, Kobe University, Kobe, Japan*

[2] *Graduate School of Agricultural Science, Kobe University, Kobe, Japan*

[3] *Kansai Research Center, Forestry and Forest Products Research Institute, Kyoto, Japan*

1. INTRODUCTION

Root respiration plays an important role in carbon cycling of forests and is a major source of soil CO_2 efflux. It is known that fine roots, defined usually as roots of <2 mm in diameter, have high productivity, and high respiration rate (Dannoura et al., 2006). We found that respiration rate of fine roots was not only remarkably high but also fluctuated widely. This is probably due to the arbitrary classification. It is suggested that the architecture of fine roots is directly related to their physiological and functional activity (Pregitzer et al., 2002). Thus, the objective of this study was to clarify the relationships between root respiration and root architecture of fine roots <2 mm diameter after more detailed classification.

2. SITE DESCRIPTION AND METHODS

The study site is located in Yamashiro, Kyoto (34°47'N, 135°51'E). The forest consists of deciduous broadleaved species (mainly *Quercus serrata*) and evergreen broadleaved species (mainly *Ilex. pedunculosa*).

We developed a portable system for measuring CO_2 flux from small sample using GMP343 (VAISALA, Finland; Fig.1). Measurement was conducted in the night of Aug. 1. Small intact segments of fine roots in *Q.serrata* were collected carefully and then their respiration rates were measured immediately in the field. Air temperature change was less than 1 ℃ during the measurement. After that, we brought the samples to the laboratory and measured their architecture (diameter, length, surface area, volume, number of root tips) with WinRHIZO Pro 2007a (Regent Instruments, Quebec, Canada).

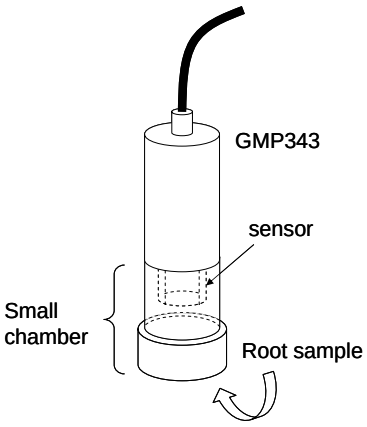


Fig.1 The static chamber system for measuring root respiration

3. RESULTS AND DISCUSSION

Root respiration of fine roots <0.5 mm was higher than that of larger roots (Fig.2a). A positive correlation was found between specific root area (SRA; $cm^2\ g^{-1}$) and the respiration rate (Fig.2b). Therefore, it is concluded that respiration from the roots having large SRA has a higher contribution to total root respiration. The analysis of root respiration connecting to its architecture is important for evaluation of the carbon cycle belowground.

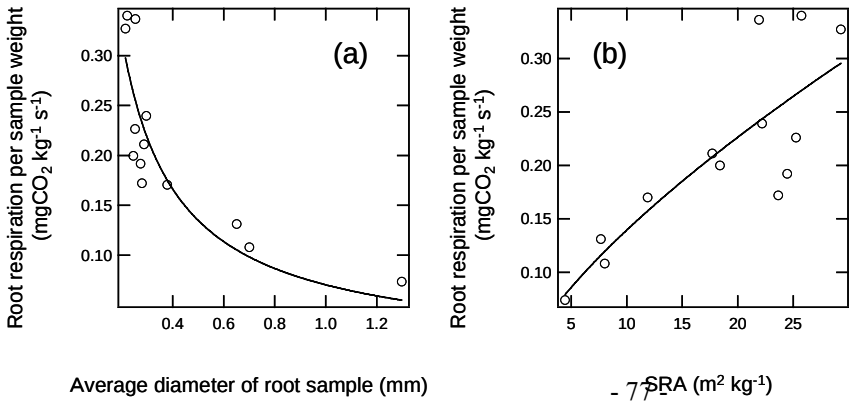


Fig.2
(a) Relationship between average diameter and respiration of fine roots
(b) Relationship between SRA and root respiration

P50

PARTITIONING OF WATER FLUX IN OIL PALM PLANTATIONS – SEASONAL VARIATIONS IN SAP FLOW UNDER IRRIGATED CONDITIONS

K.Suresh[1] and Ch. Nagamani

[1]National Research Centre for Oil Palm, Pedavegi, Andhra Pradesh, India

Oil Palm, which yields about 4-6 t oil per ha per year, has been introduced into India during the eighties under non-traditional environments to bridge the gap between the demand and supply of vegetable oil in the country. It is grown to an extent of about 80,000 ha and a national committee has proposed a potential of about 8.00 lakh ha. Considering the importance of the crop, there is a need to study its impact and its sustainability in the new environment. Water use is one of the important issues to be addressed in this regard. Water balance of oil palm plantations can be assessed if the total water flux measured by eddy covariance is partitioned into soil and under-storey evaporation and tree transpiration. Hence the measurement of tree transpiration is very much essential in this regard.

The sap flow was measured in a 9 year old oil palm plantation (Palode hybrid) grown on sandy clay soils at Pedavegi, Andhra Pradesh, India by heat dissipation method (Granier, 1985, 1987) using 20 mm long probes and connected to a data logger. The reference evapotranspiration were calculated from the Penman-Monteith equation using the standardized set of input parameters like air temperature, humidity, wind speed, net radiation taken from an automatic weather station (Delta-T, U.K.) installed nearer to the plantation. All the measurements along with sap flux were calculated as averages values for each hour.

Sap flux measurements in mature oil palm plantations were made continuously since January 2006 onwards. The diurnal variations in the sap flux indicated that the sap flux increased gradually from 9.00 AM reaching a peak during 1.00 to 2.00 A.M and then decreased thereafter as the day progressed. The parabolic trend was seen during all the days during all the months. The evapotranspiration and vapor pressure deficit also showed the same trend as that of the sap flux. This shows that the sap fluxes in oil palm plantations are closely associated with environmental variables like evapotranspiration and vapor pressure deficit. Seasonal variations in the sap flux indicated increased sap flux being recorded in the months of February and March. The decrease in sap flux during the dry months of May and June could be due to the closure of stomata after mid day as the atmospheric vapor pressure deficit increased.

The flux tower will be installed in the oil palm plantations at Pedavegi, Andhra Pradesh shortly. Then the transpiration data will be later processed together with the flux data obtained from eddy covariance.

Cancelled

CHANGE OF VEGETATION AND CARBON DYNAMICS IN A LARCH FOREST AFTER TYPHOON DAMAGE

T. Sano [1], T. Hirano[1], D. Kukita[1], S. Shirahama[1], N. Liang[2], H. Oguma[2], K. Inukai[2] and Y. Fujinuma[2]

[1] *Graduate School of Agriculture, Hokkaido University, Sapporo, Japan*
[2] *National Institute for Environmental Studies, Tsukuba, Japan*

Typhoon is an important disturbance factor for forest ecosystems in East Asia, which are damaged extensively and intensively. It is thought that the disturbance affects ecosystem factors including vegetation dynamics, soil organisms and micrometeorology, and consequently change carbon cycling of forest ecosystems. In particular, the function of forest ecosystems to fix carbon would be changed drastically by typhoon disturbance.

A plantation of Japanese larch (*Larix kaempferi* Sarg.) in Tomakomai, Hokkaido, Japan was destroyed by Typhoon Songda in September 2004. About 90 % trees were blown down by strong wind. In this study, we compare vegetation properties, biomass and net ecosystem exchange (NEE) before and after the typhoon damage.

Methods

The study site is Tomakomai Flux Research Site in Hokkaido, Japan (42˚44'N, 141˚31'E). Before the typhoon damage, this forest was a 45-year-old plantation of Japanese larch with some broad-leaved trees. The canopy height was 15 m and the maximum leaf area index (LAI) was 5.6 m^2 m^{-2}. After the typhoon, all stems of larch trees were removed from the forest floor for commercial use, whereas stumps and branches were left.

Vegetation properties (species, aboveground biomass and LAI) were measured monthly from July through December in 2006 after the typhoon. Vegetation was harvested from 10 quadrats of 1 m^2 every month. Similar data of understory species in 2001 were used for comparison.

NEE was continuously measured using a multichannel automated chamber system from June through November in 2006. The system comprised 6 chambers and an infrared CO_2 analyzer (LI-820, LI-COR). The chambers were made of clear PVC and cubic (0.9 m × 0.9 m × 0.9 m) in shape. All chambers were set on the ground including vegetation to measure NEE. Ecosystem respiration (RE) in the daytime was estimated from soil temperature at 0.01 m depth using an empirical model derived from nighttime NEE. Gross primary production (GPP) was calculated as the difference between RE and NEE (GPP = RE - NEE).

Results and Discussion

Dominant understory or invading species was pteridophyte (e.g. buckler fern) in 2001 before the typhoon damage, but was red raspberry (*Rubus idaeus*) in 2006. Live aboveground biomass was 2.7 ton ha^{-1}, which excludes trees, in 2001 and 3.6 ton ha^{-1} in 2006. It was larger after the typhoon damage than before that.

Maximum NEE, RE and GPP during the measurement period in 2006 was 1.9, 6.2, 4.6 μmol m^{-2} s^{-1}, respectively (Fig.1). Seasonal variation in RE was strongly related to soil temperature variation, and the decrease of GPP in the fall season was caused by decresing LAI of red raspberry. Cumulative NEE for about 5 months between June and November was 130 gC m^{-2}, whereas it was -313 gC m^{-2} in 2001 before the typhoon damage. This clear change of NEE indicates that ecosystem changed from carbon sink to source by the typhoon damage.

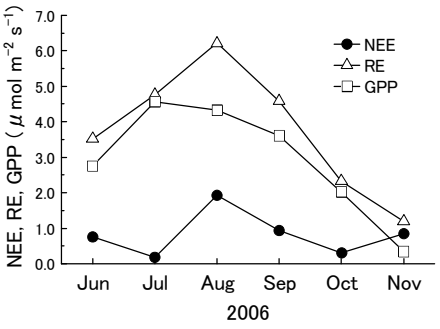


Fig.1 Seasonal variation in monthly means of NEE, RE and GPP in 2006.

P52

CARBON CYCLE AND GRAZING EFFECT OF STEPPE ECOSYSTEM IN CENTRAL MONGOLIA

Sheng-Gong Li

Institute of Geographic Sciences & Natural Resources Research, Chinese Academy of Sciences, Beijing, P.R. China

cancelled

Steppe ecosystem composes most of Mongolian territory. Because of its vast area, the Mongolian steppe ecosystem likely plays a pronounced role in the global carbon and water cycles. Carbon and water exchanges of the steppe receive influences from both global change and anthropogenic activities. Overgrazing is one of the major reasons leading to steppe degradation and desertification, and potentially increased carbon emission in Mongolia. Therefore, it is important to have a better understanding of how grazing affects the carbon cycle of the Mongolian steppe ecosystem. This study reports seasonal and interseasonal variation of net ecosystem CO_2 exchange over a grazed steppe ecosystem in central Mongolia by means of the eddy covariance technique. Through a grazing removal experiment, this study also examines the structural and functional changes of the steppe 3-year after grazing exclusion.

P53

BLOCKING EFFECT TO THE SOIL MOISTURE EVAPORATION BECAUSE OF DRY SURFACE LAYER SPECIAL STRUCTURE

YongLi Wang[1] WenYi Yang[1] HuiLi Gong[2]

[1]The Inner Mongolia Autonomous Region Meteorological Bureau, Huhhot, China

[2]Capital Normal University, Beijing, China

Cancelled

There are many sand-land and deserts in north china, a large area of bare sand distribute in these regions, dry surface layer (DSL) always cover the bare sand. The soil evaporation rate is greatly reduced because the sand surface was covered by dry surface layer, soil moisture dissipation was inhibited effectively in sand-land and desert.

After a rainfall, with the dissipation of the surface water in bare sand, a dry surface layer is gradually formed. The dry surface layer has a very special structure, tight fine and loose coarse sand layers alternate from top to bottom, in a certain depth, the dry surface layer no longer downward, we call it composite layers structure. So some closed air cavity is formed in every coarse layer. This structure block the transmission of soil moisture, break the capillary effect of soil. The dry surface layer is deeper the inhibition to the soil moisture dissipation is more obvious. When the special structure of dry surface layer is corrupted, soil evaporation rate is increased greatly. The dry surface layer structure is more important than its depth in inhibition the dissipation of soil water.

