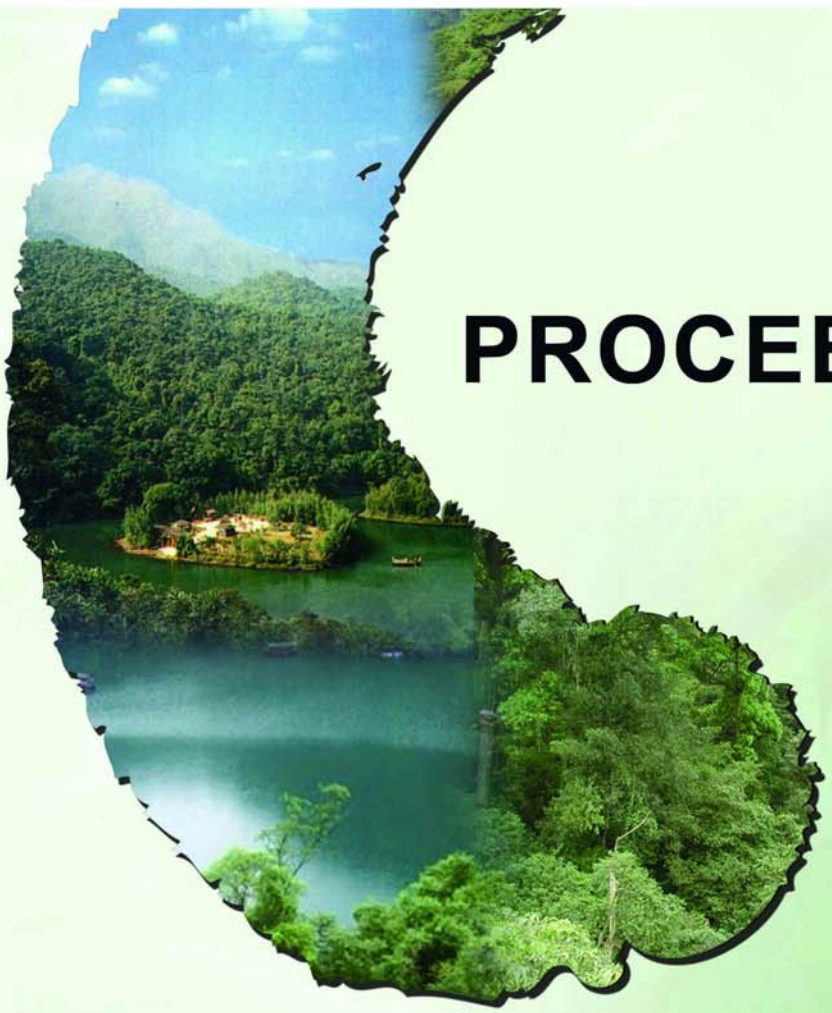
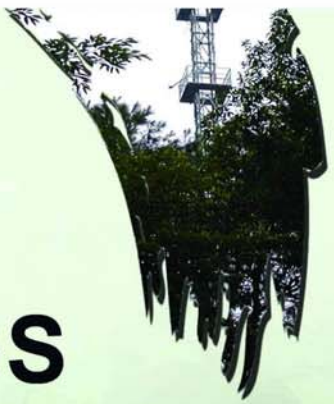
AsiaFlux Workshop 2010

New Challenges of Fluxnet Community to Resilient Carbon/Water Management





PROCEEDINGS

December 1-3, 2010
Guangzhou, China

Organized by
AsiaFlux Steering Committee
Co-Organized by
Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences
South China Botanical Garden, Chinese Academy of Sciences

AsiaFlux Workshop 2010

New Challenges of Fluxnet Community to Resilient Carbon/Water Management

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Yanling Hotel, Guangzhou, China

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It is reported that increase in atmospheric carbon dioxide concentration induced from such human activities as fossil fuel combustion, concrete manufacture and land use change mainly contribute to global climate change. Human society and natural ecosystem might not adapt to this rapid climate change. Cutting carbon emission and enhancing carbon sequestration at the regional scale have become an urgent task in the whole world. Terrestrial ecosystems play a significant role in offsetting atmospheric CO_2 and balancing the overall carbon budget. During the past two decades, with the development of regional and global networks of eddy covariance flux measurements, our understanding of the carbon budget for diverse ecosystems has been greatly improved. However, flux measurements are facing new challenges towards the mission of regional carbon management.

On the one hand, our understanding on the interactions between carbon processes with other biogeochemical processes (e.g., water cycle and nitrogen cycle) at a local scale is still quite limited, while clarifying the connections between these cycles is the basis for carbon management intervention. On the other hand, the methodology on scaling carbon flux from a specific site to a whole region is evolving. Many approaches are integrated and illustrate promising perspective, but they still have great uncertainties and need further assessments. In addition, our focus on the dynamics of ecosystem carbon budget should not be focused on normal conditions only. More attention should be paid to the interactive impacts of natural disturbances and human activities on carbon cycle and other associated biogeochemical processes.

AsiaFlux is a science community with a mission to bring Asia's key ecosystems under observation to ensure quality and sustainability of life on earth. Our vision is to be the learning frontiers of ecosystem science, service and stewardship, where knowledge is produced and practiced based on systems thinking to fulfill sustainability. This 9th AsiaFlux workshop will discuss the scientific challenges on the current issues in flux measurement and monitoring; couplings among cycles of carbon, water and nitrogen; the effects of natural and human disturbances on ecosystem assessment; a new synthesis on regional carbon budget; as well as resilient carbon/water management and ecosystem stewardship. Scientists from AsiaFlux communities and other regional networks will assemble to share their latest achievements on these issues.

Joon Kim, Guirui Yu, and Akira Miyata
Chair & Vice-Chairs of AsiaFlux

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AsiaFlux Workshop 2010 Schedule

Date/Place		8	9	10	11	12	13	14	15	16	17	18	19	20
Nov. 30		Registration(09:00-21:00) Ice Breaker (18:00-20:00)												
Dec. 1	Yan Xiang Hall (2F)	Registration (08:00-)	Opening Session (9:00-10:20)		Plenary Session (10:50-12:10)		Lunch (12:10-13:30)	Oral Session I (13:30-16:05)		Poster Session Ⅰ (16:10-18:00)			Banquet (18:30-20:30)	
	Yan Yi No.1 Hall (3F)							Oral Session II (13:30-16:20)						
Dec. 2	Yan Xiang Hall (2F)		Plenary Session (9:00-10:20)		Oral Session III (10:35-11:50)		Lunch (12:00-13:30)	Oral Session IV (13:30-16:05)		Poster Session II (16:10-18:00)				
	Yan Yi No.1 Hall (3F)							Oral Session V (13:30-16:05)						Young Scientist Meeting (19:30-)
Dec. 3	Yan Xiang Hall (2F)		Plenary Session (9:00-10:20)		Oral Session VI (10:40-11:40)		Lunch (12:00-13:30)							
Dec. 4	Field Excursion	Field Excursion – Dinghushan Site												

Ice Breaker: Yan Ling Hall (4F), Yanling Hotel
Banquet: Yan Ling Hall (4F), Yanling Hotel
Oral Sessions: Yan Xiang Hall (2F), Yanling Hotel
Yan Yi No.1 Hall (3F), Yanling Hotel
Poster Sessions: Yan Xiang Hall (2F), Yanling Hotel
Business Displays: Corridor near the Yan Xiang Hall (2F), Yanling Hotel
Young Scientist Meeting: Yan Yi No.1 Hall (3F), Yanling Hotel

AsiaFlux Workshop 2010 Program

December 1, 2010 (Wednesday)

Opening Session: Yan Xiang Hall (2F) — December 1 09:00-10:20

Moderator: Shenggong Li

Welcome Addresses

09:00-9:03	From the chair of local organizing committee	Shenggong Li
09:03-9:15	From the chair of AsiaFlux	Joon Kim
09:15-9:25	From the sponsors	Yinglan Zhang
09:25-9:30	From the host	Shenglei Fu

Regional reports

09:30:09:40	Report from AsiaFlux	Joon Kim
09:40:09:50	Report from JapanFlux	Takashi Hirano
09:50:10:00	Report from KoFlux	Hyojung Kwon
10:00:10:10	Report from TaiwanFlux	YueJoe Hsia
10:10:10:20	Report from ChinaFLUX	Shenggong Li
10:20-10:50	*Group picture & break*	

Plenary Session: Yan Xiang Hall (2F) — December 1 10:50-12:10

Chair: Takashi Hirano

10:50-11:30	K01	Getting the most out of land surface flux measurements: The need for proactive initiatives to achieve regional resilience and sustainability	John Tenhunen
11:30-12:10	K02	In-situ measurement of water vapor isotopes in ecological and hydrological research	Xuhui Lee

Oral Session I: Current Issues in Flux Measurement and Monitoring
Yan Xiang Hall (2F) — December 1 13:30-16:05

Chair: Shenglei Fu and Liukang Xu

13:30-13:45	O01	Open-path measurements of methane flux using eddy-covariance technique	Liukang Xu
13:45-14:00	O02	Input and distribution of rice root-derived carbon in plant-soil-micro-ecological system following ^{14}C continuous labeling	Tida Ge
14:00-14:15	O03	Contribution of the understory to the overall water use by mixed temperate forest	Eunyoung Jung
14:15-14:30	O04	An in situ staining method for determining radial variation of xylem sap flow of different tree species in subtropical China	Fei Xu
14:30-14:45	O05	Stem respiration characteristics of rubber (Hevea brasiliensis) plantations in Xishuangbanna, SW China	Liqing Sha
14:45-15:05		*Break*	
15:05-15:20	O06	Evaluation of ecosystem greenhouse gas emission by integrating eddy covariance and cavity ring-down laser spectroscopy (CRDS)	Jaeill Yoo

15:20-15:35	O07	Pooling of CO_2 in a tropical seasonal rain forest located at a spot valley	Yugang Yao
15:35-15:50	O08	Energy and CO_2 exchange between Taihu and atmosphere	Wei Xiao
15:50-16:05	O09	Development of CO_2 flux data processing system of ChinaFLUX	Xiaoli Ren

Oral Session II: Couplings among Cycles of Carbon, Water, and Nitrogen
Yan Yi No.1 Hall (3F) December 1 13:30-16:20

Chair: Yong Li and Jinkyu Hong

13:30-13:45	O10	Impact of the Asian monsoon climate on ecosystem carbon and water exchange	Jinkyu Hong
13:45-14:00	O11	Characters of carbon and nitrogen concentrations outlet from tropical seasonal rainforest small catchments in Xishuangbanna, Southwest China	Wenjun Zhou
14:00-14:15	O12	A comprehensive study of carbon and water metabolism of a tropical seasonal rain forest	Yiping Zhang
14:15-14:30	O13	Effects of simulated nitrogen deposition on growth and photosynthesis of 1-year-old Chinese fir (*Cunninghamia lanceolata*) seedlings	Yingchun Liao
14:30-14:45	O14	The multi-temporal scale analysis of environmental control on net ecosystem exchange of CO_2 in forest ecosystems	Mi Zhang
14:45-15:05		*Break*	
15:05-15:20	O15	Carbon-Water relations of typical ecosystems in China: Results from flux measurements and field surveys along climatic gradients	Zhongmin Hu
15:20-15:35	O16	Interannual net CO_2 exchange in a continental alpine meadow ecosystem on the northern Tibetan plateau	Peili Shi
15:35-15:50	O17	Root and microbial respiration in a seasonal dry dipterocarp forest, Thailand	Phongthep Hanpattanakit
15:50-16:05	O18	Modelling N_2O emissions from agroecosystems using WNMM	Yong Li
16:05-16:20	O19	Contribution of organic nitrogen to plant nutrition depends on soil organic nitrogen concentration in grasslands	Xingliang Xu

December 2, 2010 (Thursday)

Plenary Session: Yan Xiang Hall (2F) December 2 09:00-10:20

Chair: Hyojung Kwon

09:00-09:40	K03	Perspectives on terrestrial carbon fluxes: Quantification and vulnerabilities	Riccardo Valentini
09:40-10:20	K04	Estimating nocturnal ecosystem respiration from the vertical eddy flux and change in storage of CO_2	Ray Leuning
10:20-10:35		*Break*	

Oral Session III: Interfaces between Carbon Science and Society: Resilient Carbon & Water Management
Yan Xiang Hall (2F) December 2 10:35-11:50

Chair: Kazuhito Ichii

10:35-10:50	O20	Carbon budget and management for eastern Asian grasslands	Yuling Fu

10:50-11:05	O21	The carbon storage of old-growth forests means the huge potential carbon sequestration for the world forest	Yingchun Liu
11:05-11:20	O22	Stoichiometric response of plantation to nitrogen and phosphorus fertilization in subtropical China	Jingyuan Wang
11:20-11:35	O23	N_2O emissions from a tea field in subtropical China	Xiaoqing Fu
11:35-11:50	O24	Nitrous oxide emissions from agriculture in China	Chao Fu

Oral Session IV: Effects of Disturbances on Ecosystem Assessment

Yan Xiang Hall (2F) December 2 13:30-16:05

Chair: Chhakchhuak Lalrammawia and Mei Huang

13:30-13:45	O25	Impacts of extreme precipitation on tree plantation carbon cycle	Mei Huang
13:45-14:00	O26	Assessment of the damage caused by the 2008 ice storm on subtropical forest in Jiangxi, China	Leilei Shi
14:00-14:15	O27	Evapotranspiration and energy exchange in flooded and aerobic rice fields in the Philippines	Ma. Carmelita R. Alberto
14:15-14:30	O28	Physical protection of soil aggregate inhibit the response of soil organic matter decomposition to temperature	Hongsheng Liu
14:30-14:45	O29	Detecting the impact of the climatic factors and land use practices on the vegetation distribution in northern Shaanxi province, China	Lang Wang
14:45-15:05		*Break*	
15:05-15:20	O30	Soil carbon stock and fluxes of two typical ecosystems in a semiarid area, Loess Plateau of China	Chanjuan Hu
15:20-15:35	O31	Effect of seasonal soil moisture dynamics on carbon fluxes of *cenchrus ciliaris* l. grassland in semi-arid region of southern India	Chhakchhuak Lalrammawia
15:35-15:50	O32	Drought sensitivity of a primary tropical seasonal rainforest	Zhenghong Tan
15:50-16:05	O33	Quantifying impact of typhoon on net ecosystem exchange in a sub-tropical mangrove ecosystem	Hui Chen