P54

Water-use efficiency (WUE) of the ecosystem and canopy of mixed temperate forest under sufficient soil water supply

De-Xin GUAN, Ting-Ting SHI, Jia-Bing WU, An-Zhi WANG,
Chang-Jie JIN, Miao WANG, and Shi-Jie HAN

Institute of Applied Ecology, Chinese Academy of Sciences, Shenyang 110016, China,

Summary Exploring the characteristics of water use efficiency (*WUE*) of old forest is helpful to understand the mechanics of carbon and water exchange of forests. We conducted synthetic measurements, including eddy covariance (EC) monitoring above and under canopy, chamber method for soil efflux and photosynthesis of understory plants of the mixed temperate forest in Northeastern China during three growing seasons from 2003 to 2005, to calculate the half hourly and daily *WUE* at ecosystem and canopy scales. The soil water supply is sufficient during the experimental period. We calculated interval averages of both *WUE* and synchronous photosynthetically active radiation (*PAR*) or water vapor deficit (*VPD*) values to represent their relation. The results showed that (1) Half hourly *WUE* approached maximum value as *PAR* was around 500 to 600 at ecosystem and canopy scales. *WUE–PAR* relation fit empirical equation $WUE = (a + b\ PAR / (c + PAR)) \exp(-k\ PAR)$, in which parameter *a*, *b*, *c* and *k* varied with *VPD*. (2) *WUE* decreased in exponential function with *VPD* increasing. (3) Daily *WUE* was 7.09 to 7.46 mg g^{-1} and 13.9 to 16.45 mg g^{-1} for ecosystem and canopy respectively. (4) Both half hourly and daily *WUE* data of canopy were more scattered than those of ecosystem in the *WUE–PAR* and *WUE–VPD* relationship due to the uncertainty in canopy *WUE* calculation.

Keywords: water use efficiency, eddy covariance, photosynthetically active radiation, water vapor deficit, mixed temperate forest.

email: guan.dexin@hotmail.com, dxguan@iae.ac.cn
telephone number: +24+86 83970336
fax number: +24+86 83970300

Cancelled

P55

EVALUATIONS OF METHANE EMISSIONS AND GREENHOUSE EFFECT IN PADDY FIELD IN THE HILLY AREA OF THE CENTRAL SICHUAN BASIN OF CHINA

ABSTRACT

Y. Y. Wang[1] , B. Zhu[2] and C. S. Hu[1]

1 Center for Agricultural Resources, Institute of Genetics and Developmental Biology, Chinese Academy of Sciences, Shijiazhuang, China

2 Institute of Mountain Hazards and Environments, Chinese Academy of Sciences, Chengdu, China

Paddy rice cultivation is one of the largest sources (approximately 15–20% of the annual total) of atmospheric methane. This study was undertaken to monitor rice (*Oryza sativa L.*, duration 120–125 days) CH_4 emission and the greenhouse effect by changed N fertilizer quantity under straw addition practices in kharif (June–September) season in the hilly area of the central Sichuan basin of China. Effects of N fertilization on paddy field CH_4 emissions were conducted as N_0 (no N applied) and N_{150} (150 kg N·ha^{-1}) without straw addition and straw-N_{75} (75 kg N·ha^{-1}) and straw-N_{150} (150 kg N·ha^{-1}) at a rate of 10620 kg straw·ha^{-1}. The CH_4 emission was monitored for 105 days by closed chamber method, starting from the first day after rice transplanting.

The results showed: The maximum CH_4 emission peaks of the seasonal variation in N_0 and N_{150} emerged in the 99 days after rice transplanting, the values were 24.012 and 28.497 mg·m^{-2}·h^{-1} respectively. The maximum CH_4 emission peaks of the seasonal variation in straw-N_{75} and straw-N_{150} emerged in the 57 and 71 days after rice transplanting respectively, the values were 28.267 and 50.178 mg·m^{-2}·h^{-1} respectively. The seasonal CH_4 emission quantities of N_0, N_{150}, straw-N_{75} and straw-N_{150} were 291.100, 292.332, 505.729 and 553.598 kg·ha^{-1} respectively. Based on a century scale, the methane warm potential (MWP) of N_0, N_{150}, straw-N_{75} and straw-N_{150} were 6110.907, 6138.978, 10620.310 and 11625.560 kg CO_2 equivalent respectively. The environmental benefits were calculated based on a century scale, the results showed the MWP per yield of N_0, N_{150}, straw-N_{75} and straw-N_{150} were 1.209, 0.752, 2.015 and 1.929 kg CO_2 equivalent respectively. In the different level of N fertilization, the MWP per yield of N_{150} decreased 32.14% compared with that of N_0, the MWP per yield of straw-N_{150} decreased 4.74% compared with that of straw-N_{75}. At different N fertilization rates, the straw-N_{150} and the N_{150} had better production benefits than the others.

Key words: Paddy field, Methane emissions, Greenhouse effect, The hilly area of central Sichuan Basin

Contact: Dr. Yuying WANG, wangyuying@sjziam.ac.cn

Cancelled

P56

DIURNAL VARIATION OF ISOPRENE CONCENTRATION ABOVE YAMASHIRO EXPERIMENTAL FOREST, CENTRAL JAPAN

T. Miyama[1], M. Okumura[2], A. Tani[3], Y. Kominami[1], I. Hosoda[1], M. Dannoura[4] and S. Tohno[2]

[1] *Kansai Research Center, Forestry and Forest Products Research Institute, Kyoto, Japan*

[2] *Graduate School of Energy Science, Kyoto University, Kyoto, Japan*

[3] *Graduate School of Nutritional and Environmental Science, University of Shizuoka, Shizuoka, Japan*

[4] *Graduate School of Science and Technology, Kobe University, Kobe, Japan*

1. INTRODUCTION

Many kinds of trees emit biogenic volatile organic compound (BVOC) including organic atmospheric trace gases, i.e., isoprene, terpenes, alkenes, alcohols, esters, carbonyls and acids. Emission inventories show that isoprenoid is the most prominent compound of BVOC. The amount of carbon emitted by plants as isoprene (C_5H_8), the probably most substantial fraction of isoprenoid emission, accounts for up to 2% of NPP in most cases, but can reach higher values (15-50 %) under special conditions (Kesselmeier et al., 2002). The emission of BVOC contributes significantly to the reactive hydrocarbons and net carbon budget in the troposphere and greatly influences atmospheric chemistry through the region-wide formation of photochemical oxidants and the lifetime of methane. Thus, precise measurement of the BVOC flux of forests is strongly needed. Many of the recent studies on the emission of BVOC have focused on forests especially in Europe and the US. However, there have been very few studies on BVOC in Asia even though there are endemic BVOC emitters. *Quercus serrata Thunb.* (Japanese deciduous oak) is one of the isoprene emitters in Japan and it is the main tree species of the Yamashiro Experimental Forest (YEF). Thus, we preliminarily measured the diurnal variation of isoprene concentration above the YEF.

2. SITE DESCRIPTION AND METHODS

The YEF is located in a valley in Yamashiro, Kidugawa, Kyoto (34°47'N, 135°51'E), in a hilly, mountainous region of central Japan and at an elevation of about 220 m asl. The forest consists of deciduous broadleaved species (mainly *Q. serrata*) and evergreen broadleaved species (mainly *I. pedunculosa*). The diameter at breast height (DBH) of all trees has been measured in the YEF every 5 years (Goto et al., 2003). According to Goto's results, *Q. serrata* accounted for 27.5% of the total biomass in the YEF. The forest canopy height was about 10 m and the height of a micro-meteorological tower on the ridge was 25 m. In this study, the diurnal variation of concentration above the YEF was measured. The measurements were conducted between 0:00 a.m. on 27 May and 2:00 a.m. on 28 May. It was a sunny and windy day. Measurements were taken every 2 hours by an automated air sampler. Isoprene was trapped by adsorbents (Tenax 200 mg and Carbotrp 100 mg) packed into stainless steel tubes (Perkin-Elmer) for every 2 hours. Inlets of the automated air sampler were set at 25 m and 9.3 m height of the micro-meteorological tower. Ozone scrubbers (four layers of MnO_2-coated copper nets) were applied at the inlets. Samples were stored at <5°C until analysis. A GC-MS system (Shimazu QP5050A) was used to analyze isoprene of the samples subjected to two-stage thermal desorption (Perkin-Elmer ATD). The capillary column used was a SPB-5 (60 m × 0.25 mm, ID, 1 μm, Supelco Inc., Bellefonte, PA, USA).

3. RESULTS AND DISCUSSION

Isoprene concentration above the YEF showed a remarkable diurnal variation. Mixing ratios of isoprene both at 25 m and 9.3 m increased with an increase of PPFD and air temperature. The maximum concentration ratio of isoprene in ambient air was observed at noon. The nighttime concentration of isoprene was lower than the detection limit. The concentration of isoprene ranged from 0 to 0.99 ppb at 25 m and from 0 to 2.42 ppb at 9.3 m. Almost throughout the day time, isoprene concentration at 9.3 m (near the crown height of *Q. serrata*) was higher than that at 25 m. Concentrations of isoprene positively correlated with PPFD and air temperature. These results are consistent with the theory that the emission of biogenic isoprene is mainly controlled by leaf temperature and light intensity (Guenther et al., 1993). To better estimate the carbon budget at the YEF, we need to obtain critical information including the rate of isoprene emission and processes of transformation on *Q. serrata* leaf and degradation in ambient air above the YEF.

P57

MODIS-derived Shortwave and Net Radiation in South Korea

Hyun-Woo Kim[1], Keun-Chang Jang[1], Young-Ryel Ryu[2], Joon Kim[3], and Sin-Kyu Kang.[1]*

[1]Dept. Environmental Sciences, Kangwon National University, Chuncheon, Korea

[2]Dept. Environmental Science, Policy and Management, University of California, Berkeley, USA

[3]Dept. Atmospheric Sciences, Yonsei University, Seoul, Korea

Shortwave (SW, 0.3–3.0 μm) radiation is one of the key terms of the surface energy budget and is vitally important for climate studies and many applications such as agricultural meteorology and air–sea–ice interaction studies. In addition, the accurate monitoring of SW is a fundamental process in various meteorological and ecological studies including the estimation of gross primary production and evapotranspiration. Many methods have been developed, and recently the Moderate Resolution Imaging Spectroradiometer (MODIS) also offers an opportunity to improve regional monitoring of shortwave radiation. This study was carried out to validate MODIS-derived shortwave radiation estimates with those measured from 72 National Weather Stations (NWS) and to map the spatial patterns of root mean square errors between these data in South Korea. Input variables for estimating shortwave radiation were retrieved from various MODIS products. These data were successfully validated using ground measured data in the location of NWS in South Korea. The values of coefficient determination ranged from 0.77 to 0.85, but the regression patterns are different among locations due to several factors and arious analyses are being continued to clarify them. The results of this study will be used to estimate the seasonal and spatial variation of net radiation and evapotranspiration in near future.

Cancelled

P58

Local Scale Mapping Net Primary Production Using MODIS Satellite Data

Abd Wahid Rasib, Ab. Latif Ibrahim, A.P. Cracknell, Mohd Azahari Fandi and Wan Hazli Wan Kadir

Department of Remote Sensing
Faculty of Geoinformation Science and Engineering
Universiti Teknologi Malaysia, 81310, Skudai, Johor, MALAYSIA
wahid@fksg.utm.my

Abstract

Satellite data from Moderate Resolution Imaging Radiometer (MODIS) is currently being used to extract net primary production (NPP) at global scale. Over the years, small scale on-ground flux tower measurements using the eddy covariance method have been used to validate the global MODIS NPP at a number of test sites. However, until now MODIS satellite data have not been adequately tested to map local NPP despite the use of local field flux tower measurements for validation. This is due to the low spatial resolution (1 km x 1 km) of MODIS satellite data and the variability of NPP with locations. Thus, in this study, MODIS satellite data is attempts to map local scale NPP for Pasoh Forest Reserve in Malaysia. Micrometeorological approach is then used to map NPP from three years (2004, 2005 and 2006) of MODIS satellite data. The NPP map produced shows the patterns of estimated MODIS NPP values for Pasoh Forest Reserve.