Oral Session V: CarboEastAsia & HydroEastAsia

Yan Yi No.1 Hall (3F) December 2 13:30-16:05

Chair: Weimin Ju and Nobuko Saigusa

13:30-13:45	O34	Resilience of forest ecosystems to disturbances caused by strong winds	Nobuko Saigusa
13:45-14:00	O35	Effects of climate change and plantation on carbon budget of coniferous forests in Poyang lake basin from 1981 to 2008	Shaoqiang Wang
14:00-14:15	O36	Evapotranspiration mapping: from local to region	Hyojung Kwon
14:15-14:30	O37	Uptake of isoprene oxidation products by tree samplings and flux measurement of the compounds above a Japanese larch forest	Akira Tani
14:30-14:45	O38	On estimating wet canopy evaporation from deciduous and coniferous forests in Korea	Minseok Kang
14:45-15:05		*Break*	

15:05-15:20	O39	Estimation of carbon balance of typical forest ecosystems in Eastern Asia using eddy covariance technique	Leiming Zhang
15:20-15:35	O40	Multi model and data analysis of terrestrial carbon cycles in Asia: First synthesis result	Kazuhito Ichii
15:35-15:50	O41	Changes in water use efficiency and driving factors of east Asia over the past 25 years	Weimin Ju
15:50-16:05	O42	A new method of terrestrial ecosystem evaluation with the parallel coordinates plot	Masayuki Kondo

December 3, 2010 (Friday)

Plenary Session: Yan Xiang Hall (2F) December 3 09:00-10:20

Chair: Shenggong Li

09:00-9:40	K05	Carbon source and sink distribution in conterminous US forests based tower flux, inventory and remote sensing data	Jingming Chen
09:40-10:20	K06	Terrestrial carbon balance in East Asia	Shilong Piao
10:20-10:40		*Break*	

Oral Session VI: Regional Carbon Budget: A New Synthesis
Yan Xiang Hall (2F) December 3 10:40-11:40

Chair: Yuling Fu

10:40-10:55	O43	Progress on the application of cyber-infrastructure for carbon cycle research based on ChinaFLUX	Honglin He
10:55-11:10	O44	Soil carbon sequestration for 'grain for green' project in Loess Plateau, China	Ruiying Chang
11:10-11:25	O45	Application of model-data synthesis on simulating carbon and water fluxes at forest ecosystems in ChinaFLUX	Min Liu
11:25-11:40	O46	Net ecosystem productivity using biometric and remote sensing techniques in tropical rain forest	Ab Latif Ibrahim

December 1, 2010 (Wednesday)

Poster Session I: Yan Xiang Hall (2F) 16:10-18:00

Current Issues in Flux Measurement and Monitoring

P101 The necessary area in a plot for CO_2 efflux measurement - the case in common and immature forest soil *Koji Tamai*

P102 A regression model of NEE time series based on correlation analysis and Time-Lag analysis *Xiao Xie*

P103 Environmental controls over the seasonal variation of soil respiration in three stands in a north subtropical forest, central China *Qingpeng Yang*

P104 Continuous measurement of heat and carbon dioxide fluxes in an urban area *Yasuhiro Mitake*

P105 Carbon gases exchange in northern peatland of China *Yuqing Miao*

P106 Characteristics of N_2O flux and the relationship between N_2O and CO_2 emission in the marsh wetland of northeast China *Li Sun*

P107 Leaf phenology in a tropical monsoonal evergreen forest at Sakaerat, Thailand, detected by fixed view camera images - analyses on the individual scale *Takahisa Maeda*

P108 Frequency response of a low-power closed-path CO_2 and H_2O eddy covariance system *Hongcheol Kim*

P109 Seasonal variability of water vapor and heat fluxes over typical surfaces in the Haihe river basin *Ziwei Xu*

P110 Development of CH_4 and BVOC flux measurement system in a deciduous broad leaved forest *Takafumi Miyama*

P111 Effect of different nitrogen sources and straw adding on N_2O emission from vegetable soil *Ningning Jiang*

P112 Present and future studies of heat, CO_2 and water fluxes in Vietnam *Tran Cong Huan*

P113 Methane emission from wet area in the temperate forest - Contribution of water and temperature to methane efflux *Kenichi Yoshimura*

P114 The effect of substrate characteristics and water content on leaf litter respiration *Mioko Ataka*

P115 Carbon dioxide exchange at single and double cropping field in Japan *Daisuke Kajihara*

P116 Surface-atmosphere exchange over tropical turf grassland using eddy covariance *Amy Fang Lim Chua*

P117 Seasonal dynamics of soil respiration in a rubber plantation ecosystem *Duangrat Satakhun*

P118 Tree surface temperature in a primary tropical rain forest and rubber plantation in southwestern China *Qinghai Song*

P119 Allocation of assimilated C in Tibetan montane pasture revealed by $^{13}CO_2$ labeling *Yakov Kuzyakov*

P120 Turbulent fluxes of air-sea exchange measured at Yongxing Island, Xisha, China *Xiao Liu*

P121 The effect of a three-side-open automated chamber on GHG measurement *Yunfan Wan*

Couplings among Cycles of Carbon, Water, and Nitrogen

P122 The effect of fertilization on the partition and accumulation of carbon and nitrogen in rice plants *Lei Feng*

P123 Dynamics of net ecosystem carbon dioxide exchange and its environmental factors in Inner Mongolia desert steppe *Jun Chen*

Interfaces between Carbon Science and Society: Resilient Carbon & Water Management

December 2, 2010 (Thursday)

Poster Session II: Yan Xiang Hall (2F) 16:10-18:00

Effects of Disturbances on Ecosystem Assessment

P201 An experimental study of in-situ chemical oxidation using a quasi-multidimentional system *Huali Chen*

P202 Effects of soil moisture and temperature on CO_2 and CH_4 soil-atmosphere exchange of various land use/cover types in Xilin river catchment *Xing Wu*

P203 Effects of plant invasion on carbon cycle of estuarine wetland: an eddy covariance approach *Haiqiang Guo*

P204 Assessment of potential landslides on Naerin watershed:linking eco-hydrology model and slope stability model *Jungyeol Choi*

P205 Evaluation of the impacts of defoliation by tropical cyclones on a Japanese forest's carbon budget using flux data and a process-based model *Akihiko Ito*

P206 Assessing vulnerability and adaptation responses to rainfall-related landslides in China, a case study of Enshi prefecture in Hubei province *Minjie Duan*

CarboEastAsia & HydroEastAsia

P207 Continuous monitoring of ecosystem production and soil respiration using automatic field moving *Jaeseok Lee*

P208 Inter annual variation of climatic, soil moist conditions and evapotranspiration – the case in the lowland evergreen forest in Cambodia *Koji Tamai*

P209 Soil warming in a cool-temperate mixed forest enhances heterotrophic and basal respiration rates *Maricar Morales Aguilos*

P210 Gui-based eddy flux calculation and analysis software *Masahito Ueyama*

P211 Simulation of carbon cycle processes in typical forest and grassland ecosystems *Na Zhang*

P212 Detection of variability of lake size in Mongolia using Landsat imagery *Gyoungbin Lee*

P213 Hydrological responses characterized by a rainfall-runoff model using Korea land data assimilation system(KLDAS) *Yong Jung*

P214 Validation of energy and water flux using Korea land data assimilation and flux tower measurement *Daeun Kim*

P215 Comparison of gap-filling procedures for synthesized determination of annual carbon budgets of CarboEastAsia data set *Kentaro Takagi*

P216 Effects of soil temperature and moisture on soil respiration on temperate deciduous forest in Gwangneung, Korea *Eunhye Lee*

P217 Preliminary results on optimization of CLM3.5-DGVM using CO_2 flux data at Gwangneung site *Young-Hee Lee(or Heejeong Lim)*

P218 Carbon dioxide exchange at three paddy fields in Asia *Takahiro Takimoto*

P219 Long-term measurements of isoprene fluxes above warm-temperate mixed forest in Japan *Okumura Motonori*

P220 Simulation of carbon balance using Jules land surface model in a deciduous forest in central Korea *Jewoo Hong*

P221 Measurement of soil respiration with automatic open/close chamber system on regenerated forest in Yanggu, Korea *Eunhye Lee*

K01

GETTING THE MOST OUT OF LAND SURFACE FLUX MEASUREMENTS: THE NEED FOR PROACTIVE INTIATIVES TO ACHIEVE REGIONAL RESILIENCE AND SUSTAINABILITY

John Tenhunen

Department of Plant Ecology, University of Bayreuth, 95440 Bayreuth, Germany

Information gains related to the analysis of ecosystem function obtained via monitoring with eddy covariance flux measurements have moved beyond the lessons learned at individual sites and via network cross-site comparisons. Examples now demonstrate how tower site data bases contribute to regional balances and potential management of water resources and carbon sequestration. Furthermore, assessments of the time dependent dynamics of regional balances are supported by monitoring of land surface exchanges that have been carried out along chronosequences characterizing vegetation succession, and with respect to natural and anthropogenic disturbance. Thus, we can obtain a vivid picture of land surface exchanges with the atmosphere, even recently including complex structures such as urban areas, where efforts are made to separate natural and anthropogenic components.

Land surface exchange measurements alone may provide some indication of healthy vs. stressed systems, e.g., in situations where relationships between NEE and R_{eco} or ET appear to shift, or where seasonality in flux relationships changes. However, we know since the International Biological Program (IBP) that ecosystem stress response, recovery and resilience are equally apparent in turnover of materials, nutrient loss or retention, resource use efficiencies, and additional ecosystem properties. At landscape scale, this means that changes occur in hydrology, the seasonal course of soil resource stores, trace gas emissions, and transport of nutrients and carbon in river systems, with feedbacks on land surface exchange. In today's terminology, we know that this indicates a modification in ecosystem services provided to us by the landscape or region of interest, and upon which we depend. Landscape and regional response to stress or to global change is extremely complex and difficult to understand, since it includes the mosaic response of natural, productive, and multiple-use ecosystems along with urban and industrial areas.

Nevertheless, we live in an era when it is critical to anticipate and actively manage natural areas and their provision of services, despite global change. This requires new types of reseach teams, new funding instruments, new integrative tools and new partnerships with government and non-government agencies in order to carry out problem solving and adaptive governance. Global change will impact all ecosystem types, leading to modifications in fluxes and in flux dependent ecosystem services. We must structure our scientific efforts to improve our understanding of such modifications, and to support a multi-dimensional, multi-disciplinary knowledge-based management of natural resources at regional scale. Resilience and sustainability in this context means that we carry out proactive capacity-building which allows us to responsibly set regional goals for ecosystem service outputs, simultaneously with adequate knowledge of the compromises that are entailed.

These principles are illustrated with information from flux network observations, and ongoing regional modeling efforts of the TERRECO project carried out in S. Korea. The contributions of information from flux tower measurements to landscape process models, and to the broadly used assessment and decision-support tools SWAT and INVEST are featured.

K02

IN-SITU MEASUREMENT OF WATER VAPOR ISOTOPES IN ECOLOGICAL AND HYDROLOGICAL RESEARCH

Xuhui Lee

School of Forestry and Environmental Studies, Yale University, New Haven, CT 06511, USA

In-situ measurement of the D and ^{18}O compositions of water vapor in the atmospheric opens a new window of research on the water cycle in terrestrial ecosystems. In this paper, the author will review the progress to date on laser-based measurement technology, identify areas in need of more developmental work, and discuss the applications of this emerging technology. Data collected in the field experiments by the author and his collaborators will be used to (1) characterize the temporal variations in the vapor isotopic compositions in surface air, (2) gain insights into the isotopic interactions between ecosystem water pools and fluxes, (3) to constrain water use strategy at the ecosystem scale, and (4) to quantify the coupled exchange of ^{18}O in water and carbon dioxide in field conditions. These experiments reveal a number of canopy-scale emergent properties that are not observable at the leaf and plant scales but are important for modeling the isotopic coupling between the terrestrial vegetation and the atmosphere.

K03

PERSPECTIVES ON TERRESTRIAL CARBON FLUXES: QUANTIFICATION AND VULNERABILITIES

Riccardo Valentini

Department of Forest Science and Environment, University of Tuscia, Viterbo, Italy

Currently about 45% of total green house gases emissions globally remain in atmosphere, the remaining 55% are store in land and oceans ecosystems. In particular terrestrial carbon accounts for about 2.8 Pg C y^{-1} of sinks both in living biomass and soils. Remarkably a same order of magnitude (1.5 Pg C y^{-1}) is emitted by terrestrial land as land use changes and disturbances driven by human activities and climate perturbations.

There is, however, no scientific evidence that the Earth's flora will continue to absorb carbon at the same rate in the future. In this respect, any measure taken by means of enhanced terrestrial sinks to offset fossil fuel emissions will have a temporary effect which will allow us to buy between 15 and 100 years in which to develop alternative longer-term CO_2 reduction strategies, depending on the mean residence time of the protected sinks. After that, any measure for emission reduction will have to be permanent and achieved by technological means. Despite the temporary nature of biological carbon sequestration, ecological restoration through enhancement of ecosystem services can have a positive effect on climate stabilization. Indeed, compared to reforestation and afforestation, human-induced natural regeneration and/or improvement of existing vegetation can be more effective in enhancing both carbon sequestration and biological diversity, and protecting soil against degradation and desertification. However biological carbon sequestration is also affected by climate and it is influenced by its variability. Also, disturbance regimes (e.g., fires, wind storms, pests, etc.), although often dominated by human activities, are triggered by climate variability and extremes. In this paper we discuss the current carbon cycle variability and the different methods and approaches available to quantify the terrestrial ecosystem carbon budget.

K04

ESTIMATING NOCTURNAL ECOSYSTEM RESPIRATION FROM THE VERTICAL EDDY FLUX AND CHANGE IN STORAGE OF CO_2

Eva van Gorsel[1], Nicholas Delpierre[2], Ray Leuning[1]

[1] CSIRO Marine and Atmospheric Research, Canberra, Australia

[2] Ecologie, Systematique et Evolution (ESE), CNRS and Universite Paris Sud, France

Micrometeorological measurements of night time ecosystem respiration can be systematically biased when stable atmospheric conditions lead to drainage flows associated with decoupling of air flow above and within plant canopies. The associated horizontal and vertical advective fluxes cannot be measured using instrumentation on the single towers typically used at micrometeorological sites. To remove biases, a threshold in friction velocity, u_* is often used to exclude periods when advection is assumed to be important, but this is unsatisfactory when within- and above-canopy flows are decoupled.

Data from 25 flux stations in a wide variety of forest ecosystems globally was used to examine a new approach to estimating nocturnal respiration developed by van Gorsel et al. (2007, Tellus, 59B, 307-403). The approach assumes that advection is small relative to the vertical turbulent flux (F_C) and change in storage (F_S) of CO_2 in the few hours after sundown (Fig. 1a). The sum of F_C and F_S reach a maximum during this period, and this sum is used to derive a temperature response function for ecosystem respiration (Fig. 1b). Measured hourly soil temperatures are then used with this function to estimate respiration R_{Rmax}. The new approach yielded excellent agreement with (1) independent measurements using respiration chambers (Fig. 1c), (2) with estimates using ecosystem light-response curves of $F_c + F_s$ extrapolated to zero light, R_{LRC}, and (3) with a detailed process-based forest ecosystem model, R_{cast}. At most sites respiration rates estimated using the u_*-filter, R_{ust}, were smaller than R_{Rmax} and R_{LRC}. Agreement of our approach with independent measurements indicates that R_{Rmax} provides an excellent estimate of night time ecosystem respiration.

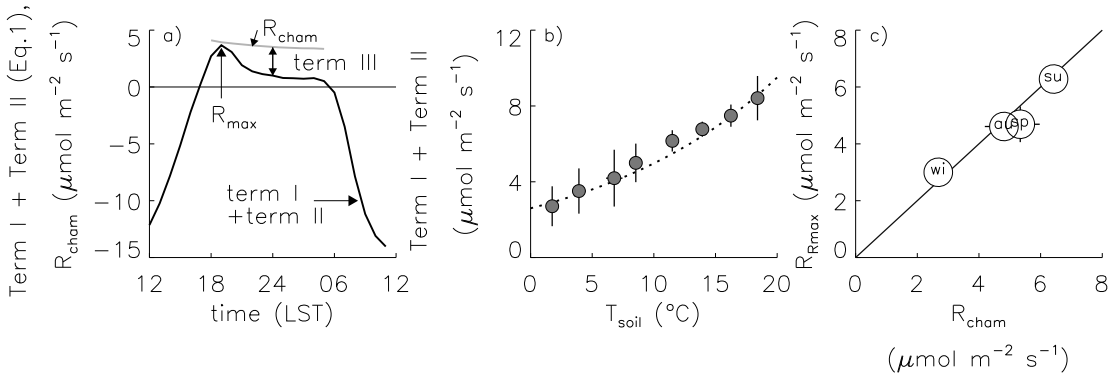

Figure 1. a) Daily course of the sum of term I (eddy flux) and term II (change in storage term) and total ecosystem respiration derived from chamber measurements (R_{cham}); b) temperature response function; c) respiration derived from micrometeorological measurements (R_{Rmax}) against chamber measurements. Data were measured at Tumbarumba from 2001-2005.

K05

CARBON SOURCE AND SINK DISTRIBUTION IN CONTERMINOUS US FORESTS BASED TOWER FLUX, INVENTORY AND REMOTE SENSING DATA

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The Integrated Terrestrial Ecosystem Carbon Cycle model (InTEC) is used for the first time to estimate the carbon source and sink distribution in conterminous US forests, through integrating both disturbance and non-disturbance (CO_2, nitrogen, climate) effects on the forest carbon cycle. Forest Inventory and Analysis (FIA) data are used to produce a forest stand age map in 2000 and to derive NPP-age relationships for 18 species groups in 10 ecoregions. Remote sensing data are used to update the forest age map through detecting disturbed areas in between 1990 and 2000 and to provide the inputs of leaf area index and land cover to the model. These LAI maps are co-registered with the forest age map to derive LAI-age relationships that are the key missing information in the construction of NPP-age relationships using FIA data. MODIS GPP in 2000, monthly climate data from 1901 to 2006, and soil texture data are also used as additional inputs to the model. The historical spatio-temporal variations of NPP, NEP and NBP in all conterminous US forests are computed using InTEC from 1901 to 2006 in monthly time steps at 1 km resolution. Eddy covariance data in recent years taken at 37 US forest sites are used to validate the model, with R^2=0.71 and mean bias error= -48 g C m^{-2} yr^{-1}. These results show that the annual NPP of conterminous US forests increased from 1476 Tg C yr^{-1} in the early 20th century to 1892 Tg C yr^{-1} in the early 21st century, whereas the NBP increased from -32.9 Tg C yr^{-1} to 422.5 Tg C yr^{-1} in the same period. The overall results indicate that forest sink extended from northern regions to southern and southeast regions and the maximum sink occurred in the Kentucky and Tennesee states after 1990. The spatial NBP pattern is similar to that of our nested atmospheric inversion with a focus in North America. The simulated soil and forest biomass carbon stocks compare well with several existing published results.

K06

TERRESTRIAL CARBON BALANCE IN EAST ASIA

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East Asia is maybe one of the most critical and sensitive regions in the climate system. During the past two decades, mean annual temperature over China increased by more than 0.6 ºC/decade, a much faster rate than the mean temperature trend over land (~0.27°C/decade; IPCC, 2007). Associated with this warming, a significant change in seasonal precipitation pattern has been also observed. Such rapid shifts in temperature and precipitation certainly impact the regional carbon balance between productivity and decomposition rates. Better quantification and understanding of the carbon cycle of East Asian ecosystems, and of its perturbation by past and current climate change, is a high priority where research is needed. In this study, we show current terrestrial carbon balance of East Asia and its mechanisms using three independent approaches, biomass and soil inventories, biogeochemical models, and atmospheric inversions. Our results suggest that East Asia's terrestrial ecosystems is a net sink of 0.21 - 0.33 PgC yr^{-1} over the last three decades, implying that about 16-24% of it's CO_2 emissions from burning fossil fuels have been removed by C accumulation in the terrestrial biosphere. In addition, I will also discuss a non-equilibrium conceptual framework that must be taken into account when studying the current NEP distribution.

O01

OPEN-PATH MEASUREMENTS OF METHANE FLUX USING EDDY-COVARIANCE TECHNIQUE

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Methane is one of the most important greenhouse gases in the atmosphere. The estimated total positive radiative forcing on global warming from CH_4 is about 30% of that from CO_2. Present measurements of methane fluxes have mostly been made with chamber techniques or with the eddy covariance approach using closed-path analyzers. Both chambers and closed-path analyzers have advantages, but chamber measurements are discrete in time and space, may disturb soil surface integrity, and often are labor-intensive. Present closed-path gas analyzers for measuring methane flux employ advanced technologies such as TDLS (Tunable Diode Laser Spectroscopy), ICOS (Integrated Cavity Output Spectroscopy), WS-CRDS (wavelength scanned cavity ring-down spectroscopy) and others, but require high flow rates at significantly reduced optical cell pressures to provide adequate response time and sharpen absorption features. Such methods, when used with the eddy covariance technique, require a vacuum pump and a total of 400-1500 W of grid power for the pump and analyzer system. Because of this requirement, spatial coverage of eddy covariance methane flux measurements is limited. Remote marshes of Arctic tundra, rice field regions of Southeast Asia, wetlands of Canada, Amazon, or the Florida Everglades, and other highly methanogenic remote regions have few eddy covariance methane measurement stations. This hinders our understanding of those processes affecting atmospheric CH_4 abundance and their impact on climatic change. Open-path analyzers offer a number of advantages for measuring methane fluxes using the Eddy Covariance technique over agricultural fields, various natural ecosystems, and other contexts (e.g. landfills, animal husbandry etc.). Advantages include undisturbed in-situ flux measurement, no frequency response errors from tube attenuation, and the capability of remote deployment with solar panel power supply systems. In this paper we present a new open-path methane analyzer and its field performance making flux measurements. The instrument is built using TDLS (Tunable Diode Laser Spectroscopy) technology in a multipass optical cell configuration. Field maintenance is minimized by a self-cleaning mechanism to remove contamination on the lower mirror. The RMS noise is around 2 ppb $\cdot Hz^{-1/2}$. Eddy Covariance measurements of methane flux using this analyzer for the period between 2006 and 2009 in four ecosystems with contrasting weather and moisture conditions are presented. Four ecosystems include (1) fallow agricultural field in Nebraska, (2) sawgrass wetland in the Florida Everglades, (3) coastal wetlands in Arctic tundra, and (4) pacific mangroves in Mexico. Data were processed using EdiRe software following standard FLUXNET protocols, including stationarity test, frequency response correction, and Webb-Pearman-Leuning term.

O02

INPUT AND DISTRIBUTION OF RICE ROOT-DERIVED CARBON IN PLANT-SOIL-MICRO-ECOLOGICAL SYSTEM FOLLOWING ^{14}C CONTINUOUS LABELING

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Root-derived carbon (C) into soil plays an important role in global C cycling. The microcosm experiment was carried out to quantify the input and distribution of rice-derived C into soil C pool by using a ^{14}C continuous labeling technique. Destructive samplings of rice (Oryza sativa) were conducted after labeling for 80 days. The allocation of ^{14}C-labeled photosynthates in plants dissolved organic C, microbial biomass C in rice-planted soil and pools of soil organic C were examined over ^{14}C labeling span. The amount of rice biomass C was ranged from 1.97 to 6.41 g $plot^{-1}$ in different tested paddy soils after labelling for 80 days. The amount of ^{14}C in the soil organic C (^{14}C-SOC) was also dependent on the soils, ranged from 114.34 to 348.22 mg C kg^{-1}, , accounting for 4.09% to 5.62% of the rice biomass C, respectively. The amounts of ^{14}C in the dissolved organic C (^{14}C-DOC) and in the microbial biomass C (^{14}C-MBC), as proportions of ^{14}C-SOC, were 2.21%–3.54% and 9.72%–17.92%, respectively. The ^{14}C-DOC, ^{14}C-MBC, and ^{14}C-SOC as proportions of total DOC, MBC, and SOC, respectively, were 6.72%–14.64%, 1.72%–7.69%, and 0.73%–1.99%. Moreover, the distribution and transformation of root-derived C had a greater influence on the dynamics of DOC and MBC than on the dynamics of SOC. Further studies are required to ascertain the functional significance of soil microorganisms (such as C-sequestering bacteria and photosynthetic bacteria) in the paddy system.

Keywords: ^{14}C continuous labeling, microbial biomass, rice, photosynthesized C allocation, root exudation, rhizodeposition

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O03

CONTRIBUTION OF THE UNDERSTORY TO THE OVERALL WATER USE BY MIXED TEMPERATE FOREST

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Transpiration is a critical component of the natural water cycle. Quantifying transpiration in forest stands is, therefore, necessary in order to design sound management strategies for water resources. In this study, two different methods, thermal dissipation probe (TDP) and stem heat balance (SHB), were used to determine transpiration of over- and under-story tree species in a mixed temperate deciduous forest, located in Gwangneung, South Korea. The forest was dominated by *Quercus serrata* and *Carpinus laxiflora* in the overstory, and *Euonymus oxyphyllus* and *Celtis jessoensis* in the understory. The basal area of the overstory species and leaf area index of the understory species were 3.8 m^2 ha^{-1} and 1.0 m^2 m^{-2} respectively. During the growing season of 2008, understory species contributed about 50% of the total stand transpiration.The averaged water use by the overstory species was 0.92 mm d^{-1} while it was 0.89 mm d^{-1} for understory species. Although light penetration into the forest understory was less than 10 % of the above-canopy light intensity, the understory had a significant contribution to the overall water use by the mixed forest stand. This underscores the significant role played by the understory in forest catchment water balance and that it should always be considered when quantifying water use by forest stands.

O04

AN IN SITU STAINING METHOD FOR DETERMINING RADIAL VARIATION OF XYLEM SAP FLOW OF DIFFERENT TREE SPECIES IN SUBTROPICAL CHINA

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The main errors for evaluating forest transpiration by sap flow method arise during the scaling from single-point measurements to whole trees, owing to the uncertainty of sapwood area and radial variation in xylem sap flow. An in situ staining method was proposed to solve this difficulty in two deciduous trees (*Schina superba, Liquidambar formosana*) and three coniferous trees (*Cunninghamia lanceolata, Pinus massoniana, Pinus elliottii*) in subtropical China. The study results indicated that there was a significant radial variation in xylem sap flow based on the dyed trace. However, the variation patterns of sap flow did not simply follow an increase or decrease way from bark to pith, but follow a more complex manner than expectation. The sap flow varied so frequently and abrupt change even occurred between two adjacent points. Not all parts of the sapwood are good at water transportation. This great variation might be attributed to the vessel structure and distribution in xylem. Tree species and canopy structure obviously affected the sap flow and its radial variation pattern. Generally, water was transported faster in deciduous than in coniferous tree species. Different patterns were also observed between individuals of the same species.