Cancelled

P59

RETRIEVAL SURFACE AIR TEMPERATURE FORM MODIS ATMOSPHERIC PROFILE PRODUCTS

K. Jang, H. Kim, and S. Kang

Kangwon National University, Chuncheon, Republic of Korea

Air temperature is one of the most important physical variables describing terrestrial environmental conditions. Many scientists have developed methods to measure this variable accurately. Moderate Resolution Imaging Spectroradiometer (MODIS) senses throughout the earth nearly twice per day, which provides an opportunity to improve regional monitoring of air temperature. The wide spectral range (36 bands) and high spatial (250m, 500m, and 1000m) and temporal resolution of MODIS enable it to observe the earth's atmosphere and continuously monitor the atmospheric changes. This study aims to develop an algorithm to retrieve air temperature from MODIS atmosphere product, and to validate MODIS-driven air temperature data for clear days with those observed from 72 National Weather Stations (NWS) in Korea in 2006. In this study, we used air temperature produced from MODIS atmospheric profile products of AQUA satellite by using Environment for Visualizing Images (ENVI) software based on Interactive Data Language (IDL). Air temperature was extracted from valid lowest layer of atmospheric profile product including 20 levels. Our preliminary results indicated that MODIS-driven air temperature showed good agreement with ground-based observations. The root mean square error and r square values ranged from 2.71℃ to 7.98℃ and from 0.92 to 0.68, respectively. The regression patterns represented different for each location of NWS. In case of Inje (ID 41), disappearance of air temperature value in the 20th layer caused largest error (RMSE = 7.98℃). This error was related to difference between surface pressure measured by MODIS and surface pressure observed in NWS. MODIS-driven surface pressure underestimated in inland area and overestimated in costal area. In order to increase air temperature prediction and to correct the difference of surface pressure of each location, we are conducting additional analysis.

P60

SATELLITE-BASED LONG-TERM ESTIMATE OF CARBON/WATER FLUXES OVER AN OLD-GROWTH CHINESE TEMPERATE MIXED FOREST：2000-2006

S. Han[1], J. Zhang[1*], S. Song[1], G. Yu[2]

[1]Institute of Applied Ecology, Chinese Academy of Sciences, Shenyang, China
[2]Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China

Cancelled

Works from multi aspects including remote sensing, modeling and long-term measurements are needed to clarify the role of old-growth forests and to reduce the uncertainties in global carbon/water accounting. In this study, the enhanced vegetation index (EVI) and Land surface temperature (LST) derived from MODIS products were regressed directly against tower measured fluxes components to estimate the carbon and water fluxes over an old-growth Chinese temperate mixed forest ecosystem for year 2000 to 2006.

EVI was better correlated with GPP than RE and NEE. Although variation in respiration probably accounted for by variation in surface temperature rather than greenness, respiration by EVI was better than that by temperature probably for, in this ecosystem, plant respiration consumed about 60% of GPP. This old-growth forest ecosystem is carbon sink although there were significant inter-annual variations in fluxes components.

Eddy ET was regressed against EVI and LST. The model performed reasonably well compared with VPM-ET model and measurements.

*Correspondence: jhzhang@iae.ac.cn

P61

QUANTIFYING SPATIAL HETEROGENEITY OF UPWARD RADIATION COMPONENTS USING HIGH RESOLUTION SATELLITE IMAGERIES

S. Moon, J. Kim and D. Lee

Yonsei University, Seoul, Korea

The remote sensing observations of land surface properties are inevitably influenced by the landscape heterogeneity. In this paper, we introduce a geostatistical technique to provide a quantitative interpretation of landscape heterogeneity in terms of key land surface parameters. The study areas consist of the two KoFlux sites: (1) the Gwangneung site, covered with temperate mixed forests on a complex terrain, and (2) the Haenam site with mixed croplands on a relatively flat terrain. The semivariogram and fractal analyses were performed for both sites to characterize the spatial heterogeneity of two radiation parameters, i.e., land surface temperature (*LST*) and albedo. These parameters are the main factors affecting the reflected longwave and shortwave radiation components from the two study sites. We derived them from the high-resolution Landsat ETM+ satellite images collected on 23 Sep. 2001 and 14 Feb. 2002. The results of our analysis show that the characteristic scales of albedo was >1 km at the Gwangneung site and approximately 0.3 km at the Haenam site. For *LST*, the scale of heterogeneity was also >1 km at the Gwangneung site and >0.6 to 1.0 km at the Haenam site. At both sites, there was little change in the characteristic scales of the two parameters between the two different seasons.

Acknowledgements: This research was supported by grants (code: 1-8-3) from Sustainable Water Resources Research Center for 21st Century Frontier Research Program, the A3 Foresight Program of the Korea Science and Engineering Foundation, and BK21 Program of the Ministry of Education and Human Resources Development of Korea.

P62

A phenology model to predict spring onset of vegetation in Korea using MODIS leaf area index

So-hee Kim, Jung-jae Lee, Eun-kyung Kim, Sinkyu Kang*

Department of Environmental Science, Kangwon National University, Chuncheon 200-701. South Korea

It was reported that recent climate change observed from long-term meteorological observations has caused earlier spring onset of vegetation in Korea. The earlier spring onset of vegetation results in prolonged growing season, which affects plant productivity and respiration, soil organic matter dynamics, and interactions among different trophic levels in terrestrail foodweb. In this study, a phenology model to predict spring onset of vegetation was developed using moderate resolution imaging spectroradiometer (MODIS) landcover and leaf area index (LAI) together with climate data at 13 locations in South Korea from National Weather Stations. Data from 2004 to 2006 were utilized for the model development and the model was evaluated using data from 2001 to 2003. The model was divided into two steps to consider bud physiology: the first step is breaking of rest period described by chilling requirement (Cr) and the second step is overcoming quiescence period described by heating requirement. It requires daily maximum and minimum temperature as an input and calculates daily chill days. Accumulation of negative chill days (Cd) until reaching a chilling requirement and then accumulating positive anti-chill days (Ca). We hypothesized that dormancy starts October 1 and when the sum of Cr and accumulated Ca over zero, bud-burst appears. As model parameters, threshold temperature(Tc) and chilling requirement were determined by iterative cross-validation. The estimates of parameters were ranging from about -70 to -230 chill days for Cr in Tc 6℃. Chlling requirement shows significant correlation with daily maximum air temperature (r^2=0.8388). We were validated using three case of chilling requirement. First, the mean value for all sites. Second, the each estimating values for each sites. Third, the values calculated using daily maximum air tempaerature for each sites. The mean absolute error (MAE) between the predicted and MODIS based onset were 4.1, 2.7 and 1.9 days for three case, respectively. Calculated chilling requirement is more appropriate to predict onset. But we didn't identify correlation between MODIS onset and ground onset. So we need to more comparison with ground observation and MODIS onset.

P63

THE SPATIAL PATTERNS AND INTERANNUAL VARIATIONS OF HETEROTROPHIC RESPIRATION AND ITS ROLE IN REGIONAL CARBON BUDGET IN CHINA

B. Tao, K. R. Li, F. X. Gu, M. K. Cao[1]

[1] *The Institute of Geographic Sciences and Natural Resources, Chinese Academy Sciences, Beijing 100101China.*

Using a high resolution climate database and an improved processed-based model, we estimated the spatial patterns of Heterotrophic Respiration(HR) and its relationship with climate variations in China over the past twenty years on a 10-day-0.1°tempo-spatial resolution. The simulated HR was compared to the estimated soil respiration using a regression-based model Raith et al. developed (2002). Our estimated showed that the total HR fluctuated between 3.07 and 3.43 Pg C/yr, with an average of 3.20 Pg C/yr, increasing at 0.014 Pg C/yr2. The annual HR was positively correlated with temperature (R^2=0.56, P <0.01), so the highest and lowest HR occurred in years with the highest (1990, 1994 and 1998) and lowest temperatures (1983, 1989 and 1993), respectively. Except in Southeast China, HR is positively correlated with temperature across China, but its relationship with precipitation differed in different regions. In Southwest China (R^2=0.66, P <0.01), Central China, and South China (R^2=0.37, P <0.05), HR had a clear correlation to NPP. The higher HR increasing trend was found in Northeast China and North China. With the global warming, the capacity of carbon uptake in terrestrial ecosystem will undermine since the relatively weaker temperature dependence of NPP. But how the heterotrophic respiration responses to temperature variations (usually using Q_{10} value in most process-based models) still remain uncertainties.To many ecosystem models in which Q_{10} value was regarded as a constant, considering the decline in the temperature sensitivity of soil respiration or heterotrophic respiration with warming will avoid overestimating of heterotrophic respiration.

Keyword: Heterotrophic respiration, Carbon budget, climate change, China

Cancelled

P64

ESTIMATING PARAMETERS IN A SOIL ORGANIC MATTER MODEL BY MONTE CARLO SAMPLING: A CASE STUDY OF JAPANESE ARABLE SOIL

Jomura, M. [1], Yokozawa, M. [1], Yonemura, S. [1], and Iizumi, T.[1]
[1]National Institute for Agro-Environmental Sciences, Tsukuba, Japan

1. INTRODUCTION

There is about three times as much carbon in soils as in vegetation. The response of soil organic carbon (SOC) to global warming is one of the key uncertainties to predict global carbon cycling in the future. The temperature response of soil organic carbon is the subject of a continuing debate (Davidson & Janssens 2006). Soil incubation experiment showed whether Q_{10} of heterotrphic respiration changed according to the change in the ratio of labile and recalcitrant SOC to the total SOC (Fang et al. 2005, Knorr et al. 2005) and the results were in the both sides. Based on the kinetic theory, Arrhenius function shows that the temperature response has positive relationship to the activation energy, so recalcitrant material with high activation energy is thought to have high temperature response (Bossato & Agren, 1999) and that is supported by the data of field experiments (Fierer et al, 2005). Not only a prediction logically obtained but also field experimental data are important, thus experimental data is expected to show this relationship clearly. However, obtaining decomposition rate of soil organic carbon, especially recalcitrant, old carbon, is extremely difficult problem. This study proposed the method to determine the temperature response of SOC. We used the long-term SOC data for 9 and 14 years and management legacy in the two Japanese cropland arable soils and modified Roth-C model with the temperature dependency expressed by Q_{10} and estimated Q_{10} of four soil organic carbon compartments using Marcov Chain Monte Carlo method.

2. DATA AND METHODS

We used the two long-term experimental data obtained from a gray lowland soil and a brown lowland soil of Japanese non-volcanic upland. These data were obtained from the data of National soil inventory (Nakai and Kohara, 2003). These fields were managed without N and K input during the experimental period. Management legacies of these fields such as soil cover and monthly input of plant residues were also obtained. Soil carbon was measured using soil core sampling of a plough layer. We applied RothC model (Jenkinson & Coleman, 1994) to simulate the turnover of soil organic carbon. Q_{10} value was set for each SOC compartment (DPM, RPM, BIO, HUM) and Marcov Chain Monte Calro method was used to estimate the value in the way introduced by Xu et al. (2005).

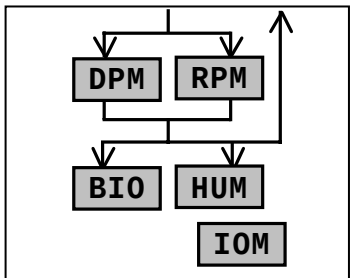


Fig. Scheme of Roth-C model

3. RESULTS AND DISCUSSION

After the initial spin-up, HUM was the largest compartment in the total SOC and next to it RPM and IOM were large and DPM and BIO were much little compartment to be less than 2% of the total SOC in the both sites. Posterior probability density functions (PPDF) of Q_{10} for DPM and BIO were poorly constrained. PPDF of Q_{10} for RPM showed moderately convex form but varied within the site. Only for PPFD of Q_{10} for HUM was mostly constrained and skewed to high Q_{10} value and had nearly 4 in both sites. Estimated mean Q_{10} was the middle of the given range for DPM and BIO because of having the form like a uniform distribution and the confidence interval (95 %) was almost the same as the given interval. On the other hand, mean Q_{10} values of RPM were 3.8 and 2.4 in Akita and Kumagaya, respectively and confidence interval (95%) was narrower than that of DPM and BIO. Mean Q_{10} of HUM were 4.2 and 3.7 in Akita and Kumagaya, respectively and the confidence intervals (95%) were 50 to 60% of the given interval, which were much narrower than the other compartments. The comparison between measured data and estimated data using mean value of Q_{10} showed a good reproducibility in the both sites. Moreover, simulation results using 1000 randomly selected parameters from the accepted values reproduced the variation in measured data and showed parameterization was well suited. This study concluded that MCMC technique was an effective method to determine the difference in temperature dependency among SOC compartments of Roth-C model using long-term data of SOC change.