O05

STEM RESPIRATION CHARACTERISTICS OF RUBBER (HEVEA BRASILIENSIS) PLANTATIONS IN XISHUANGBANNA, SW CHINA

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Forest ecosystem is an important pool of carbon in terrestrial ecosystem. Wood tissues contribute for large part of biomass, and to some degree their respiration influence carbon fixation of ecosystem. Stem respiration is a vital component of the carbon budget in forest ecosystems. Some data for temperate and boreal zones were available, stem respiration of rubber plantation was not found. In this study, we made *in situ* measurements of the stem respiration for 4 ages (7-, 15-, 27-, and 40-year-old) of rubber plantations in Xishuangbanna, using an infra-red gas analyzer (IRGA) method. LI-820 CO_2 gas analyzer was connected to a custom-built polyvinyl chloride (PVC) chamber. The chamber was fastened to the stem surface using thin neoprene gaskets with a strap at sampling time. The stem respiration rates of rubber trees were measured in the south and north sections at 1.3 m and 2.0 m height from March 2004 to February 2005. Measurements were taken once every month. Temperature at 1 cm depth of stem and air temperature in plantations were recorded concurrently. The tendencies of stem respiration in four types of plantations were in remarkable single-peak patterns with high rates during wet season and low rates during dry season. The stem respiration rates for 7-, 15-, 27-, and 40-year rubber were 2.299 ± 0.129, 4.989 ± 0.278, 4.678 ± 0.268, and 3.753 ± 0.205 $\mu mol.m^{-2}.s^{-1}$, respectively. Respiration rates were significantly higher for 15-y and 27-y trees than 40-y and 7-y tree ($P<0.05$), and it significantly higher in 40-y tree than that in 7-y tree. The stem respiration rates of rubber trees were similar at the same height in north and south sections and it also similar at 1.3 m and 2.0 m of the same section. Relationship between stem respiration rates and temperature were analyzed. There was an exponential correlation between stem respiration rate and stem temperature ($P<0.01$). The Q_{10} values for stem respiration of 4 age trees varied from 1.966 to 3.127, and the average Q_{10} value of 4 age trees was 2.452, which was higher compared with the range of Q_{10} values (1.60~2.38) reported in previous studies in tropical trees and were close to other trees in China (1.96~3.33). Annual stem respiration rates (except branches) of 7-, 15-, 27-, and 40-year-old plantations were estimated as 1.74, 5.54, 7.53, 7.59 t $C.hm^{-2}.a^{-1}$, respectively.

Key words: Rubber tree, Tree age, Stem respiration, temperature, Q_{10}

O06

EVALUATION OF ECOSYSTEM GREENHOUSE GAS EMISSION BY INTEGRATING EDDY COVARIANCE AND CAVITY RING-DOWN LASER SPECTROSCOPY (CRDS)

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The terrestrial ecosystems in Asia are playing an important role on the green-house gases (GHG) emission and the climate system due to their diversity, rapid land-use and cover change, and changing hydrological cycle associated with the monsoon climate. In various ecosystems, numerous studies using closed-path eddy covariance technique have been conducted to quantify GHG fluxes. In order to monitor these fluxes (e.g., CH_4 and CO_2), we combine two techniques: (1) cavity ring-down spectroscopy (CRDS) used by Korea Research Institute of Standards and Sciences (KRISS) and (2) eddy covariance technique used by KoFlux and AsiaFlux community. In this presentation, we present a preliminary result from our pilot field experiment and report the current progress along with difficulties and challenges in employing these two techniques in various ecosystems in Monsoon Asia.

Acknowledgment: This research was supported by Korea Research Council of Fundamental Science and Technology (KRCF) through the KRISS project of Basic Research and "CarboEastAsia - A3 Foresight Program" of National Research Foundation of Korea.

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O07

POOLING OF CO_2 IN A TROPICAL SEASONAL RAIN FOREST LOCATED AT A SPOT VALLEY

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A tropical rain forest was strongly correlated with global carbon cycling and atmospheric CO_2 concentrations. CO_2 concentrations and their corresponding environmental factors were measured in an Asian tropical rain forest located in a small valley to investigate the CO_2 pooling effect and its mechanism of formation. Pooling of CO_2 was observed at dusk (16:00-22:00), and the accumulated CO_2 subsequently flowed away after dusk. The pooling of the CO_2 peaked when the highest temperature and soil respiration were observed both on the diurnal and seasonal scales. The comprehensive analysis of experimental data in our studied site led to a reasonable hypothesis that explored the mechanism of this pooling phenomenon. The implications of this study suggested that when eddy covariance and other micrometeorological measurements of carbon flux in sites located in valley terrain are made, the pooling and subsequent disappearance of CO_2 should be taken into account.

O08

ENERGY AND CO_2 EXCHANGE BETWEEN TAIHU LAKE AND ATMOSPHERE

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As a large shallow eutrophic lake (mean depth ~ 2m and an area of 2338 km^2), Taihu Lake has big effect on local weather and climate change, and the algae bloom is a hot spot of current scientific research. But the land surface parameterization of Taihu Lake was not well validated and the meteorological mechanism controlling algae growth was not clearly identified because of the lack of in-situ measurement of energy and CO_2 exchange on the lake and atmosphere interface. Here we make the first try to install an eddy covariance system on Taihu Lake to continuously measure the water, heat and CO_2 exchange between lake and atmosphere. Supporting measurement included radiation budget, micrometeorological variables and water temperature. The objectives of the study were to get the first-hand data of lake surface parameters and identify the connection between algae bloom and carbon cycle processes. The experiment has been conducted from June 13, 2010 to present.

Our preliminary results indicate that the magnitudes of sensible heat flux and latent heat flux were lower comparing to agricultural ecosystem, while water heat flux was the biggest part of energy budget. Diurnal composite analysis shows that sensible heat flux and latent heat flux were positive in both day and night, ranging from 11 W m^{-2} to 26 W m^{-2} and from 65 W m^{-2} to 138 W m^{-2} respectively. Diurnal composite of water heat flux ranged from -120 W m^{-2} to 300 W m^{-2} calculated from water temperature gradient measurement. The energy balance closure was 81%. The radiation budget indicated that sky long-wave radiation was always lower than the long-wave radiation emitted from water surface, with mean bias of 40 W m^{-2}. The albedo of water surface shows obvious daily variation, higher at sunrise and sunset time, with value of ~ 0.2, and lowest at noon, with value of ~ 0.08. With similar solar elevation angle (10:00 LST), albedo changed obvious in different days, ranging from 0.04 (DOY 224) to 0.17 (DOY 197) (figure 1). Obvious diurnal pattern of net ecosystem CO_2 exchange (NEE) was found during several periods with good fetch. Figure 2 shows time series of NEE from DOY 231 to 236, where NEE is negative at most time and big negative signal occurred at midnight. The daily variation is around 0.2 mg m^{-2} s^{-1}. With increasing capacity to measure the energy budget and CO_2 exchange together with algae growth monitoring, it should be possible to provide references to the climate change research, help improve the weather model performance and interpret the meteorological mechanisms controlling algae bloom.

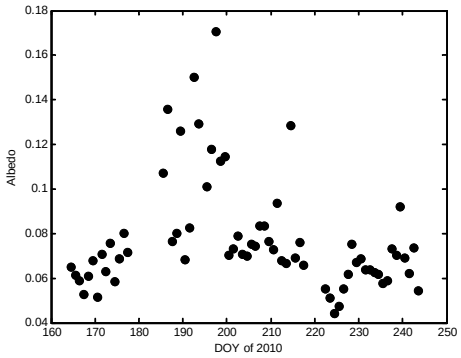

Figure 1 time series of suface albedo at 10:00 LST

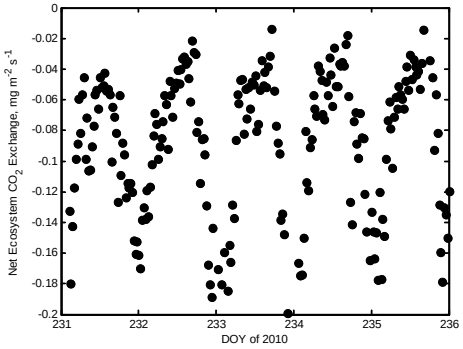

Figure 2 Time series of NEE during DOY 231-236.

O09

DEVELOPMENT OF CO_2 FLUX DATA PROCESSING SYSTEM OF CHINAFLUX

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Eddy covariance technique is a popular and reliable method to directly measure CO_2 flux in ecosystem. However, due to some inevitable operational and meteorological constraints, a series of processing work are needed to be done before explaining ecological significance from the data. Based on the state of the art of carbon flux research, Chinese Terrestrial Ecosystem Flux Research Network (ChinaFLUX) integrated turbulent flux computation, quality control and gap filling, separation and calculation of carbon flux exchange of different time scales into a formulated procedure and developed it into a completed system in 2007. Although having addressed some traditional problems such as: tedious processing, inconsistent methods and lag of processing; the system's dependence on development platform led to the difficulties in data reuse, exchange and sharing. On the view of improvement, ChinaFLUX designed and published flux processing Web Services and coupled online flux processing system. In addition, to further automate the flux processing and analysis, we built an automated processing platform based on scientific workflow, and realize remote calling of flux processing web services by using Kepler. The innovation team by now has accomplished the convenient, fast, integrated and automated flux data processing, as well as algorithms reusing and sharing. Doubtlessly, the building of CO_2 Flux Data Processing System by ChinaFLUX has made and will, as always, make contribution to the flux research community in the future data processing algorithms expanding, reusing and sharing.

Keywords: Chinese Terrestrial Ecosystem Flux Research Network (ChinaFLUX), CO_2 flux data processing system, web service, scientific workflow, Kepler

O10

IMPACT OF THE ASIAN MONSOON CLIMATE ON ECOSYSTEM CARBON AND WATER EXCHANGES

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The monsoon system is an important natural driver of ecosystem carbon and water exchanges in Asia and is being altered by anthropogenic forcings. This system is accompanied by heavy rainfall and typhoons in the main growing season, thus causing alterations of environmental conditions such as rainfall, wind, and temperature; therefore, it acts as a natural disturbance to forests in Asia. Therefore, degradation of ecosystem service by monsoon activity reinforced by anthropogenic factors in a changing climate is of great concern. In this study, we presented observational evidences for the interplay of terrestrial carbon and water dynamics with the Asian monsoon and their implication in ecosystem modeling. We analyzed three-year eddy-covariance data at a temperate deciduous forest in Korea. We used wavelet power and coherence spectra to investigate the Asian monsoon system and to determine its impact on the ecosystem. During the study period, our analysis showed strong coupling between ecosystem functioning and temporal variations of monsoon climate. Further scrutiny on the model outputs showed that the model did not accurately reproduce the observed plant phenology and thus ecosystem carbon and water exchanges disturbed by monsoon activities. Our findings suggest that under projected climate scenarios, terrestrial carbon sinks in monsoon Asia will decline if the monsoon disturbance will exceed its natural range of variation and if there is no enhancement in the robustness of the ecosystem in this region. More information can be found in Hong and Kim (2010).

Acknowledgement

This research was supported by ″Advanced Research on Meteorological Sciences (NIMR-2009-C-1)″ of the National Institute of Meteorological Research/Korea Meteorological Administration, a grant (code: 1-8-3) from Sustainable Water Resources Research Center for 21st Century Frontier Research Program, and the A3 Foresight program of the Korean Science and Engineering Foundation.

Reference

Hong J and Kim J (2010) Impact of the Asian monsoon climate on ecosystem carbon and water exchanges: A wavelet analysis and its ecosystem modeling implications, Global Change *Biology*, *in press*.

O11

CHARACTERS OF CARBON AND NITROGEN CONCENTRATIONS OUTLET FROM TROPICAL SEASONAL RAINFOREST SMALL CATCHMENTS IN XISHUANGBANNA, SOUTHWEST CHINA

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Despite growing attention concerning the role of dissolved organic carbon (DOC) in forest ecosystems, but the concentrations characters of total carbon (TC), total dissolved carbon (TDC), total inorganic carbon (TIC), total organic carbon (TOC), total nitrogen (TN), dissolved organic carbon (DOC), dissolved inorganic carbon (DIC) and dissolved nitrogen (DN) under field condition in tropical seasonal rainforest remain poorly understand. In a one-year study, we investigated the seasonal variation in TC, TDC, TOC, DOC, TIC, DIC, TN, DN and their relations among them and their relationships with rainfall, stream flow and stream water temperature in two small catchments in tropical seasonal rain forest in Xishuangbanna, Southwest China. All the concentrations of total and dissolved carbon and nitrogen, stream flow, rainfall, stream water temperature were measured concurrently with all the carbon and nitrogen components detected by TOC/TN analyzer (Eelementar, Germany) for one year from Jan. 2009 to Dec. 2009 in two small catchments, one is 25.4 ha (S1), another is 75.9 ha (S2). In the both stream, 1) All the carbon and nitrogen concentrations have variances in seasonal dynamic: TIC and DIC: dry hot season > fog cool season > rainy season, and others components are at the same seasonal ranks: dry hot season > rainy season > fog-cool season. 2) By compared the concentrations in two catchments: TIC, DIC concentrations were higher in S2 in every season, TOC, DOC, TN, DN concentrations were greater in S1 in every season, but the TDC and TC concentrations were the higher in S1 in dry hot season, were the less in other seasons. 3）TDC occupied most of TC in both stream, and DIC was the maximum carbon component. Except TDC, there existed obvious difference in the rations of each carbon and nitrogen component to TC between two headwater streams. The C: N ratios were differing each other in both headwater streams. 4) Not every carbon and nitrogen components concentrations related to rainfall, temperature and stream flow. There were differences in the relationships between concentrations and environmental factors even though the same components concentration in the both catchments. In consequence, the concentration of total and dissolved, carbon and nitrogen concentrations were varied seasonal. The influences from environment factors were not in line in two headstreams. The concentrations of carbon and nitrogen, all proportions of different carbon component to total carbon and the ratios of carbon to nitrogen of S1 were not agreed with those of S2.

O12

A COMPREHENSIVE STUDY OF CARBON AND WATER METABOLISM OF A TROPICAL SEASONAL RAIN FOREST

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Tropical rain forests play important roles in the global carbon cycle and climate change. We report a six-year eddy covariance carbon and water flux campaign in a primary tropical seasonal rain forest in southwest China. Additional measurements such as inventory, soil respiration were also carried out. The results show that: An unexpected seasonal pattern of net ecosystem carbon exchange was detected, with carbon lost during the rainy season and stored in the dry season. Strong seasonality of ecosystem respiration was suggested to primarily account for this seasonal pattern. The studied ecosystem was a carbon sink as determined by both eddy covariance (1.19 Mg C ha^{-1} yr^{-1}) and biometric methods (3.59 Mg C ha^{-1} yr^{-1}). Biometric and eddy covariance based net ecosystem production showed no convergence in our investigation period. The large biomass increment, caused by the rapid annual growth rate of large trees, primarily accounted for the large ecosystem carbon sink derived from the biometric method. High leaf respiration in relation to carbon allocation and low ecosystem carbon use efficiency (0.34) were observed at our site. Mean daily ecosystem ET was 2.6 mm day^{-1} during the dry season from November to April and was 3.1 mm day^{-1} during the rainy season from May to October. ET was controlled by soil water availability in the hot-dry season, by LAI in the early rain season and by atmospheric conditions in the mid-to-late rainy season and the cool-dry season. The total ET was substantially higher than the corresponding precipitation in the dry season. The extra amount of water evaporated in the dry season was mainly due to the depletion of soil water stored in the previous rainy season.

This report was based on the following three publications (*indicates corresponding author):

1. Zhang Yiping*, Tan Zhenghong, Song Qinghai, Yu Guirui, Sun Xiaomin, 2010, Respiration controls the unexpected seasonal pattern of carbon flux in an Asian tropical rain forest, *Atmospheric Environment*, **doi:10.1016/j.atmosenv.2010.07.027.**
2. Tan Zhenghong, Zhang Yiping*, Yu Guirui, Sha Liqing, Sun Xiaomin, Tan Jiangwei, Den Xiaobao and Song Qinghai, 2010, The carbon balance of a primary tropical seasonal rain forest, *Journal of Geophysical Research-Atmospheres*, **115, D00H26**, **doi:10.1029/2009JD012913.**
3. Li Zhiheng, Zhang Yiping*, Wang Shusen, Yuan Guofu, Yang Yan, Cao Min. 2010, Evapotranspiration of a tropical rain forest in Xishuangbanna, southwest China, *Hydrological Processes*, **2010, 24**, **2405 – 2416, doi: 10.1002/hyp.7643.**

O13

EFFECTS OF SIMULATED NITROGEN DEPOSITION ON GROWTH AND PHOTOSYNTHESIS OF 1-YEAR-OLD CHINESE FIR (*CUNNINGHAMIA LANCEOLATA*) SEEDLINGS

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To study the impact of nitrogen deposition on 1-year-old Chinese fir (*Cunninghamia lanceolata*) seedlings in pots, the dissolved NH_4NO_3 was sprayed on the seedlings every 3 days for 1 year. The simulated elevated N depositions were equivalent to N0 (0), N1 (6 g N/(m^2 a)), N2 (12 g N/(m^2 a)), N3 (24 g N/(m^2 a)) and N4 (48 g N/(m^2 a)). The results indicated that medium N treatments (N2, N3) enhanced growth significantly. The height, stem base diameter and per-seedling biomass of Chinese fir seedlings increased with N loads and decreased in the high N treatments. Compared to N0, the height and per-seedling biomass were highest in N2 treatment and increased by 10.77% and 12.35%, respectively. The stem base diameter was highest in N3 treatment and increased by 8.81% compared to N0. The net photosynthetic rate (Pn) in treatments N1, N2, N3, N4 increased by 1.20%, 9.28%, 24.23% and 4.30%, and the highest photosynthetic rate by 67.09%, 125.32%, 148.10% and 51.90%, respectively. The N1–N3 treatments, especially N2, stimulated light compensation point (LCP) of the seedlings significantly, but N4 exhibited inhibitive effect. Compared with LCP, light saturation point (LSP) showed weaker response to N loads, positive to N2, but negative to all other N treatments. Low-to-medium N treatments (N1, N2) enhanced Chl (a + b) by 2.19% and 37.15%, while medium-to-high N treatments (N3, N4) reduced Chl (a + b) by 7.95% and 15.56%, respectively. Water use efficiency (WUE) and stomatal conductance (C) decreased slightly with N loads.

O14

THE MULTI-TEMPORAL SCALE ANALYSIS OF ENVIRONMENTAL CONTROL ON NET ECOSYSTEM EXCHANGE OF CO_2 IN FOREST ECOSYSTEMS

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Temporal periodic variation in net ecosystem exchange of carbon dioxide (NEE) was decided by relevant temporal variation in meteorological forcing variables, biological processes, and phenology, which span hours, days, seasons, and years. In this study, we chose two typical forest ecosystems of China, Changbaishan temperate mixed forest (CBS) and Dinghushan subtropical evergreen broad-leaved forest (DHS). Continuous wavelet transform was applied to identify temporal pattern of periodicities of NEE in the two forest ecosystems, based on half hour CO_2 flux data and routine meteorological data measured from 2005 to 2008. Cross wavelet transform and wavelet coherence were applied to examine changes in relationships between NEE and environmental variables with temporal scales in the two ecosystems. Our analyses show that NEE at CBS had pronounced periodicities at daily scale (1 day) during growing season, semi-annual scale (176 days), and annual scale (352 days). The NEE at DHS had pronounced periodicities at daily scale (1day), three month (88-104 days) scale, and annual scale (352 days). In the two forest ecosystems, dominant environmental factors controlling NEE were light factor (photosynthetic active radiation, PAR) at daily scale, but temperature (air temperature, T_a, soil temperature, T_s) and water factors (vapor press deficit, VPD, soil water content, SWC, and precipitation, P) at annual scale. At CBS, phase difference between NEE and PAR was almost anti-phase (–180°) at daily scale, and about –160° at annual scale. However, phase differences between NEE and T_a, NEE and P were anti-phase at annual scale. At DHS, phase difference between NEE and PAR was anti-phase at daily scale, and about 130° at annual scale. Phase difference between NEE and T_a, NEE and P were almost 90° and 70°, respectively, at annual scale. The results indicate that the temporal course of net carbon uptake in the two ecosystems corresponded with PAR at daily scale. However, at annual scale, the changes in net carbon uptake at CBS were in agreement with temperature and precipitation. At DHS, temperature and water factors controlled the changes in net carbon uptake at annual scale, but the temporal pattern of net carbon uptake was not the same to the temporal patterns of temperature and water factor. Uncovering temporal periodic variation in NEE and changes in environmental control on NEE with temporal scale can promote development and test for cross-scale mechanism models of carbon cycle. These will improve accurate evaluation of ecosystem carbon budget and ecosystem carbon sink/source management under climate change.

O15

CARBON-WATER RELATIONS IN TYPICAL ECOSYSTEMS IN CHINA: RESULTS FROM FLUX MEASUREMENTS AND FIELD SURVEYS ALONG CLIMATIC GRADIENTS

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Water is a key factor controlling ecosystem carbon fluxes in most ecosystems. Focusing on the relationship between precipitation and vegetation productivity, as well as ecosystem-level water use efficiency (GPP/ET), we reviewed our studies on carbon-water relations in typical ecosystems in China. With the approaches of in situ eddy covariance measurements and surveys along climatic gradients, we conducted our work along two terrestrial transect in China: China Grassland Transect (CGT) and North South Transect of East China (NSTEC). The former is a grassland transect with a precipitation gradient, and the later is a forest transect with a temperature gradient. Our main findings are (1) ANPP increases exponentially with the increase of mean annual precipitation (MAP) along CGT. The inter-annual variation in ANPP is greater in dry regions than that in arid regions. (2) PUE increases with MAP along the precipitation gradient on CGT, implying the relationship between vegetation productivity and MAP at regional and global scales should be a logistic form function, rather than the exponential function as the popular Miami model describes. (3) Forests have higher WUE than grasslands. Seasonal and inter-annual variations in WUE are mainly controlled by leaf area index (LAI) in grasslands, and by canopy conductance, which is influenced by environmental factors, in forests; (4) Precipitation and temperature is the key driving factor controlling the spatial variations in WUE across ecosystems.

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O16

INTERANNUAL NET CO_2 EXCHANGE IN A CONTINENTAL ALPINE MEADOW ECOSYSTEM ON THE NORTHERN TIBETAN PLATEAU

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Aim: The alpine meadows of the Tibetan plateau in continental climate condition experience interannual variation and frequent episodic weather events. A long-term measurement is needed to quantified carbon dynamics in a range of climatic conditions. To examine the impact of precipitation variability affected soil moisture on ecosystem CO_2 exchange, the change of carbon sink-source relationship was analyzed during the period 2003–2008.

Location: In Damxung alpine meadow, Tibetan Autonomous Region, China (30°29'52.20"N; 91° 3'59.04"E, 4316 m a.s.l.).

Methods: Observations of 5-year eddy covariance measurement of CO_2 exchange in semi-arid climate on the Tibetan Plateau were examined by univariate linear or non-linear regression analysis. Multiple linear regressions were used to analyze the primary controlling factors of CO_2 fluxes at 8-day and annual scale. The effects of environmental moisture factors, i.e. soil moisture, precipitation, VPD, evapotranspiration fraction (EF) and land surface water index(LSWI) on CO_2 fluxes were compared. The relationships of CO_2 fluxes with NDVI, enhanced vegetation index (EVI) and LAI were also compared. Additionally, we analyzed the relationships between CO_2 fluxes and albedo or LST.

Results: 1) Soil moisture was one of the most important environment factors controlling CO_2 budget. 2) NDVI, EVI, LAI, LSWI and EF were all significantly related to NEE, GEE or Re. Additionally, LST was also significantly related to NEE or GEE. 3) Precipitation could affect annual variations of CO_2 budget to some extent. When the annual precipitation amount was below the multi-year mean precipitation, the alpine meadow acted as a net carbon source, conversely contrary. 4) The optimal air temperature for net carbon uptake and gross carbon uptake were 9.41°C and 9.65°C, respectively. 5) Albedo was also an important factor controlling CO_2 fluxes. NEE, GEE and Re all decreased with increasing albedo.

O17

ROOT AND MICROBIAL RESPIRATION IN A SEASONAL DRY DIPTEROCARP FOREST, THAILAND

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Soil respiration is one of the most important processes in the carbon cycle of terrestrial ecosystems. Understanding soil respiration and its sub-components (i.e. root versus microbial respiration) is thus important for evaluating its roles in global carbon cycle and its response/feedbacks to climate change/climate variability. However, study of soil respiration and partitioning it into sub-components are sparse in tropical forest ecosystem. Particularly, there is very little information either on seasonal and diurnal variations of root and microbe respiration, or the explanation why such variations occur. This study, thus, aims to determine the fluxes, estimate the contribution of root and microbial respiration to overall soil respiration, and investigate variations of CO_2 emissions from dry dipterocarp forest soil. The emission and partition of CO_2 from soils were studied by using trenching method in associated with the automated chamber. The study was carried out in a regenerated dry dipterocarp forest, Ratchaburi Province (13^o 35' 13.3" N, 99^o 30' 3.9" E), western Thailand. Soil respiration at the site was measured hourly and continuously since February 2008 and this paper reports the results since that time up to January, 2009. The result of total emissions from soil during a year period was 3.06 $kgCO_2$ m^{-2}, or 8.36 tC ha^{-1}. This was partitioned into emissions from root respiration as 1.08 $kgCO_2$ m^{-2} or 2.95 tC ha^{-1} (35 % of total) and microbial respiration as 1.99 $kgCO_2$ m^{-2} or 5.42 tC ha^{-1} (65 % of total), respectively. In addition, the results showed strong seasonal patterns that were positively correlated with soil moisture. During February, 2008 to January, 2009, contribution of microbial to total respiration ranged from 52% to 82.15%, being highest in August. In this dry dipterocarp forest, microbial respiration seems to response more actively than root respiration to moisture and temperature changes.

Keywords: Soil respiration, Microbe respiration, Root respiration, Seasonal variations, Dry dipterocarp forest

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O18

MODELLING N_2O EMISSIONS FROM AGROECOSYSTEMS USING WNMM

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N_2O is a potent and long-lived greenhouse gas, contributes a Radiative Forcing of +0.16±0.02 W m^{-2} of the atmospheric greenhouse effect, and is very effective in absorbing infrared radiation, and its global warming potential is 310 times greater than carbon dioxide (CO_2) for a 100-year time horizon. Anthropogenic activities contributing to N_2O emissions include the application of N fertilizers, crop biological N fixation, tillage, irrigation, animal manure, aquifers, sewage, industry, automobiles, biomass burning, land clearing and trash incineration. More than 60% of N_2O emissions come from soil-based processes (Prather *et al*. 1995). Globally, agricultural lands contribute about 35% of all N_2O emissions (FAO/IFA 2001). The production of N_2O from soils is primarily from the microbially-mediated nitrification and denitrification processes. N_2O flux from soils, relatively small compared to other N fluxes, is dependent on soil temperature, soil water content, O_2 availability, N substrate availability (nitrate and ammonium), and organic C substrate availability (Davidson 1991). All these regulators are strongly influenced by climate, vegetation, soil properties (bulk density, organic matter, pH and clay content), and land-use management or agricultural practices. N_2O production is also influenced by other complex interacting N processes in the plant-soil N cycle, such as plant N uptake, ammonia volatilisation and nitrate leaching. All these influencing variables and processes contribute to high spatial and temporal variability of N_2O emissions. Computational models, which simulate N_2O emissions from soils by integrating all the influencing variables and interacting processes, provide a useful means of assessing gas fluxes at field-to-regional scales (Chen *et al*. 2008). Since the first Focht's N_2O simulation model, various models were constructed to predict N_2O production from nitrification and denitrification in agroecosystems, such as DNDC (Li *et al*. 1992), ecosys (Grant 2001), DAYCENT (Parton *et al*. 2001), WNMM (Li *et al*. 2005), FASSET (Chatskikh *et al*. 2005), CERES-NOE (Gabrielle *et al*. 2006) and so on. In this paper, we report on our experiences of simulating N_2O emissions from irrigated maize-wheat, irrigated wheat, rainfed wheat, irrigated pasture and sugarcane ecosystems by using the Water and Nitrogen Management Model (WNMM).