REFERANCES: Davidson & Janssens Nature 2006; Fang et al. Nature 2005; Knorr et al. Nature 2005; Bossato & Agren Soil Biol. Biochem. 1999; Fierer et al. Ecology 2005; Nakai & Kohara Soil Sci Plant Nut. 2003; Jenkinson & Coleman Eur. J. Soil Sci. 1994; Xu et al. Glob. Biogeochem. Cyc. 2005

P65

Application of eco-hydrological model in multiple forested watersheds

Bo-Ra Lee[1], Eun-Sook Kim[2], Eun-young Jung[2], Tae-Hee Hwang[3], Sin-Kyu Kang[1*]

[1] Kangwon National University, ChunChon, South Korea

[2] Seoul National University, Seoul, South Korea

[3] The University of North Carolina, North Carolina, USA

** Corresponding Author Email: Kangsk@kangwon.ac.kr*

Interest in quantifying carbon and water flux over large geographical areas has increased in recent years. Many researchers are using various levels of observation and ecosystem models to estimate carbon and water flux. In this study, we examined the flux of carbon and water by using the ecosystem model, Regional Hydro-Ecologic Simulation System RHESSys. Our specific purpose is to test suitability of parameterization determined in an well-designed experimental watershed (Gwangneung Research Watershed) for predict the carbon and water fluxes in other watershed (Gangseonry Watershed in Mt. Jumbong and Mt.Gyebang) characterized with different climate, topography, and vegetation structure. RHESSys uses Geographic Information System (GIS) layers as spatial inputs and daily meteorological data as temporal inputs. The model framework is designed to simulate water, carbon, and nitrogen processes including rain interception, evapotranspiration, infilitration, streamflow, photosynthesis, respiration, soil organic matter dynamics, nitrification, denitrification, etc. The reliability of model predictions were evaluated by using daily and yearly streamflow, soil water content (SWC), stem radial growth, and net primary product (NPP) from the two watersheds. The NPP was estimated with tree-ring data. In addition, we were predicted transpiration and compared sapflow data. The simulation results of the Gwangneung Watershed agreed well with field observations: the RHESSys reasonably predicted daily and yearly variations of streamflow, SWC, and stem radial growth. The identical parameters were applied to the Gangseonri Watershed in Mt. Jumbong. Simulation results of Gangseonry Watershed were a reasonably reproduced annual NPP and daily SWC except for March, 2005. In such of this results, It is able to apply to validation of Moderate Resolution Imaging Spectroradiometer(MODIS). Our initial effort for multi-watershed application of RHESSys showed promising results for broad-scale model application in Korea but further model tests on various watersheds needs for identifying causes of errors and more enhanced model predictions.

P69

INSTRUCTIONS FOR PREPARING ASIAFLUX WORKSHOP2007

Effects of precipitation and its intensity on latent and sensibleheat fluxes in a rainfed maize agroecosystem Abstract

Yijun Li[a,b], Guangsheng Zhou[a,c] Zhenzhu Xu[a]

[a] Key Laboratory of Vegetation and Environmental Change, Institute of Botany, the Chinese Academy of Sciences, Beijing 100093, China

[b] Graduate School of the Chinese Academy of Sciences, Beijing 100039, China

[c] Institute of Atmospheric Environment; China Meteorological Administration, Shenyang 110016, China

Cancelled

Water and heat exchanges were very important to water cycle and mass exchange in agroecosystem, especially in the growing season. Measurements of latent heat flux (LE) and sensible heat flux (H_s) were made with an eddy covariance system from Jun., 2004 to Sept, 2006 in a rainfed maize agroecosystem of northeast China. This paper analyzed diurnal and seasonal variations of LE and H_s, and their associations with precipitation. The diurnal variations of LE and H_s presented a converse "U" distribution, with their peak values at 12:30 ~ 13:30. The maximum LE was about 655 w•m^{-2} (at 13:00 Jul. 8, 2004), and the maximum H_s 369 w•m^{-2}(at 13:00 May.31, 2004). Seasonal variation of LE had the same course as its diurnal variation, whereas seasonal variation of H_s differed from its diurnal variation. Based on the analysis on relationship between precipitation and LE, we found precipitation had complicated effect on LE, due to the effects of others environmental factors. However, the effects of precipitation on LE would be decreased strongly under continuous few sunlit days before or after precipitation. In same precipitation intensity, LE and net radiation had very fine correlation, which was to say the effects of precipitation intensity on LE would be increased with enough net radiation, more stronger precipitation intensity and more many LE.

P73

UP-SCALING CARBON STORAGE DISTRIBUTION MAP OF *PINUS DENSIFLORA* STANDS FROM PLOT TO LANDSCAPE LEVEL USING GIS/RS

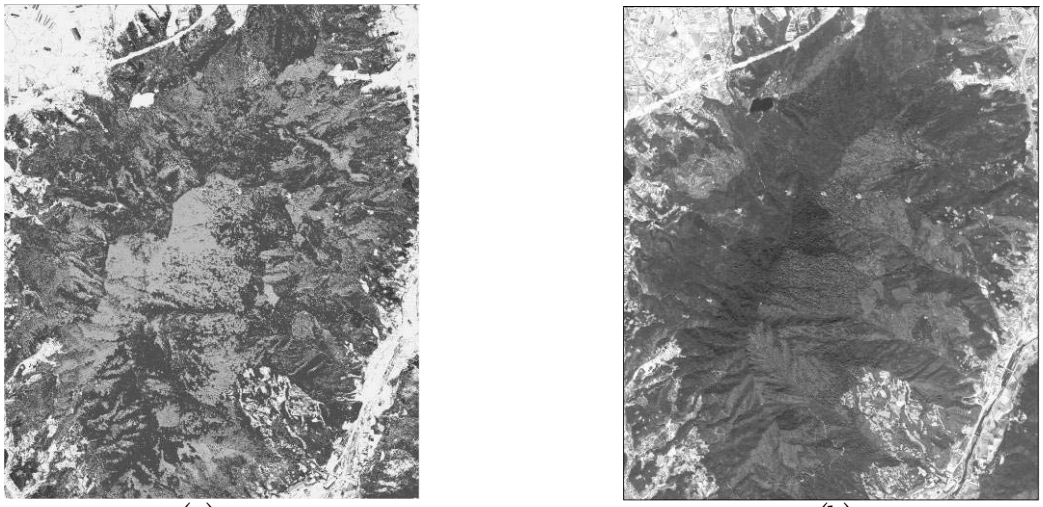
T.M. Kim[1], C.C. Song[1], W.K. Lee[1], Y. Son[1], S.W. Bae[2], and C.S. Kim[3]

[1] *Korea University, Seoul, Korea*
[2] *Korea Forest Research Institute,Pochon, Korea*
[3] *Jinju National University, Jinju, Korea*

This study suggested a process for up-scaling spatial distribution map of carbon storage in *Pinus densiflora* stands from plot to landscape level in Korea. Carbon storage in forest stands was divided into vegetation carbon storage (VCS) and soil carbon storage (SCS).

Through plot based experiment, it was proven that the VCS has close relationship with tree size and the SCS with tree age and stand density. Using these relationships of plot level experiment, estimation functions of VCS and SCS were derived with influencing factors of dbh (diameter of breast height), age, and density.

Current carbon storage distribution of *Pinus densiflora* stands in landscape and regional level could be estimated from spatial distribution map (Fig 1a) of *Pinus densiflora* stands which was prepared using high resolution satellite imagery of Quickbird (Fig 1b). A GIS based process model, in which dbh and stand density could be predicted by topological factors of slope, aspect, elevation and environmental factors of soil temperature and moisture, was incorporated to predict future carbon storage in *Pinus densiflora* stands.



(a) (b)

Fig 1 Spatial distribution of *Pinus densiflora* stands (a) classified from Quick imagery (b)

Index of Participants

AOKI, Masatoshi
Tokyo University of Agriculture and Technology
Japan
P05

ARUMUGAM, Alagesan
National Chung Hsing University
TAIWAN
P37

BRUNET, Yves
INRA
France
O15

CHANG, Shuenn-Chin
Taiwan

CHANG, Shih-Chieh
National Dong Hwa University
Taiwan
S03

CHEN, Shiping
The Chinese Academy of Sciences
China
O32, O55

CHEN, Yuan-Lung
Taiwan

CHEN, Bor-Ru
National Taiwan University
Taiwan
P45

CHEN, Yi-Ying
National Central University
Taiwan
P11

CHENG, Shih-Min
National Taiwan University

CHU, Hou-Sen
National Donghwa University
Taiwan
P09

DANNOURA, Masako
Kobe University
Japan
S04, **P06**, P49, P56

DEMETRIADES-SHAH, Tanvir
LI-COR Biosciences
USA
O14

FAIDI, Mohd Azahari
Universiti Teknologi Malaysia
Malaysia
O21, **O24**, P58

FANG, Chih-Yi
National Taiwan University
TAIWAN
P34

FU, Yuling
Chinese Academy of Sciences
China
O23, **P43**

FUJINUMA, Yasumi
National Institute for Environmental Studies
Japan
R01, O33, P07, P21, P23, P47, P51

GU, Fengxue
Chinese Academy of Agricultural Sciences
China
O12, **O43**, P10, P63

GUAN, De-Xin
Chinese Academy of Sciences
China
P54, P18

HAMOTANI, Ken
Osaka Prefecture University
Japan
O33

HAN, Shijie
Chinese Academy of Sciences
China
P18, P27, P54,**P60**

HE, Wenqing
Chinese Academy of Agricultural Sciences
China
O12

HIRANO, Takashi
Hokkaido University
Japan
R01, O51, **O54**, P47, P51

HIRATA, Ryuichi
National Institute for Environmental Studies
Japan
O51, P02, P25

HSIA, Yue-Joe
National Donghwa University
Taiwan
S03, **O02**, P09, P17, P34

HSIAO, Hsuan-Mei
National Taiwan University
TAIWAN

HSIEH, Cheng-I
National Taiwan University
Taiwan
O13, P13, P34, P45

HUANG, Jian
China Meteorological administration
China
P46

HUANG, Hui
Chinese Academy of Sciences
China
O41

HUANG, Cheng-Wei
National Taiwan University
Taiwan
P13

INUKAI, Koh
National Institute for Environmental Studies
Japan
P51

JANG, Keunchang
Kangwon National University
Korea
P59, P57

JIA, Qing Yu
China Meteorological administration
China

JIA, Zhijun
Chinese Academy of Sciences
China
O44, O53

JIA, Bingrui
Chinese Academy of Sciences
China

JOMURA, Mayuko
Natural Institute for Agro-Environmental Science
Japan
S04, P04, P06, **P64**

KANCHERLA, Suresh
National Research Centre for Oil Palm
India
P50

KANG, Sinkyu
Kangwon National University
Korea
S01, **O25**, P57, P59, P62, P65

KANG, Minseok
Yonsei University
Korea
P08, **P12**

KATOU, Soushi
JAPAN

KIM, Joon
Yonsei University
Korea
R01, S01, O25, P08, P12, P19, P28, P57, **P61**

KIM, So-Hee
kangwon national university
Korea
P62

KIM, Hyunwoo
Kangwon National University
Korea
P57, P59

KISHIMOTO, Ayaka (W. Mo)
National Institute for Agro-Environmental Sciences
Japan
P26

KOMINAMI, Yuji
Forestry and forest products research institute
Japan
S04, P03, P04, P06, P49, P56

KONDO, Hiroaki
National Institute of Advanced Industrial Science and Technology
JAPAN
O51, **P15**, P21, P26