O19

CONTRIBUTION OF ORGANIC NITROGEN TO PLANT NUTRITION DEPENDS ON SOIL ORGANIC NITROGEN CONCENTRATION IN GRASSLANDS

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Terrestrial plants have been identified to have the capacity to take up organic nitrogen (N) directly from soils, and it has been suggested that organic N contributes much more to plant N nutrition in N-limited than N-sufficient ecosystems. However, only very a few studies have attempted to quantify the ecological significance of organic N to plant N nutrition in the field. We quantified the contribution of organic N to plant nutrition in the field applying either double-labelled (^{14}C and ^{15}N) algae or a mixture of ^{15}N labelled inorganic (ammonium, nitrate) and organic N forms (glycine) in a temperate steppe in Inner Mongolia and an alpine meadow in the Tibetan Plateau.

Using double-labelled (^{14}C and ^{15}N) algae, we showed that organic N contributed >13% to plant nutrition in *Stipa aliena* and *Saussurea superba* and >21% in *Kobresia humilis* in the alpine meadow with high soil organic matter (SOM) concentration. By comparison, organic N only contributed <5% in *Leymus chinensis*, *Festuca ovina* and *Artemisia tanacetifolia* in the temperate steppe with low SOM concentration.

Using a mixture of ^{15}N-labelled N forms, we used a fairy ring in the alpine meadow showed organic N contributed much more to plant nutrition for the five dominant species (*Kobresia humilis*, *Elymus nutans*, *Stipa aliena*, *Gueldenstaedtia diversifolia* and *Gentiana straminea*) in the fungus growing zone (high N available level) than in the outer zone (low N available level) of the fairy ring. Likely, we found in the temperate steppe that two dominant species (*Leymus chinensis* and *Festuca ovina*) at higher N available level took more organic N from soils than at lower N available level. These findings have important implications that dominant species can switch their N uptake patterns to acclimate to nutrient enrichment and that the contribution of organic N to plant nutrition in grasslands is positively related to the concentration of organic N in soils.

Keywords: ^{15}N labeled approach, organic N, inorganic N, temperate steppe, alpine meadow

O20

CARBON BUDGET AND MANAGEMENT FOR EASTERN ASIAN GRASSLANDS

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There is clearly a great deal of uncertainty regarding the role of grasslands in the global carbon budget, and the drivers of CO_2 flux dynamics differ among a range of grasslands under various climatic conditions and management practices. There are evidences that some grassland can be significant sources or sinks of atmospheric CO_2, while other of these lands are carbon neutral. Studies have shown that the annual amount and the timing of precipitation remain dominant factors in the CO_2 exchange in temperate semiarid grassland and Mediterranean grassland. There are large areas of temperate and alpine grasslands in East Asia. The temperate steppe represents one of the typical vegetation types on the Eurasian continent. This ecosystem is more xeric and water stressed than many other ecosystems and is ecologically fragile and sensitive to climate change (Li et al., 2005; Niu et al., 2008). An experimental study has found reductions in CO_2 flux under warming, whereas increased precipitation stimulated ecosystem CO_2 fluxes and also alleviated the negative effects of warming on NEE (Niu et al., 2008). Meanwhile, alpine meadow ecosystems also covers a large area with high soil carbon density (Ni, 2002), which may have played an important role in global carbon cycles. Studies have indicated that alpine meadows are highly sensitive to temperature change (Kato et al., 2006) and may have significant potential for releasing CO_2 under climatic warming because of the sensitivity of frigid soil to warming (Wang et al., 2002). In our presentation, we will give a general overview on carbon budgets in grassland ecosystem and the effects of climate change and human disturbance on carbon budget of grasslands in eastern Asia, which will help provide scientific support for sustainable management on grasslands in East Asia.

O21

THE CARBON STORAGE OF OLD-GROWTH FORESTS MEANS THE HUGE POTENTIAL CARBON SEQUESTRATION FOR THE WORLD FOREST

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Old forest is regarded as the reference of the most carbon stock for the planted or forest before mature stage. We searched literature and databases for site aboveground biomass from global old-growth forests, calculated the average aboveground biomass of each ecological zone, tried to develop the relationship of aboveground biomass with the latitude, longitude, temperature and precipitation, and obtained potential aboveground carbon storage of global forest by spatial interpolation. We discovered (1) the mean aboveground biomass of old-growth forest for each ecological zone was more than the values that Intergovernmental Panel on Climate Change advised values, temperate oceanic forest was the most carbon-dense forests of the world, about 213 t C ha^{-1}, more than tropical rainforest, about 195 t C ha^{-1}. (2) At global scale, the aboveground biomass of old-growth forests declined from tropical to polar and this feature of zonal law is significant in eastern Asia, north of the Euro-Asia continent, America East, Africa. (3) The old-growth forests had more aboveground biomass in the ecological zone with higher temperature and more precipitation. Temperature was the most important factor that influent the aboveground biomass of old-growth forests. The aboveground biomass rose first and down as the mean annual temperature changing from -20 to 28℃, the turning point was about 10℃. (4) The potential aboveground biomass of the global forest was 538.76 Pg C, tropical rainforests was the most carbon storage ecological zone, about 322.78 Pg C, and Africa is the most carbon storage continent, about 135.83 Pg C. The huge aboveground biomass and potential carbon storage of old-growth shows the large amount of carbon sequestration.

Keywords: Globe, Old forest, Aboveground biomass, Potential carbon storage

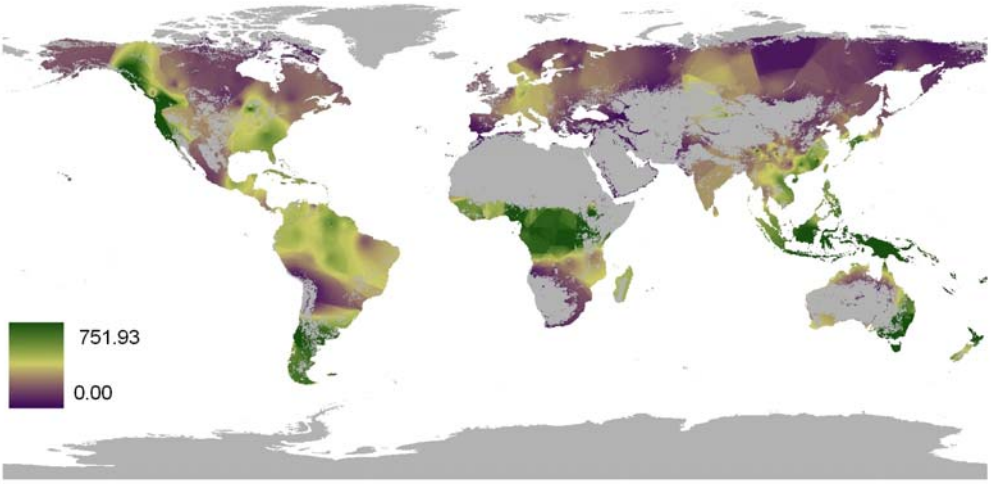

Figure Spatial distribution of global forest biomass potential

O22

STOICHIOMETRIC RESPONSE OF PLANTATION TO NITROGEN AND PHOSPHORUS FERTILIZATION IN SUBTROPICAL CHINA

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Nitrogen (N) and phosphorus (P) availability can limit vegetation growth in most terrestrial ecosystems. It is widely acknowledged that N and P addition will modify ecosystem structure and function. We examined the effects of N and P additions (100 kg N ha^{-1} $year^{-1}$, 100 kg P ha^{-1} $year^{-1}$, 100 kg N ha^{-1} $year^{-1}$+100 kg P ha^{-1} $year^{-1}$) on foliar chemistry and stoichiometric ratios (C:N:P ratios) of four dominant species (*Pinus elliottii, Pinus massoniana, Cunninghamia Lanceolata, Schima superba*) in a subtropical plantation in southern China. After three years of addition, we found that plant samples responded miscellaneous to the treatment. N addition increased little C:N ratios, but this response was adverted in the P addition treatments. Fertilization generally lowered N:P ratios.

Key Words: Ecological Stoichiometry, Fertilizer enrichment, plantation, tissue nutrient concentrations

O23

N_2O EMISSIONS FROM A TEA FIELD IN SUBTROPICAL CHINA

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Nitrous oxide (N_2O) is one of the potent greenhouse gases, and accurate estimation of N_2O emissions from fertilized arable lands is vital for the national greenhouse gas inventory and the development of emission mitigation strategies. It is well-known that acidic soils are characterised with low pH, high acidification and high N_2O production and emissions due to chemo-denitrification, compared with other cropped soils. Given the booming and intensifying of tea industries in subtropical China, we therefore continuously observed N_2O emissions from a tea field using the static closed chamber method under three different agricultural practices: the conventional treatment (CON, 450 kg N ha^{-1} y^{-1} with three even splits: two in March-May using urea and one in October using oil seed trashes), the rice straw mulching treatment (SM, the nitrogen fertilizer application rate refers to the CON treatment), and the non-fertilizer treatment (CK). The measurements start from January 2010 and we have made observations of N_2O emissions from the soil for eight months so far. The straw mulching and fertilization took placed on 25 March and 15 April 2010, respectively. The results show that the fertilization moderately favored N_2O emissions from the tea field soil. Compared with CK (emitted 12.0 kg N ha^{-1} N_2O), CON and SM both showed larger N_2O emissions, and they emitted 24.9 and 22.2 kg N ha^{-1}, respectively, for the whole observation period. SM emitted slightly less N_2O than CON. Thus it may imply that the rice straw mulching, the widely used practice to transfer organic materials from lowland to upland in subtropical region of China, has the potential to reduce N_2O emissions in the tea field. Other environmental variables may also play important roles in controlling N_2O emissions, such as topography, temperature and rainfall. We observed that low fluxes responded well to cold seasons and high fluxes to the continuous raining seasons. In addition, with each sampling, we observed that N_2O concentrations in chambers show a significantly positive linear correlation with the time. Furthermore, the increasing rates of the N_2O concentration in chambers vary among treatments and land uses. We also plan a study of combined temporal and spatial variability of N_2O emissions to investigate the N_2O emission characteristics in the tea field.

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O24

NITROUS OXIDE EMISSIONS FROM AGRICULTURE IN CHINA

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Based on the IPCC (2006) methodology, this paper presents a systematic estimation of nitrous oxide emissions from agriculture (NEA) in China from 1990 to 2008. The result is that NEA increased from 433.9 Gg N_2O-N in 1990 to 637.7 Gg N_2O-N in 2008, with an average annual increase of 2.16%. In respect of source categories, direct emissions from agricultural soils (DEAS) are the main sources of NEA in China, and synthetic nitrogen fertilizers and urine and dung deposited by grazing animals on grassland are the main sources of DEAS. In respect of spatial distribution, the North China Plain (including Shandong, Henan, and Hebei Province) and the Sichuan Basin (including Sichuan Province and Chongqing City) were regions with highest NEA in China. Differences between our estimates and others and uncertainties in this paper are mainly due to emission factors for direct N_2O emissions from fertilized cropland (EF_1) and fractions of total nitrogen excretion managed in each AMMS ($MS_{(T,S)}$). Finally, in respect of mitigation strategy and environmental management, we recommend the combination of mitigation strategies of NEA and non-point pollution prevention, the comprehensive assessment on the GHG effects of various measures in agriculture, as well as enhanced data monitoring and statistics to assess NEA in China.

O25

IMPACTS OF EXTREME PRECIPITATION ON TREE PLANTATION CARBON CYCLE

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Extreme precipitation events are expected to increase in frequency and magnitude in the future due to global warming. In this study, we use an atmospheric-vegetation interaction model (AVIM2) to estimate the likely impacts of extreme precipitation events on ecosystem carbon fluxes and carbon stocks in south China tree plantation. Our results indicate that shifting from moderate precipitation events to extreme precipitation events, keeping the monthly precipitation unattained, could decrease the tree plantation carbon accumulation. The tree plantation net primary productivity, net ecosystem productivity, soil carbon stock, and vegetation carbon stock could be decreased. The sensitivity test shows that the tree plantation carbon stock could decrease by 3.3% if the extreme precipitation last for 500 years.

O26

ASSESSMENT OF THE DAMAGE CAUSED BY THE 2008 ICE STORM ON SUBTROPICAL FOREST IN JIANGXI, CHINA

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In early 2008, an unexpected ice storm hit the southern China, caused heavy damage to forest ecosystems, especially in subtropical region, such as in Jiangxi and Hunan provinces. The objective of this study is to evaluate the damage of subtropical forest resulted from the severe ice storm and to analyze the effect of terrain factors on the damage with remote sensing data in Jiangxi Province. Results indicated that the ice storm caused EVI abruptly decreased from 0.28 to 0.23. The damages of forest are obviously affected by topography conditions. With elevations higher, the EVI losses curve had a parabola trend, which inflection point was around elevation 700m. And the larger EVI losses occurred at deeper slope. The EVI loss was the least on the south slopes and gradually intensified to the southwest, northeast, northwest and north slopes. But the difference on EVI reduction between south and north slope showed a decreasing trend with the increasing elevation from 9 m to 1000 m, and tend to zero when elevations higher than 1000m. We found that the reduction on EVI by the ice storm is quite similar for mixed coniferous forest (0.037) and native hardwood forests (0.039), but is the highest for the pure coniferous forests (0.045). This result suggests that the artificial pure coniferous forests are most vulnerable to the ice storm disturbance.

O27

EVAPOTRANSPIRATION AND ENERGY EXCHANGE IN FLOODED AND AEROBIC RICE FIELDS IN THE PHILIPPINES

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The seasonal and annual variability of surface energy components, evapotranspiration, crop coefficient, and crop water productivity were investigated under two different rice environments: flooded and aerobic soil conditions, using the eddy covariance technique during 2008-2009 cropping periods. This study was intended to monitor the environmental impact, in terms of evapotranspiration and energy exchange, of shifting from lowland rice production to aerobic rice cultivation as an alternative to maintain crop productivity under water scarcity.

Average of four cropping seasons, the available net radiation was partitioned to 85.7±4.6% latent heat flux (LE), 12.5±2.9% sensible heat flux (H), and less than 1% soil heat flux (G) for the flooded rice field while it was 80.5±1.4% latent heat flux (LE), 18.9±0.8% sensible heat flux (H), and less than 1% soil heat flux (G) for the aerobic field. The aerobic rice fields had higher sensible heat flux and lower latent heat flux than flooded fields. The aerobic rice fields had 48% more sensible heat flux while flooded rice fields had 10% more latent heat flux. Consequently, the aerobic rice fields had significantly higher Bowen ratio (0.22±0.02) than flooded fields (0.14±0.04), indicating that a larger proportion of the available net radiation was used for sensible heat transfer or for warming the surrounding air.

The aerobic rice field had significantly lower average growing season evapotranspiration (ET) rates (3.86±0.26 mm d^{-1}) than the flooded field (4.28±0.23 mm d^{-1}). The ET rates in aerobic rice fields were influenced more by bulk surface conductance (G_s) while the flooded rice fields were primarily controlled by net radiation. The crop coefficient, K_c, of aerobic fields (0.97±0.04) was significantly lower than that of flooded rice fields (1.08±0.08).

However, the crop water productivity (WP_{ET}) of aerobic rice (0.39-0.46 g grain kg^{-1} water) was significantly lower than that of flooded rice (0.88-1.51 g grain kg^{-1} water). Even if the total evapotranspiration of the aerobic rice fields was about 10% lower than that of the flooded fields, but the yield of the aerobic rice was much lower than that of the flooded rice, so, the WP_{ET} of aerobic fields was about 60% lower than that of the flooded rice fields.

The concept of aerobic rice holds promise as a water-saving technology in the tropics if water productivity could be enhanced through the development of aerobic rice varieties that can achieve high yields per unit evapotranspiration. Likewise, to reduce sensible heat transfer that brings warmer aerobic rice environment, the amount and timing of irrigation input should also be optimized so as to prevent extreme dry soil conditions.

The results of this investigation will contribute to a thorough evaluation of alternative water-saving technologies by providing a unique opportunity to understand the environmental impact of water and heat exchange over different rice production systems.

O28

PHYSICAL PROTECTION OF SOIL AGGREGATE INHIBIT THE RESPONSE OF SOIL ORGANIC MATTER DECOMPOSITION TO TEMPERATURE CHANGE

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The increase in global temperature could accelerate the decomposition of soil organic matter, which could feedback on the climate system. The direction and magnitude of terrestrial carbon cycle feedback to projected global warming is the temperature sensitivity of soil respiration. Given to most of soil organic matter is stabilised by several chemical and physical mechanisms within soil architecture, we hypothesized that the compartmentlization of substrates and soil microbes in the soil matrix could decline the temperature sensitivity of soil organic matter decomposition. We test our hypothesis by incubating soils with different aggregate size (CK, 200-2000 μm, 65-200 μm, and <65 μm) treatments conducted at five temperature regimes. Overall, soil CO_2 efflux increased exponentially with temperature increasing, but the temperature sensitivity of soil respiration was similar among three aggregate size treatments. Surcase activity generally increased with aggregate size decreasing, regardless of soil depth. Isolated soil aggregates showed higher or significantly higher surcase activity than bulk soil. However there were no significant difference in cellulose activity between bulk and isolated soil aggregates. Water soluble carbon content vared greatly among different aggregate size and locations. ANOVA results showed that soil depth and location, other than aggregate sizes had dramatic effects on Q10. Similarily results of stepwise regression indicated that there was no causal relationship between soil aggregate size and Q10. These results indicate the decreased effect on Q10 in the microaggregates originates from soil organic matter protection rather than from microbial properties or other nutrient limitations. In conclusion, we found experimental evidence that soil organic matter protection can weaken the temperature sensitivity of soil organic matter decomposition.

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O29

DETECTING THE IMPACT OF THE CLIMATIC FACTORS AND LAND USE PRACTICES ON THE VEGETATION DISTRIBUTION IN NORTHERN SHAANXI PROVINCE, CHINA

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Global climate changes and land management practices variations have altered the vegetation distribution recent years especially in the arid and semi-arid region. It would be much easier to understand how these factors affect the ecosystem if the spatial and temporal dynamics of the vegetation cover were mapped in the environmental sensitive areas. An example of a typical ecologically fragile area in China, northern Shaanxi Province, is presented to investigate what vegetation changes are seen at the regional scale, and how they correlate to local land-use changes and/or land management policies. This area is under the backgrounds of returning farmland to forestland, grassland and of the integrated management of soil and water loss from 2000 to 2008. The data included in this integrated assessment includes remote sensing information acquired with MODIS-NDVI, climate and statistical data, as well as farmers' participatory data. The results show that the large-scale vegetation cover has increased, which correlates well with the ecological restoration efforts. The vegetation cover change shows some correlation with the climate variables (both lagged and simultaneous) but climatic factors alone do not fully explain the regional increase in vegetation. Although climate changes have some impact on regional scale vegetation pattern, the direct force behind the significant vegetation change is most likely associated with land use policies. The results from this study are contributing to the increasing growth of literature in climate change research and the land use practices on the complex issue of multiple stressors. The vegetation cover is effectively increased as a prospective goal by the land management practices of China.

O30

SOIL CARBON STOCK AND FLUXES OF TWO TYPICAL ECOSYSTEMS IN A SEMIARID AREA, LOESS PLATEAU OF CHINA

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Carbon sequestrations are found when cultivated soils are allowed to revert to native vegetation. In the hilly area of Loess Plateau, China, the Chinese government has provided huge amounts of funds and established incentive policies to discourage farmers from cultivation of short-term crops on the sloping land and instead to plant woodland shrubbery or grass to control soil and water loss and to improve environmental quality. *R. pseudoacacia* forest planted by human and grassland were two main vegetation types after cultivation abandoned on the hill slopes in Loess Plateau of China. The purpose of this study was to compare soil carbon stock and fluxes of these two different vegetations. The experiment was conducted in Yangjuangou catchment near Yan'an City, Shaanxi province, China. Two types of slopes, including F (forest planted by human) and G (grass) which restored for 25 years were chosen. The sample sites were spaced every 35-45m along the hill slope and each slope had six sampling sites. 0-10cm and 10-20cm soil samples were collected from each site to analyze soil organic carbon and other physicochemical properties. Meanwhile, soil respiration and environment factors included soil moisture and soil temperate were mensurated using LI8100 from 9:00 o'clock to 17:00 o'clock in July 2007, October 2007 and May 2008 in same sample sites. The average concentration of soil organic carbon under forest was 6.39g.kg^{-1} in 0-10cm and 4.85g.kg^{-1} in 10-20 cm; their values were higher than 5.57g.kg^{-1} and 4.69g.kg^{-1} for 0-10cm and 10-20cm of grassland. There was no significant difference of soil organic carbon stock between forest and grassland for the slope scale. The forest had 742gC.m^{-2} for 0-10 cm depth and 553gC.m^{-2} for 10-20 cm depth, while the grassland had 695gC.m^{-2} for 0-10 cm depth and 578gC.m^{-2} for 10-20 cm depth. However, the carbon stock had different variation trends along the slope for forest and grassland. The forest had higher carbon stock in middle slope and lower in lower slope both in 0-10 cm and 10-20 cm soil depth while the carbon stock of grassland was highest in lower slope. The carbon stock in upper slope and middle slope of forest were higher than grassland and grassland had higher carbon stock in lower slope than forest. Moreover, the significant differences were existed between these two vegetations under upper slope for 0-10 cm and lower slope for 10-20 cm. For the whole slope, the average daily values of soil CO_2 emission were 1.27 μmol.m^{-2}.s^{-1} and 1.39 μmol.m^{-2}.s^{-1} under forest and grassland respectively. Soil CO_2 emission had different diurnal and seasonal variation trends under forest and grassland. The carbon flux was higher in spring for forest and less variation between different seasons. The grassland had highest carbon flux in summer and about treble higher than autumn and spring. However, in draught season, the carbon fluxes of both two vegetation types were decrease with increasing soil temperate; soil moisture was the main limited factor in the draught season in the semiarid area. In conclusion, compare to grassland, forest on the slope had higher soil carbon stock and lower carbon flux, it was better for soil carbon sequestration. Along the slope, grassland had more effect on carbon distribution and made carbon deposited in the lower slope; forest seems to be better stick up to erosion and soil organic carbon was less removed.

O31

EFFECT OF SEASONAL SOIL MOISTURE DYNAMICS ON CARBON FLUXES OF *CENCHRUS CILIARIS* L. GRASSLAND IN SEMI-ARID REGION OF SOUTHERN INDIA

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Introduction：*Cenchrus ciliaris* L. (Buffel grass) is one of the most important forage crops of India and other tropical and semi-tropical regions of the world due to its low water demand, high nutrition content and ability to recover from grazing. Grasslands in semi-arid regions of the southern part of India experienced hot and dry summer which adversely affects the physiological conditions of plants. The semi-arid tropics are likely to undergo changes in future due to the critical environmental conditions of changing temperature and precipitation pattern.

Material and methods：Eddy Covariance (EC) was installed using CM10 tripod and 3D sonic anemometer and an open path infrared CO_2/H_2O analyzer (Model LI-7500: LI-Cor Inc., Lincoln, NE, USA) were installed 2m above the ground. Soil moisture reflectometer and averaging soil temperature probe were placed up to 8cm depth from the soil surface. Measurement was conducted during July, 2008 to June, 2009.

Results and discussion：

The daily NEE and soil moisture content showed similar seasonal variations. Ecosystem CO_2 uptake was observed soon after the rainfall during late July that indicate the starting of the growing season which lasted till the mid of January. The high CO_2 uptake during September to December corresponded with the rainy season during which high soil moisture content was observed. Maximum average CO_2 uptake of -18.73 g m^{-2} d^{-1} was observed in November. Soil moisture content showed minimum of 0.022 m^3 m^{-3} in July and maximum value of 0.275 m^3 m^{-3} in October. The gradual decrease in soil moisture from late December corresponded with the gradual decrease in CO_2 uptake and eventually the release of CO_2 by the ecosystem. Positive NEE from late January to June indicated that the ecosystem was a source of CO_2 in the dry season during which soil moisture was below 0.08 m^3 m^{-3}. Short duration of CO_2 uptake was observed after the rewetting during April and May of summer season.

The variation in diurnal NEE was strongly regulated by seasonal changes during the study period. During the wet season although there was high nocturnal CO_2 efflux from the ecosystem, the daytime uptake of CO_2 was comparatively much higher. Maximum average uptake of -1.809 g m^{-2} $30min^{-1}$ was observed during December at 12:30 hrs. In February, March and June, the average CO_2 fluxes were close to zero. In March, positive average NEE was observed during daytime which implies that the ecosystem respiration rate exceeded the assimilation rate due dormancy induced dry condition.

Ecosystem respiration (R_{eco}) showed similar pattern of seasonal variation with soil moisture. The R_{eco} ranged from 0.0309 CO_2 mg m^2 s^{-1} in July to 0.365 CO_2 mg m^2 s^{-1} in October which corresponded to the minimum soil moisture of 0.018 m^3 m^{-3} in July and maximum soil moisture of 0.324 m^3 m^{-3} in October. R_{eco} showed strong positive correlation (R^2=0.768) with soil moisture and, negative correlation with soil temperature (R^2=0.498).

From this preliminary study, it is evident that grassland ecosystems in semi-arid tropics are highly sensitive to changes in soil moisture content. The immediate response in carbon uptake to the increase in soil water content by rainfall and the high carbon uptake in the wet season proved that grasslands have high carbon sequestration capacity. The grassland being a carbon source during the dry season implies that grasslands in semi-arid regions are in a critical state under the global climate change where prolonged drought has been predicted in arid and semi-arid regions.

O32

DROUGHT SENSITIVITY OF A PRIMARY TROPICAL SEASONAL RAINFOREST

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Drought sensitivity of tropical rainforests is a central issue in research on the global carbon balance and climate change. Data from seven years (2003–2009) of continuous ecosystem monitoring, as well as additional measurements, were used to investigate the drought sensitivity of a primary tropical rainforest in Xishuangbanna, Southwest of China. Water budget, drought index, and canopy phenology data indicate that the forest experiences strong seasonal droughts. A local phenomenon, which we term "intensive leaf change," is characterized by trees shedding most of their leaves late in the dry season. This phenomenon appears to be an adaptive property to cope with seasonal drought. The interannual variability in fluxes of ecosystem carbon and water are closely linked to seasonal and interannual variations in root-weighted soil moisture. Lower evapotranspiration and photosynthetic carbon assimilation were observed in drier years. The Amazonian rainforest hypothesis that forests "green-up" in dry seasons and dry years, coincident with increased radiation, did not apply to the studied forest. Evapotranspiration did not peak in the late dry season, although higher vapor pressure and solar radiation were observed at this time. Seasonal drought affected ecosystem photosynthesis and transpiration mainly through morphological adjustments, and not physiological responses. In drier years, seasonal drought resulted in enhanced intensive leaf change and reduced photosynthesis and transpiration.

This report was based on the following manuscript (*indicates corresponding author):
Tan Zhenghong, Zhang Yiping*, Song Qinghai, Yu Guirui, 2010, Drought sensitivity of a primary tropical seasonal rainforest, *Water Resource Research*, **Revising.**

O33

QUANTIFYLING IMPACT OF TYPHOON ON NET ECOSYSTEM EXCHANGE IN A SUB-TROPICAL MANGROVE ECOSYSTEM

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Although typhoon is a natural disturbance for mangrove forests, possible impact of typhoon on net ecosystem exchange (NEE) of mangrove ecosystem is unknown. The effect of Typhoon Lionrock on NEE of a subtropical mangrove forest in Zhangjiankou Estuary Ecological Research Station (117°23'E, 23°55'N) was quantified using eddy covariance system. Typhoon Lionrock, which made landfall with a speed of 82.8 km per hour at Gulei Town on September 2, 2010, is the nearest one landed during 2008 to 2010 with a distance about 25 km away from our study site. We compared NEE before and after Typhoon Lionrock, and the data at the same period last year. Strong wind and torrential rain caused the amount of litter fall more than two times over the same period last year. Furthermore, about 5~25% green leaves and twigs appeared in litter traps, which turned into dead organic matter pools and indicated refoliation and recovery. During some days, mangrove ecosystem turned from a carbon sink into a source after Typhoon Lionrock. Gross ecosystem production decreased by about 72.4% and respiration increased by about 33.1% after typhoon landed, with no significant difference between the period before typhoon and the same period last year. Our results suggest that typhoon activities can significantly reduced carbon sequestration capacities of mangrove ecosystems.