LAI, Chun-Ta
San Diego State University
USA
O11

LEE, Woo-Kyun
Korea University
Korea
P73, P48

LEE, Dongho
Yonsei University
Korea
R01, **S01**, P12, P19, **P28**, P61

LEE, Bora
Kangwan National University
Korea
P65

LI, Shenggong
Chinese Academy of Sciences
P. R. China
O31, O51, **P52**

LI, Yingnian

LI, Yi-Jun
The Chinese Academy of Sciences
China
O57, **P69**

LI, Yueqing
China Meteorological Administration
P. R. China

LI, Yaohui

LI, Xing Hua
Inner Mongolia meteorological bureau
CHINA
P44

LI, Ming-Hsu
National Central University
Taiwan
P11, **P16**

LIANG, Naishen
National Institute for Environmental Studies (NIES)
Japan
P23, **P47**, P51

LIN, Guanghui
Chinese Academy of Sciences
China
O32, **O55**

LIU, Yunfen
Chinese Academy of Sciences
China
P31

LIU, Cheng-Chien
National Cheng Kung University
TAIWAN
O22

MAEDA, Takahisa
National Institute of Advanced Industrial Science and Technology (AIST)
Japan
P15, P21, **P30**

MAKITA, Naoki
Kobe University
Japan
P49

MANO, Masayoshi
National Institute for Agro-Environmental Sciences
Japan
P20, P38, P42

MEI, Xurong
Chinese Academy of Agricultural Sciences
China
O12

MISAWA, Noriko
Kobe University
Japan
P04

MIYAMA, Takafumi
Forestry and Forest Products Research Institute
Japan
S04, P03, P06, **P56**

MIYATA, Akira
National Institute for Agro-Environmental Sciences
Japan
R01, P20, **P38**, P42

MIZOGUCHI, Yasuko
Forestry and Forest Products Research Institute
Japan
P07

MUNKHTSETSEG, Erdenebayar
Institute of Meteorology and Hydrology
Mongolia
O56

NISHIMURA, Wataru
Osaka Prefecture University
Japan
O33

OHTANI, Yoshikazu
Forestry and Forest Products Research Institute
JAPAN
R01, O51, P03, P07

PAPALE, Dario
University of Tuscia
Italy
O51

PARK, Sungbin
Yonsei University
Korea
P08, P12

PHILIP, Elizabeth
Forest Research Institute Malaysia (FRIM)
Malaysia
R04

RASIB, Abd Wahid
Universiti Teknologi Malaysia
Malaysia
O21, O24, **P58**

SAIGUSA, Nobuko
National Institute of Advanced Industrial Science and Technology
Japan
R01, O51, P15, P21, **P25**, P30

SANO, Tomohito
Hokkaido University
Japan
P51

SHI, Ting-Ting
Chinese Academy of Sciences
China
P18

SON, Yowhan
Korea University
Korea
S01, P48

SONG, Qing-Hai
Chinese Academy of Sciences
China
S05, **P29**

SUN, Xiaomin
Chinese Academy of Sciences
China
S05, O42, P01, P31, P43

TAKAGI, Kentaro
Hokkaido University
Japan
O52, **P23**, P47

TAKAHASHI, Yoshiyuki
National Institute for Environmental Studies
Japan
P02

TAKANASHI, Satoru
Forestry and Forest Products Research Institute
Japan
P07, **P33**

TAKIMOTO, Takahiro
Okayama University
Japan
P42

TAMAI, Koji
Forestry & Forest Products Research Institute
Japan
S04, **P03**

TANI, Makoto
Kyoto University
Japan
R01, **S02**, O52, P33

TAO, Bo
Chinese Academy of Sciences
China
P63

THALER, Philippe
CIRAD
France-Thailand
P36

TRIPATHI, Sandeep
Indian Council of Forestry Research and Education (ICFRE),
INDIA
R03

TU, Chiaying
National Center for Typhoon and Flooding Research
Taiwan

WANG, Yunlong
The Chinese Academy of Sciences
P. R. China
O57, **P41**

WANG, Yuying
Chinese Academy of Sciences
P. R. China
P55

WANG, Huimin
Chinese Academy of Sciences
China
O52, **P21**, P31

WANG, Chunlin
Guangdong Climate Center
China
P24

WANG, Yong Li
Inner Mongolia meteorological bureau
CHINA
P53

WANG, Jyh-Ren
Taiwan

WEN, Xuefa
Chinese Academy of Sciences
China
O42, O43, **P01**, P31

WU, Chiuan-Fang
Taiwan

WU, Chao-Wei
National Chung Hsing University
Taiwan
P32, P37

WU, Chi-Chen
National Dong Hwa University
Taiwan
P17, P09

XU, Shixiao

YAMAMOTO, Susumu
Okayama University
Japan
O51, P21, P25, P42

YAN, Huimin
Chinese Academy of Sciences
China
O23

YAN, Changrong
Chinese Academy of Agricultural Sciences
China
O12

YANG, Wenyi
Inner Mongolia meteorological bureau
CHINA
P53

YOO, Jaeil
Yonsei University
Korea
P08, **P19**

YOSHIFUJI, Natsuko
The University of Tokyo
Japan
P35

YU, Wen-Ying
China Meteorological Administration (Shenyang)
China
P40

YU, Guirui
Chinese Academy of Sciences
China
S05, O23, O31, O41, O43, P01, P10, P24, P27, P31, P43, P60

YUAN, Yi-Fu
National Central University
Taiwan
P16

YUTA, Satoko
National Institute for Environmental Studies
Japan

ZHANG, Yi-Ping
China
S05, P29

ZHANG, Junhui
Chinese Academy of Sciences
China
P27, P60

ZHANG, Yan
Chinese Academy of Sciences
China

ZHANG, Li
Chinese Academy of Sciences
China
P10, P43

ZHANG, Yuandong
Chinese Academy of Forestry
PR China

ZHAO, Xiaosong
Chinese Academy of Sciences
China
O53

ZHAO, Liang

ZHAO, Feng-Hua
Chinese Academy of Sciences
China
O31

ZHAO, Xinquan
Chinese Academy of Sciences
China
P43

ZHOU, Huakun

ZHOU, Yanlian
Chinese Academy of Sciences
China

ZHOU, Li
the Chinese Academy of Sciences
P. R. China
O57, **P39**

ZHOU, Guangsheng
The Chinese Academy of Sciences
China
O57, P39, P40, P41, P69

E&E GROUP

JAUNTERING INTERNATIONAL CORPORATION

Head Office：4F, 145, Se Wei Road, Wu Gu, Taipei Hsien, Taiwan
Tel：886-2-8981-9090 (5 Lines)　　Fax：886-2-8981-8383
http://www.jaunter.com.tw　　e-mail: jaunter@tpts5.seed.net.tw

Jauntering International Corp. has involved in meteorological & hydrological monitoring fields for around 20 years. Up to now, Jauntering International Corp. has supplied and installed more than 2,500 complete sets of monitoring stations and accessories locally in Taiwan and other region or countries including China, Hong Kong, Vietnam, Thailand, Chile, Japan, Mongolia, Indonesia, Sri Lanka, India, Venezuela, Portugal, Singapore, Malaysia, Korea, Turkey, New Zealand ..., etc.











Jauntering International Corp. manufactures and supplies complete set of meteorological and hydrological monitoring systems including meteorological sensors – wind speed, wind direction, temp., humidity, barometric pressure, solar radiation, albedometer, pyrgeometer, net pyrgeometer, quantum sensor, net radiometer, UVA, UVB, Red/Far red, evaporation gauge, leaf wetness, soil moisture, soil temp., surface temp., heat flux plate, rain gauge, visibility, and hydrological sensors – pressure transducer for water level and ultrasonic sensor for water level or snow depth, etc. Besides, our low power consumption and low cost data acquisition system series can be used for users' requirement at places where have or haven't AC power source on sites for long term monitoring purposes.

E&E GROUP

JAUNTERING INTERNATIONAL CORPORATION

Head Office：4F, 145, Se Wei Road, Wu Gu, Taipei Hsien, Taiwan
Tel：886-2-8981-9090 (5 Lines)　　Fax：886-2-8981-8383
http://www.jaunter.com.tw　　e-mail: jaunter@tpts5.seed.net.tw

Data Acquisition System & Sensor Series:

Data Acquisition System

Wind Sensors

Temp./RH Sensors

Barometric Pressure Sensor

Pyranometer/Quantum/Net Radiometer/Pyrgeometer Sensors

Red/Far Red/UVA/UVB Sensors

Soil Heat Flux Plates

Temp./Leaf Wetness Sensors

Rain Gauges

Water Level Sensors

Soil Moisture Sensor

Solar Panels

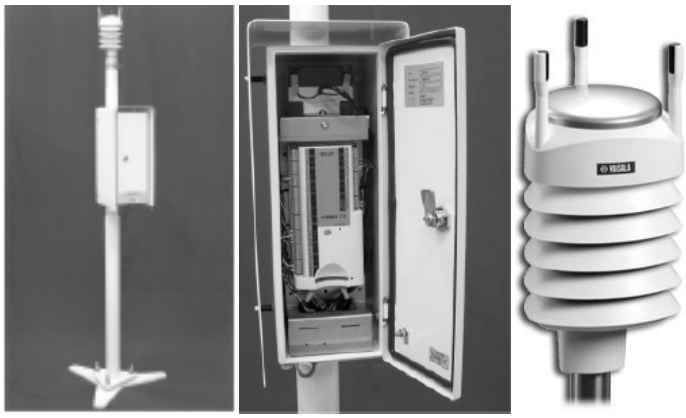
Other Sensors

Vaisala CARBOCAP® Carbon Dioxide Probe

GMP343

- ✓ Vaisala CARBOCAP® Sensor, a silicon-based non-dispersive infrared (NDIR) sensor
- ✓ Excellent accuracy （± 2.5 % of reading ）and Long term stability （< ±2% of reading / year ）
- ✓ A single-beam, dual-wavelength CO2 measurement with no moving parts
- ✓ Compensation options for temperature, pressure, humidity and oxygen
- ✓ Low power consumption （with heating max. 3.5 W/ 10…36 VDC） and heat emission
- ✓ Designed for outdoor use with diffusion-aspirated probe eliminates sampling systems and errors related to pressure differences caused by pumps.
- ✓ Compact （180L X 50D）and lightweight（360 g）

- ➢ Combined with Vaisala MAWS System & WXT510 Weather Transmitter



VAISALA
Reliable.

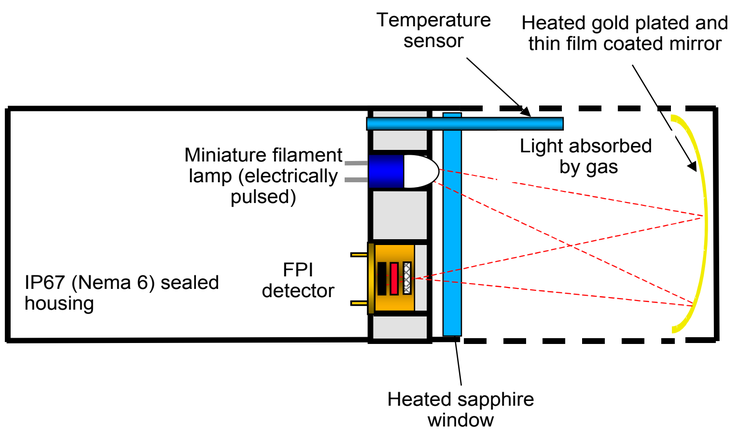
www.vaisala.com 翰昇環境科技**+886-2-29634300,www.esne.com.tw**

PERFORMANCE, APPLICATIONS AND FIELD EXPERIENCES OF A COMPACT CARBON DIOXIDE MEASUREMENT PROBE FOR OUTDOOR USE

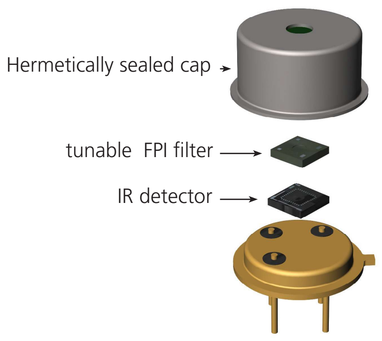
Matti Hohtola
Marko Jalonen
Mikko Laakso
Ulla Mattila
Sebastian Schimmack
Maria Uusimaa
Vaisala Oyj

Vaisala CARBOCAP® technology

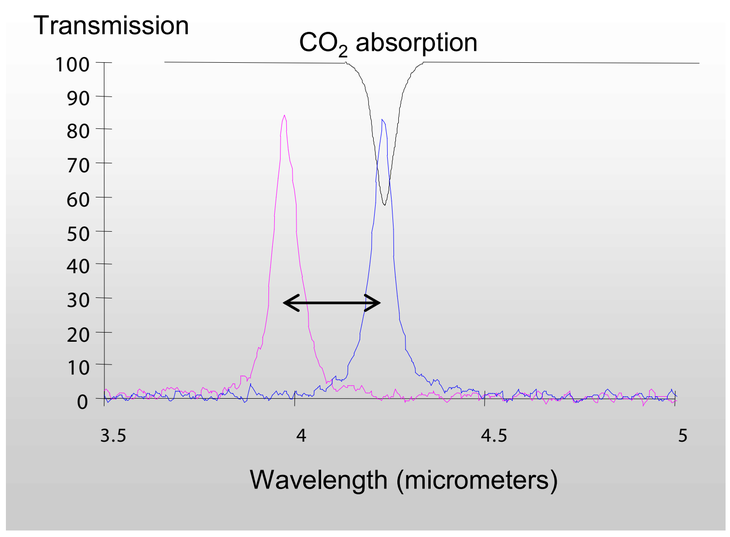
- Vaisala CARBOCAP® technology is based on the single-beam dual-wavelength NDIR principle
- An infrared (IR) light source emits a beam through the gas to be measured, which is absorbed by any existent CO_2 and the IR light passes through to the IR detector.
- Unique in the Vaisala CARBOCAP® is the use of a siliconed micro-machined Fabry-Perot Interferometer (FPI) to shift to a wavelength where no absorption occurs.
- Comparing the reference signal to the absorbed signal indicates the concentration level of CO_2 in the measured gas.



Structure of a Vaisala GMP343 CO_2 probe



Structure of the FPI detector



Measurement at CO_2 absorption wavelength and at a reference wavelength

Vaisala CARBOCAP® Carbon Dioxide Probe GMP343 for outdoor CO_2 measurement

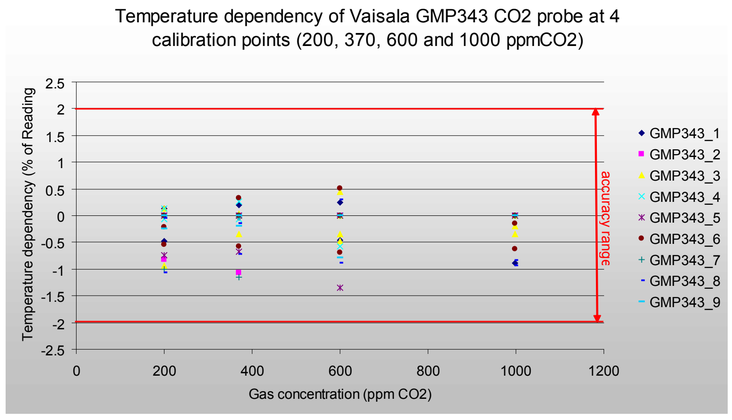
- Small and rugged probe for ecological measurement
- Diffusion-aspirated probe to avoid bulky and power-consuming sampling systems
- IP67/66 classified body – suitable for harsh environments

The Vaisala CARBOCAP® Carbon Dioxide Probe GMP343 Diffusion and Flow through probes

Calibration of the GMP343

- The Vaisala GMP343 probe is calibrated according to NMI (National Metrology Institute) and ISO9001 standards
- Each probe is calibrated at four different temperatures (-30, 0, +25 and +50°C) and seven CO_2 concentrations (0, 200, 370, 600, 1000, and 4000 ppmCO_2, 2% CO_2)
- NMI traceable calibration gases are used

Calibration station for the simultaneous calibration of 10 probes



The temperature dependency of nine GMP343 CO_2 probes at four different calibration points. Measurements were taken at temperatures of -30, 0, +25 and 50°C. The temperature accuracy of the GMP343 (in the 0...1000ppm range) is specified as being ± 2 % of readings.

Examples of GMP343 applications

Long term equilibrium sampling in soil, snow and aquatic ecosystem

Direct measurement of dissolved CO_2 in water

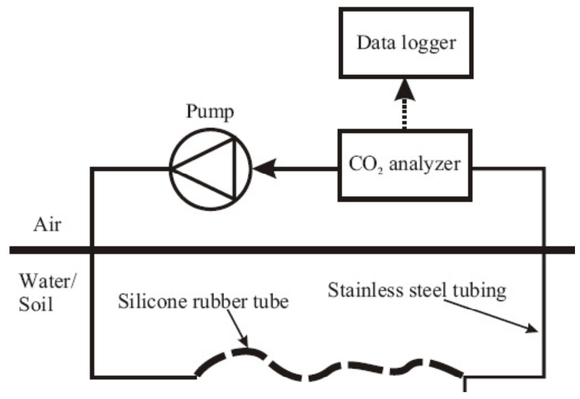
- Determine transfer of CO_2 between water and atmosphere
- Calculation of metabolic rates of aquatic communities

Direct measurement of CO_2 efflux in soil

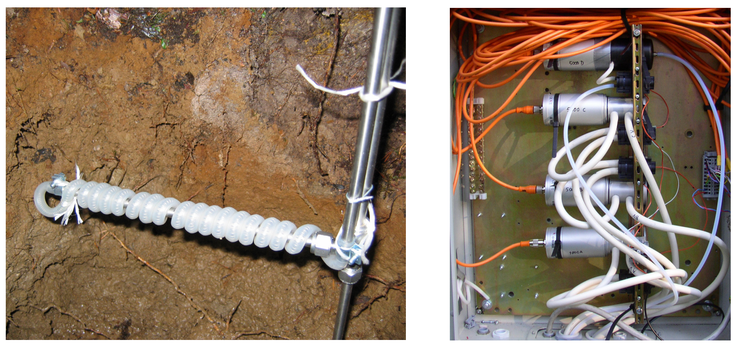
- Determine amount of CO_2 produced in different soil layers
- Investigate the transport of CO_2 between the different layers up to the atmosphere

Direct measurement of CO_2 in snow

- Determine the CO_2 diffusion rate at different depth of the continuous snow layer

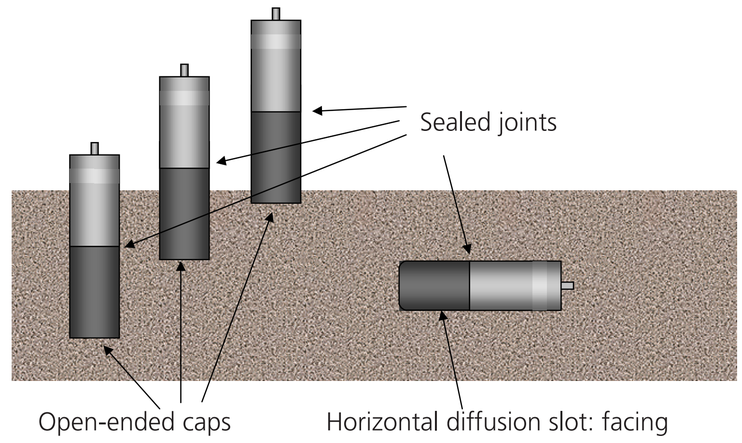


Schematic diagram of equilibrium sampling setup

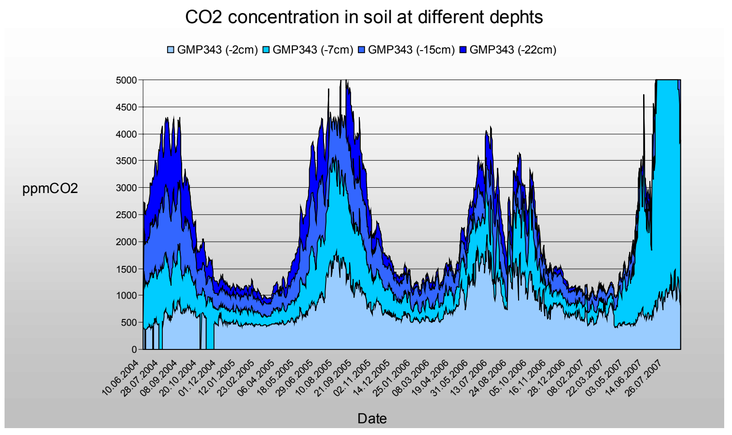


Equilibrium sampling system for soil installation

Direct in-soil measurement with buried GMP343 probe



An illustration of in-soil CO_2 measurement using the GMP343

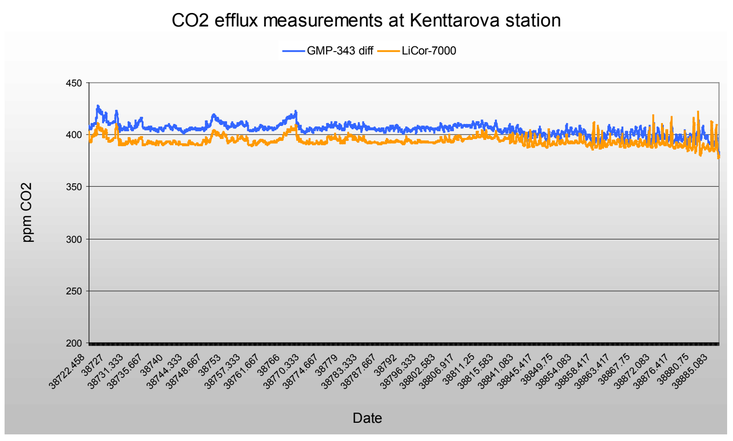


Three-year term of CO_2 measurement in soil at different depths

Long term atmospheric measurement with Vaisala GMP343 CO_2 probe at Kenttärova station

Kenttärova station is studying the carbon dioxide and energy fluxes in the atmosphere at a Norwegian spruce forest. Gas samples were taken at different heights on a 20m high measurement tower, and conveyed to a LiCor-7000 gas analyser inside a climate controlled building.

To achieve most accurate measurements the LiCor-7000 was calibrated against accredited calibration gases every 3 hours. Simultaneously measurements with the GMP343 diffusion aspirated CO_2 probe was installed outside at the tower. During the six-month term test the GMP343 readings correlated well with those of the LiCor-7000 reference.



Readings of a GMP343 and a LiCor-7000 reference during a six-month term test

Conclusions

The Vaisala CARBOCAP® Carbon Dioxide Probe GMP343 is a compact, lightweight and cost efficient CO_2 measurement instrument for ecological research.

Results from long term tests prove the usability of the probe in applications like CO_2 efflux measurement and medium accuracy atmospheric measurement.

Acknowledgements

- Prof. Pertti Hari and Dr. Jukka Pumpanen, Department of Forest Ecology, University of Helsinki
- Dr. Anne Ojala, M. Sc. Liisa Kulmala and M Sc. Jussi Huotari, Department of Ecological and Environmental Sciences, University of Helsinki
- M Sc. Juha Hatakka, Finnish Meteorological Institute - Climate and Global Change

VAISALA

www.vaisala.com

LI-COR®
Biosciences

Proven Research Technology

Leaf Area Index

LAI-2000 Plant Canopy Analyzer

- Fast, non-destructive LAI measurements
- Saves time and labor and provides on-site evaluation of LAI data
- Can be used for short or tall canopies (i.e. grass to forest); used for broad canopies (i.e. forest), small isolated canopies (i.e. individual trees) or row crop canopies
- Calculates foliage inclination angle and other relevant parameters
- Can be used under a variety of sky conditions, including full sun

Leaf Area Measurement

LI-3000C Area Meter

- Simple, fast and accurate
- Non-destructive measurements
- Can be used with detached leaves with optional conveyor accessory
- Lightweight
- 1 mm^2 resolution

LI-3100C Area Meter

- Measures area, length, maximum width, average width
- A single lens provides adjustable resolution of 0.1 or 1 mm^2
- High accuracy and repeatability, and fast, continuous operation for large quantities of samples with individual or cumulative area recorded

Radiation Measurements

Radiation Sensors

- LI-COR Quantum Sensors have set the standard for PAR measurements and are available as terrestrial (point and line), and underwater configurations. Pyranometers for global solar radiation in meteorological studies, and photometric sensors for illuminance measurements are also available.

Light Meters and Data Loggers

LI-250A Light Meter

- Hand-held, battery operated light meter that provides direct digital readouts from radiation sensors
- Designed for applications demanding performance, reliability and ruggedness
- Low power consumption allows more than 150 hours of continuous operation from a single 9-volt transistor battery.

LI-1400 DataLogger

- Simple operation and compact size
- Three external light sensor connectors allow fast setup with LI-COR radiation sensors
- Additional channels used to connect a wide range of sensors
- Channel setup is simplified by the use of *Log Routines*, eliminating entering of repetitive information
- Channel setup also includes choosing from a list of *Math Functions* that can be applied to sensor inputs

In addition to instruments for environmental and plant research, LI-COR® Biosciences is a leader in the design and manufacture of systems for biotechnology. Our biotechnology product line includes instruments, software and reagents for long read sequencing, microsatellites, AFLP®, band extractions and protein imaging for a variety of applications, from undergraduate training to drug discovery. To learn more, please contact us at www.licor.com.

LI-COR is a registered trademark of LI-COR, Inc.
AFLP is a registered trademark of Keygene, N.V. All other trademarks belong to their respective owners.
LI-COR is an ISO 9001 Registered Company.

科協儀器股份有限公司
KO HSIEH INSTRUMENTS CO.,LTD.

台北總公司	台北市忠孝東路一段 112 號 6 樓	TEL: (02)2393-4248
台中分公司	台中市三民路一段 125 之 2 號	TEL: (04)2371-5631
台南分公司	台南市崇學路 162 號	TEL: (06) 260-9022
高雄分公司	高雄市大同一路 195 號	TEL: (07) 241-2050

LI-COR®
Biosciences

Proven Research Technology

LI-COR® instruments provide *proven* solutions for a wide variety of environmental measurements, including:

- Photosynthesis
- Fluorescence
- Soil CO_2 Flux
- CO_2 and H_2O Analysis

Photosynthesis & Fluorescence

LI-6400 Portable Photosynthesis System

- Automatic CO_2, light, temperature and humidity control
- CO_2 and H_2O analyzers in the sensor he provide rapid response and eliminate tin delays
- User cleanable optical paths
- Real time graphic and numeric data
- Automatically generate response curves for CO_2 and light

6400-40 Leaf Chamber Fluorometer

- Easily connects to the LI-6400 sensor head
- Used for simultaneous gas exchange anc fluorescence measurements over the san leaf area
- Red and blue LEDs provide a uniform light field
- User-defined manual or automatic mea- surement protocols

Soil CO_2 Flux Measurements

LI-8100 Automated Soil CO_2 Flux System

- Continuous, unattended long-term mea- surements
- Fast, convenient, repeatable survey mea- surements
- Choice of 3 chambers: 20 cm long-term, 10 cm survey or 20 cm survey
- Designed to minimize perturbations witl in the chamber during measurements
- Measurements are made at or near ambi- ent CO_2 concentrations
- Uses an NDIR CO_2/H_2O gas analyzer

LI-8150 Multiplexer

- *Connect up to 16 long-term chambers*
- *30m (98.4 ft) diameter coverage*
- *Choose from 8 or 16 port configuration*
- *Easy connection to the LI-8100 Analyz Control Unit*

CO_2 and H_2O Gas Analyzers

LI-7500 Open Path CO_2/H_2O Analyzer

- Absolute, open-path, non-dispersive infrared gas analyzer with unprecedented speed and precision
- Performs simultaneous CO_2 and H_2O measurements and features programmable time delay for correlating data with other sensors
- Mounts easily to a cross arm or mast
- Low power consumption

LI-7000 CO_2/H_2O Analyzer

- High precision and sensitivity, closed path CO_2/H_2O analyzer
- User definable analog outputs updated 600 times per second
- Digital signal processing for lightning fast output, lower noise, and precise digital filtering
- User cleanable optical path
- No factory recalibration needed

LI-840 CO_2 /H_2O Gas Analyzer

- Measures CO_2 (0-3000 ppm) and H_2O (0-80 ppt) simultaneously
- High accuracy due to automatic tempera- ture and pressure compensation
- High stability with low zero and span drift
- CO_2 corrected for band broadening due to presence of water vapor
- User cleanable optical path

LI-820 CO_2 Gas Analyzer

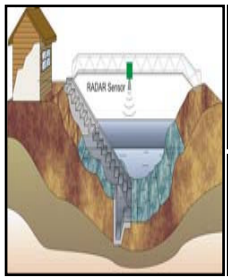
- Low cost, low maintenance CO_2 analyzer designed for continuous monitoring appli- cations
- Interchangeable optical benches, user cleanable
- CO_2 ranges to 20,000 ppm

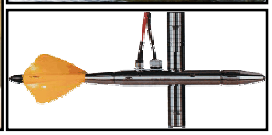
科協儀器股份有限公司
KO HSIEH INSTRUMENTS CO.,LTD.

台北總公司　台北市忠孝東路一段 112 號 6 樓　TEL: (02)2393-4248
台中分公司　台中市三民路一段 125 之 2 號　TEL: (04)2371-5631
台南分公司　台南市崇學路 162 號　TEL: (06) 260-9022
高雄分公司　高雄市大同一路 195 號　TEL: (07) 241-2050

防災監測系統整合・災害預警資訊傳輸

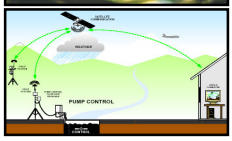
網址：http://www.allstar-stei.com.tw



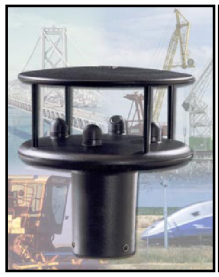


SEBA HYDROMETRIE 地表水/地下水監測系統



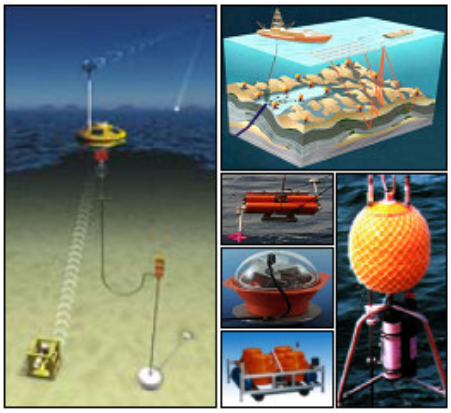


AUTOMATA, INC. 農業/氣象監測系統




GILL 超音波風速風向計

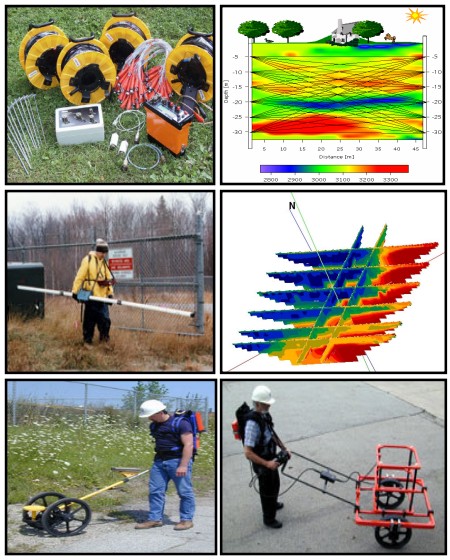
Fugro OCEANOR 海象/水文監測系統



InterOcean systems, inc. The Leader in Ocean Technology - Since 1946 海嘯/海底地震監測

2MD Scientific, Inc. 地震監測系統 eentec

MALÅ 透地雷達探測系統



ABEM 地球物理探測儀器

SARAD® 地球化學氣體觀測系統

營　業　項　目

- 各種基本量測儀器設備
- 地震/振動/噪音監測及試驗儀器
- 土木/結構/大地儀器安全監測儀器
- 土壤/岩石/水文/地質現地試驗及調查儀器
- 空氣/水/氣象/放射線/環境監測及分析儀器
- 海洋/海岸/港灣/河川監測調查及試驗儀器
- 太空/航空/軍事/能源/資源/調查及試驗儀器設備
- 各種天然及工程災害調查監測及檢測儀器
- 地上及地下結構物安全檢測及監測儀器
- 地球物理/地球化學探測儀器設備
- 各種實驗室儀器設備(土壤、岩石、地下水、材料)
- 資料擷取及自動化記錄系統
- 監測系統整合與無線傳輸系統
- 技術服務與顧問

SYSTEMS AS® INTEGRATION

智統科技工程股份有限公司
ALL-STAR TECHNOLOGY CORPORATION
TEL：(02)6600-0960 FAX：(02)2715-5673
TEL：(07) 725-9295 FAX：(07) 715-8388

台北：台北市松山區敦化北號307號11樓之2
E-MAIL：info@stei.com.tw
高雄：高雄市苓雅區四維一路128號
E-MAIL：ks@stei.com.tw

INNOVATIVE RADIOMETRY

Pyranometers
Albedometers
Pyrgeometers
UV-Radiometers
Net Radiometers
PAR Radiometers

LIGHT DETECTING AND RANGING

Typical applications include the study of atmospheric dynamics, aerosols, pollution development, cloud base, cloud properties and water vapour profiles.

OZONE & UV MEASUREMENT

Reference instrument for UV monitoring networks

Harmful UV radiation and analysis of Ozone column

Measures total column Ozone, SO_2 and NO_2

ENVIRONMENTAL MONITORING

Temperature profiling and aerosol measurements

Evapo-Transpiration systems

Sun-trackers

Dedicated Windows™ software programs

Kipp & Zonen
SINCE 1830

WWW.KIPPZONEN.COM

L E & D ER CO.,LTD.
利得儀器股份有限公司

□台北縣中和建一路 186 號 16 樓之三 TEL:(02)8227-2200
□台中市華美西街二段 311 號 3 樓之一 TEL:(04)2316-6997
□高雄市鼓山區中華一路 350 號 3 樓 TEL:(07)553-5181

CAMPBELL SCIENTIFIC, INC.®
WHEN MEASUREMENTS MATTER

Eddy Covariance Measure water vapor, carbon dioxide, heat flux

An Eddy Covariance Station measures CO_2, water vapor, or heat fluxes using the eddy covariance technique. A standard equipment set includes a CSAT3 Sonic Anemometer, a CR5000 Measurement and Control System, scalar sensors (CS7500 Open Path Infrared Gas Analyzer, FW05 fine-wire thermocouple, KH20 Krypton Hygrometer, and TGA100A Trace Gas Analyzer). Customers can add sensors to customize a system for their requirements. If the system will be solar powered, a 65 watt solar panel is the minimum required.

Features

- **Measures water vapor, carbon dioxide, and heat flux using Eddy Covariance techniques**
- **Key system components (each purchased separately):**
  - **CR5000 or CR1000 datalogger**
  - **CSAT3 Sonic Anemometer**
  - **CS7500 or KH20 Hygrometer**
  - **FW05 Fine Wire Thermocouples**
  - **TGA100A Trace Gas Analyzer**
- **Variables measured:**
  - **Wind and temperature via CSAT3**
  - **CO_2 and H_2O molar density via CS7500**
  - **Trace gas concentration via TGA100A**
  - **H_2O density via KH20**
  - **Temperature via fine wire thermocouple**

Taiwan Exclusive Representative

Sea-Land-Aero Industrial Corporation

3F., No.356, Fusing N. Rd.,Taipei 104, Taiwan, R.O.C

Tel: 886-2-2517-2700, Fax:886-2-2517-1358, e-mail: sealandaero@yahoo.com.tw

Environmental

Data Logger

dataTaker®

Intelligent Data Logging Products

Environmental Data Acquisition and Monitoring

Organisations, whether in the public or private sector, are becoming increasingly aware that the environmental impact of their operations has implications for the environment we all share. Environmental impact can take many different forms including energy usage, waste treatment and disposal, emissions and airborne pollutants, toxins, water quality and salinity, radiated and conducted emissions etc.

Environmental improvement programs need to be prepared that identify areas where improvements can be made. The programs require costing and clearly specified expected outcomes from implementation this could be a combination of environment impact and efficiency improvements in areas such as material and energy usage.

Organisations implementing environmental improvement programs need to monitor performance. Environmental data acquisition and monitoring using a data logger provide the means to monitor almost every aspect of an organisation's performance.

Designed and manufactured in Australia the new *dataTaker DT80* data logger has been designed specifically for the environmental monitoring project.

***DT80* data logger**

Versatile Measurement

Analog and digital channels, high-speed counter inputs, phase encoders inputs and programmable serial sensor channels allow the *DT80* to easily connect to most sensors and data measurement sources. Temperature, voltage, current, 4-20mA loops, resistance, bridges, strain gauges, frequency, digital, serial and calculated measurements can all be scaled, logged and returned in engineering units or within statistical reporting. Group sampling, logging, alarm and control tasks within schedules to suit your requirements. Smart sensors, GPS, PLCs and other intelligent devices are supported via 2 serial sensor ports (RS232 or RS422/485), with our optional *CANgate* interface available for CAN bus applications.

Environmental applications monitoring:

- Weather and rainfall trends
- River height and flows
- Air quality and pollution levels
- Radiated and conducted emissions
- Salinity
- Water quality
- Waste treatment
- Energy efficiency

Superior Data Storage and Communications

Store up to **5 million** data points in user defined memory, log as much or as little as you need with independent control of schedule size and mode. Overwrite or stop logging once allocated memory is full. Archive data on alarm event, copy to USB memory or transfer via FTP, the choice is yours.

Communications features include RS232 with modem support, USB, Ethernet and USB memory stick ports. Connect to the *DT80* locally, remotely or over the Internet. The web server allows browser access to data and files, FTP provides data to your office over the internet or mobile phone network, without the need for polling or specific host software.

Monitor the performance of your organisations environmental improvements programs by using the *datataker DT80* data logger.

Contact your local distributor or Datataker office.

FREE
Software & Technical Support

Australasia
Datataker Pty Ltd
7 Seismic Court
Rowville Melbourne
Victoria 3178
Tel: +61 3 9764 8600
Fax: +61 3 9764 8997
Email: sales@datataker.com.au

Distributor
SHINE INDUSTRIAL CO., LTD.
Suite 1, 2nd fl, No. 23, Sec. 1,
Hang Chou S. Rd. Taipei, Taiwan.
Tel: (02)2341-1131
Fax: (02)2321-8303
Email:sico@ms15.hinet.net

E-mail : sales2@weather.co.jp

Eddy Covariance Measurement System
C-SCT-SAT/7500

SAT & CO2/H2O Analyzer

Measurement Box

Solar Power Generation Unit

Summary

This system measures the Sensible Heat, H_2O and CO_2Flux using the eddy covariance method in our data-logger. The whole system do not require the AC power. If you choose this system, you can get the Sensible Heat, H_2O and CO_2 Flux anywhere.

Measurement Method

The measurement system both Raw 10Hz data, and calculated Flux data on the data-logger memory and Memory Card(ATA/CF card) in harsh conditions. The Flux calculation is basing on real-time each variance and covariance data, air density and specific heat at constant pressure.

Measurement Items (standard)

1. 3-axis wind component(Ux, Uy, Uz), Sonic Temperature (10Hz fluctuations)
2. CO_2, H_2O 10Hz fluctuation
3. Air Temperature and Relative Humidity
4. Short-wave and Long-wave Radiation component(4 types)
5. Air Pressure

System Customize

We prepare various kind of sensors.
For Example:
Wind Speed profile, Air Temperature & Relative Humidity profiles, Soil Heat Flux, Soil Water Content and Soil Temperature and Soil Respiration.

Contact us, and you will get the best measurement system!!

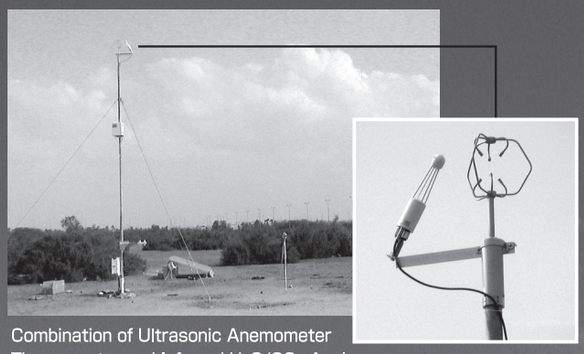
Tel +81-3-3988-6616
Fax +81-3-3988-6613
URL http://www.weather.co.jp/

Climatec

A4（210mm×297mm）

KAIJO

Flux〔Sensible heat・Latent heat・CO_2・Momentum flux〕Observation System



Combination of Ultrasonic Anemometer Thermometer and Infrared H_2O/CO_2 Analyzer

Features

Observation system to process Sensible heat flux, Latent heat and CO_2 flux, Momentum flux according to eddy correlation method with combination of Ultrasonic Anemometer and Infrared H_2O/CO_2 Analyzer.

3D Ultrasonic Anemometer

SAT series

More than 6000 units supplied to our customers.
Kaijo Sonic Ultrasonic Anemometer offers high product reliability and quality.

Ultrasonic Snow Level Gauge

SL-350

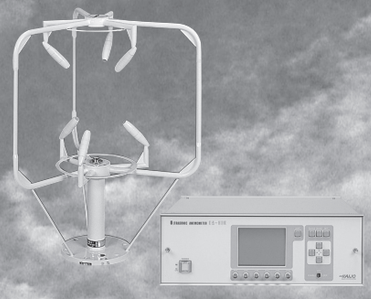
Kaijo Sonic Snow Level Gauge adopted by Japan Meteorological Agency and their observation system AMeDAS.

Doppler Sodar

AR/KPA series

Real time observation for wind direction and velocity in atmospheric boundary layer!

- Remote sensing device for easy portable observation.
- Continuous observation for instantaneous space distribution of wind direction, wind velocity, turbulence and temperature structure.



Ultrasonic Anemometer Thermometer

DA series

Observation for turbulence, heat balance and water balance・・・・
Wind observation for wind tunnel, building and bridge・・・・

- Measurement for 3 dimensional wind velocity components.
- Measurement for wind and temperature variability with high responsibility.
- Various shaped probes available（8 kinds）.

Meteorological observation system, Flux observation system, Ultrasonic snow level gauge
Ultrasonic anemometer for tunnel, Ultrasonic anemometer for clean room

KAIJO SONIC CORPORATION

Overseas Marketing & Sales Department, Marketing & Sales Division

5th floor, Shinkomusic Plaza Bldg., 2-1, Kanda-Ogawamachi, Chiyoda-Ku, Tokyo 101-0052 JAPAN
TEL.+81-3-3294-7615　　FAX.+81-3-3294-7630
E-mail:info-e@kaijosonic.co.jp　URL:www.kaijosonic.co.jp

GMP343 CO_2 Probe for Environmental Monitoring

The GMP343 is “Compact and light design”, “Simple setting” and “Low maintenance”. The GMP343 diffusion model dose not needs to draw air into the sample cell <No pump!> because the cell is set in the open air. Direct measurements minimize the risk of measurements being influenced by drawing the air including pressure change.

Performance

Sensor	Vaisala CARBOCAP®
Measuring principle	Single-Beam Dual-Wavelength NDIR
Measurement range options	0…1000ppm, 0…2000ppm, 0…3000ppm 0…4000ppm, 0…5000ppm (reduced accuracy >4000 ppm)
Accuracy	After factory calibration with 0.5 % gases ± 2.5 % of reading at the CO2 calibration points ± 1.5 % of reading
Body material and classifications	Anodized aluminum, IP66
Operating environment	Temperature 40…+60℃ Relative humidity 0…100%rh
Outputs	Analog outputs 4…20mA, 0…2.5V, 0…5V Digital outputs RS-232, RS-485
Operating voltage	10…36VDC
Dimensions	Length: 180 mm, Diameter: 55 mm Weight: 360g

WXT510 Weather Multi-Sensor

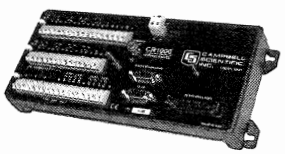
Integrates the six most essential weather parameters in one instrument: wind speed and direction, liquid precipitation, barometric pressure, temperature and relative humidity. Unique design with no moving parts makes it virtually maintenance free.

Technical Data

Wind Speed	Range : 0…60 m/s
Wind Direction	Azimuth: 0…360°
Barometric Pressure	Range : 600…1100 hPa
Air temperature	Range : -52…60 °C
Relative humidity	Range : 0…100 %rh
Rainfall - quantity	Surface area measured: 60 cm2
Rainfall-duration	counting each ten second increment whenever droplet detected
Rainfall-intensity	Range : 0 to 200 mm/h
Operating Voltage	5...30 VDC
Dimensions	Height: 240 mm, Diameter: 120 mm Weight: 620 g

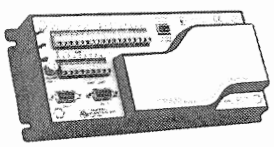
SANKO TSUSHO CO., LTD.
2-7-1 HAMAMATSUCHO, MINATO-KU, TOKYO
TEL:+81-3-5777-3627 FAX:+81-3-5777-3629
E-mail: sales@sankotsusho.co.jp URL: http://www.sankotsusho.co.jp

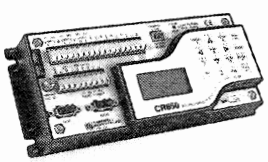
CR1000



- The CR1000 datalogger builds on the foundation of our CR10 and CR10X dataloggers.
- When used as part of a data acquisition system, the CR1000 datalogger provides the measurement and control functions.
- Designed for unattended network applications.
- 2M SRAM for data storage, program storage and CPU usage
- Memory upgrades available for 4 M SRAM
- Additional data storage using CFM100 Module with a CompactFlash® card.
- Programming: CRBasic

CR800 / CR850





- The CR800 datalogger is a smaller version of our CR1000 datalogger.
- When used as part of a data acquisition system, the CR800 datalogger provides the measurement and control functions.
- Designed for unattended network applications.
- Stores 2 Mbytes of data in FLASH memory.
- The CR850 includes an on-board keyboard display as part of its integrated package.
- Programming: CRBasic

		CR1000	CR800
Analog input		Differential 8	Differential 3
		Single End 16	Single End 6
A/D bits		13	13
Scan rate		100Hz	100Hz
Pulse counters		2	2
Switched volt,excitations		3	2
Contorol/deigital ports		8	4
Environmental temperature	normal	−25～+50℃	−25～+50℃
	XT	−55～+85℃	−55～+85℃
Size		23.9×10.2×6.1cm	24.1×10.4×5.1cm
Weight		1kg	0.7kg

CAMPBELL® SCIENTIFIC, INC.

Japan is Served By :

Taiyo Keiki Co. , Ltd.

TWC TOKYO

URL: http://www.taiyokeiki.co.jp/

E-Mail: campbell@taiyokeiki.co.jp

Urbane Bldg. Sakas 5,3-A 1-2-6

Yotsuya , Shinjuku ,Tokyo 160-0004 Japan

六合一氣象感測器
WXT510

- 測量範圍：
風速：0~60m/s
風向：0~360°
降雨：0~200mm/h
氣溫：-52~+60℃
濕度：0~100% RH
大氣壓力：600~1100hpa
降雨強度：一分鐘內以10秒記錄的平均值
- 輕巧易於安裝攜帶

戶外用二氧化碳感測器
GMP343

- 測量範圍：0~1000ppm/0~5000ppm
- 操作環境：-40~+60℃/0~100% RH
- 外殼材質：anodized aluminium
- 防護等級：IP66/IP67（耐候外殼）
- 可選擇擴散式或強制抽氣式
- 長期穩定性佳

氣象用溫溼度感測器
HMT337

- 測量範圍氣溫：-70~180℃
濕度：0~100% RH
- 操作環境：-40~+60℃/0~100% RH
- 外殼材質：G-AlSi 10Mg(DIN 1725)
- 防護等級：IP65（耐候外殼）
- 濕度感測元件具抗結露功能
- 附可追溯NIST校正報告
- 長期穩定性佳

幸託有限公司
www.xintop.com

PO.BOX：10399 台北郵局第21-128號信箱
TEL：02-2598-1199 FAX：02-2596-2331
E-mail：info@xintop.com