O34

RESILIENCE OF FOREST ECOSYSTEMS TO DISTURBANCES CAUSED BY STRONG WINDS

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Establishment of new frameworks of sustainability assessment for ecosystem functions and services is one of the most important needs for future studies based on Asian flux monitoring networks. The concept of resilience may help us to describe vulnerability and sustainability of the ecosystems; however, studies in this purpose are not well developed yet.

Resilience is often translated as an ability of a system, which recovers the system into original situation after disturbances. Resilience is also expressed as a measure of a system to cope with 'potential shocks'. In addition, the concept of resilience shows that there are multiple possibilities in the status of ecosystem after disturbance.

During the past 30 years, the purpose of forest management planning has significantly changed in Japan. Before 1980s, the three most important roles of forests were; timber production, disaster prevention, and water resource retention. However, the role of timber production had become less and less important in and after 1980s due to the reduction in timber price. There is no great difficulty in moving from the present state of the system to another when the value of the forest has changed. Resilience-based approach may help us to describe potential shift of states of the ecosystems in relation to the socio-economical changes.

There are several important 'potential shocks' for forest ecosystems. The Japan Agency of Forestry examined the significance of natural disaster from 2002 to 2007, and reported that the area of forests disturbed by strong winds was crucial, followed by heavy snow and fire. The most significant shock was the strong winds in 2004. About 10 typhoons struck the Japanese Islands from summer to autumn in the year.

As a case study, we have been estimating the temporal changes in Net Ecosystem CO_2 Exchange (NEE) and Gross Primary Production (GPP) at five forest ecosystems in Japan; Takayama Deciduous Broadleaved Forest Site (TKY; birch-oak secondary forest), Seto Mixed Forest (SMF; mixed deciduous and coniferous forest), Tomakomai Flux Research Site (TMK; artificial larch forest), Moshiri Birch Forest (MBF; broadleaved deciduous forest), and Moshiri Mixed Forest (MMF; mixed deciduous and coniferous forest) to examine the effect of strong winds caused by typhoon during the growing period of 2004.

A significant reduction in Leaf Area Index (LAI) and GPP was observed in TKY in June, August, and September 2004, caused by direct effect of strong winds. More than 90 % of artificial larch trees were collapsed as well as towers in TMK during a storm in September 2004. On the other hand, the effects of strong winds and reduction in productivity were less sensitive in SMF. In MBF and MMF, the significance of the damage might depend on ecosystem type. In the workshop, the level of disturbance in each site as well as the recovery processes of GPP in the following year will be discussed. The damage in green leaves, the increase in litter-fall, and the change in the timing of litter-fall might alter the decomposition process, nutrient-availability, and productivity in the following growing season. Based on the understandings of different recovery processes and resilience of ecosystems, suggestions for appropriate forestry management would become possible.

O35

EFFECTS OF CLIMATE CHANGE AND PLANTATION ON CARBON BUDGET OF CONIFEROUS FORESTS IN POYANG LAKE BASIN FROM 1981 TO 2008

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Forest is an important component in the research of carbon (C) cycles in which the processes are influenced by enrichment of atmospheric CO_2 concentration, higher air temperature and nitrogen (N) deposition in the context of global climate change. Because the area of subtropical plantations is larger than 50% of total planted forests in China, it is very important to calculate C sequestration potential in China's subtropical plantations. Meanwhile, the serious N deposition in southern China can also affect the forest C sequestration capacity. To analyze C-N-water cycles of coniferous plantations in Southern China will help us realize the affecting factors and limitation conditions of forest growth and C sequestration. This study makes use of a validated process-based model PnET-CN to simulate the coupling of water, C and N cycling and to analyze carbon budget of coniferous plantation in Poyang Lake Basin ($16.5\times10^4 km^2$) in southern China in responses to climate changes and land use changes.

This study indicates that the average annual NPP of coniferous forests is 611.6±160.4 $gCm^{-2}a^{-1}$ in Poyang Lake Basin (Jiangxi Province) from 1981 to 2008. Simulated annual NEP of coniferous forests is 309±89g $gC\ m^{-2}a^{-1}$, which is higher in northern Jiangxi Province indicating a stronger C sink compared to southern Jiangxi Province. The mean rate of mineralization, nitrification and nitrate leaching of needleleaf forests in Poyang Lake Basin is 6.3 ± 2g $m^{-2}a^{-1}$, 0.04 ± 0.01g $m^{-2}a^{-1}$ and 1 ± 0.2mg $m^{-2}a^{-1}$, respectively. Annual evapotranspiration is 846 ± 200mm, of which the maximum 1035 mm, 464 mm minimum. The spatial pattern of photosynthetic rate of coniferous forest ecosystem is significant different from evapotranspiration in Poyang Lake Basin. The area with the highest photosynthetic rate (1135-1237gC $m^{-2}a^{-1}$) also has the highest evapotranspiration rate (900mm a^{-1}). In conclusion, both annual NPP and NEP are significantly affected by annual temperature, while neither of annual NPP and NEP is significantly affected by precipitation, indicating that annual variation of temperature is a main factor determining C budget in Poyang Lake basin. Based on simulation, NEP increases with plantation areas, indicating that coniferous forests ecosystem played a C sink role in Poyang Lake Basin from 1981-2008.

Key words: forest ecosystem, carbon cycle, PnET model, climate change

O36

EVAPTRANSPIRATION MAPPING: FROM LOCAL TO REGION

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Evapotranspiration (*ET*) is a critical component of the terrestrial water cycle and water resource management. The spatiotemporal distribution of *ET* not only affects energy partitioning, cloud development and precipitation but also determines the amount of ground water recharge, ground water flow, and runoff. Mapping and monitoring of *ET* through the synergy of measurement-modeling-satellite imagery is thus imperative to advancing the understanding of the water cycle and its change as well as predicting weather and climate. 'HydroKorea', built upon the KoFlux infrastructure, focuses on linking *in situ* measurement, ecohydrological modeling, and remote sensing to bridge the gaps between different scales of water exchange processes in heterogeneous and complex Korean landscapes. *ET* data over multi-year eddy covariance measurements have been obtained and used for validating various modeling and remote sensing products and producing *ET* maps over the Korean Peninsula. In this presentation, we summarize the research highlights of the HydroKorea project and introduce how the project is contributing to the development of regional and international projects such as HydroEastAsia and TERRECO. Furthermore, we introduce how this eddy covariance *ET* measurement can be applied with cavity ring-down spectroscopy (CRDS) technique to measure *ET* and green house gas such as CH_4 and CO_2 fluxes.

Acknowledgements

This research is supported by a grant (code:1-8-3) from Water Resource Research Center 21st Century Frontier Research Program, Long-term Ecological Study and Monitoring of Forest Ecosystem Project of Korea Research Institute, Council of Fundamental Science and Technology (KRCF) through the KRISS project of Basic Research, and 'CarbonEastAsia' A3 Foresight Program of National Research Foundation of Korea.

O37

UPTAKE OF ISOPRENE OXIDATION PRODUCTS BY TREE SAMLINGS AND FLUX MEASUREMENT OF THE COMPOUNDS ABOVE A JAPANESE LARCH FOREST

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Methacrolein (MACR) and methyl vinyl ketone (MVK) are oxygenates produced from isoprene which is abundantly emitted by trees. The uptake rate of these compounds by leaves of three different *Quercus* species, *Q. acutissima*, *Q. myrsinaefolia*, and *Q. phillyraeoides*, at typical concentrations within a forest (several part per billion by volume) were determined. The rates of uptake of croton aldehyde (CA) and methyl ethyl ketone (MEK) were also investigated for comparison. The rates of uptake of the two aldehydes MACR and CA were found to be higher than those of the two ketones. In particular, the rate of MEK uptake for *Q. myrsinaefolia* was exceptionally low. The ratio of intercellular to fumigated concentrations, *Ci/Ca*, for MACR and CA was found to be low (0–0.24), while the ratio for the two ketones was 0.22–0.90. To evaluate the contribution of tree uptake as a sink for the two isoprene-oxygenates within the forest canopy, loss rates of the compounds due to uptake by trees and by reactions with hydroxyl radicals (OH radicals) and O_3 were calculated. The loss rate by tree uptake was the highest, followed by the reaction with OH radicals, even at a high OH concentration (0.15 pptv) both for MACR and MVK, suggesting that tree uptake provides a significant sink.

To investigate behavior of MACR and MVK within a Japanese larch forest, a flux measurement was conducted at Fuji-Hokuroku site (FHK: 35º 26' N, 138º 45' E, elevation: 1050~1150m) near Mt. Fuji, Japan. The compounds were collected using a newly developed portable REA sampling system. In the paper, the flux measurement result will be also presented.

O38

ON ESTIMATING WET CANOPY EVPORATION FROM DECIDUOUS AND CONIFEROUS FORESTS IN KOREA

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The measurement of evapotranspiration (ET) has been conducted successfully for several years at the deciduous and coniferous forests in Gwangneung, Korea. For the estimation of the annual ET, about 20% of the data was gap-filled following the standard gap-filling method (i.e., modified lookup table, MLT) of KoFlux. It is speculated that the gap-filled ET data may have been precipitation-biased (i.e., underestimated) due to the failure of taking the contribution of wet canopy evaporation (E_{WC}) into account. The measurements of ET were conducted using an open-path eddy covariance (EC) method with other meteorological and ecological measurements (e.g., leaf wetness and leaf area index) at the Gwangneung forest from September 2007 to August 2008. In order to verify the role of E_{WC} on the total ET, we compared the measured E_{WC} with the estimated E_{WC} using models (i.e., Variable Infiltration Capacity (VIC) and Noah Land Surface Models (LSM)). Out of 46 days of the total duration of wet canopy, the open-path EC system showed about 70% of system malfunction mostly due to failure of an open-path infrared gas analyzer. The magnitude of E_{WC} was similar with ET from dry and partially wet canopy. Because VIC LSM presented leaf phenology more realistically than Noah LSM, the algorithm of VIC LSM performed better than that of Noah LSM in estimating E_{WC}. There was the discrepancy of E_{WC} between the MLT method and VIC LSM. During wet canopy conditions, the available energy for E_{WC} was mostly provided by heat advection and storage. The MLT method regarded only net radiation as the available energy, resulting in underestimation of E_{WC} compared to VIC LSM. The annual E_{WC} by VIC LSM is about 10% of the annual precipitation (about 1500 mm) at Gwangneung sites. When the amount of the annual E_{WC} was added to the annual ET, the ET increased about 100 mm yr^{-1} than before. The monthly E_{WC} by VIC LSM was validated by comparing with that by a simple hydrological model, and similar magnitude and patterns between the two suggested VIC LSM as a reliable alternative for E_{WC} estimation. Based on these results, we strongly suggest applying different gap-filling procedure for wet and dry canopy condition other approaches for E_{WC} gap-filling.

Acknowledgements

This study is supported by grants (code: 1-8-3) from Sustainable Water Resources Research Center for 21st Century Frontier Research Program, the Long-term Ecological Study and Monitoring of Forest Ecosystem Project of Korea Forest Research Institute, and the A3 Foresight Program from the National Research Foundation.

O39

SPATIAL PATTERN OF CARBON EXCHANGE IN TYPICAL FOREST ECOSYSTEMS IN MONSOON ASIA

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Forest plays an important role in mitigating global climate change. Under the influence of Asian monsoon climate, Monsoon Asia is a unique region due to continuous forest biome distribution, which includes boreal forest, temperate deciduous forest, temperate mixed forest, warm temperate forest, subtropical evergreen forest, and tropical rain forest. The influence of Monsoon climate on ecosystem carbon exchange is of great potential to the annual ecosystem carbon balance. However, the mechanism of spatial pattern and its variability are still not clear. With the flux measurements which are widely distributed across diverse forest ecosystems in East Asia, it is become possible to evaluate the spatial pattern and driving mechanism of ecosystem carbon exchange under the influence of monsoon climate. Based on the long term flux data from ChinaFLUX, KoFlux and JapanFlux, which supported by the CarboEastAsia (A3 project), the study focuses on the spatial pattern and its variability of carbon exchange in typical forest ecosystems across East Asia. Due to the complex of Asia Monsoon climate, it is still necessary to extent the flux measurement periods, especially the same measurement years, and to expand the flux sites in space, especially in the boreal forest and sub-/tropical forest through international collaboration.

O40

MULTI MODEL AND DATA ANALYSIS OF TERRESTRIAL CARBON CYCLES IN ASIA: FIRST SYNTHESIS RESULT

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Understanding the terrestrial carbon budget is one of the most important tasks in the CarboEastAsia community. To understand its spatial patterns, we need a synthesis work based on the ground observation, satellite observation, and ecosystem modeling. We, CarboEastAsia modeling group members and related members from China, Korea, and Japan are working on this topic by bringing these observation, and modeling. Participating models include Biome-BGC, BEAMS (Sasai et al., 2005), CASA, LPJ, SEIB-DGVM (Sato et al., 2007), SVM, TRIFFID, VISIT (Ito et al., 2008) and so on.

Running these models from 1951 to 2006, we analyzed the annual sum of terrestrial carbon cycle component. The spatial patterns in annual GPP are basically consistent among models qualitatively with large variabilities in its magnitude. The spatial patterns in NEP are different among models; some models show large carbon sinks in Siberia, but others are not. From our first analysis, we found large differences in estimated carbon budget among models. Therefore, we are working on site-level validation, analysis of the interannual variation, calling for other models.

O41

CHANGES IN WATER USE EFFICIENCY AND DRIVING FACTORS OF EAST ASIA OVER THE PAST 25 YEARS

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Net primary productivity (NPP) and Evapotranspiration (ET), the fluxes determining the water use efficiency (WUE=NPP/ET), are affected by climate change. In order to enhance the understanding of the carbon cycle in East Asia (10°S-55°N，60°E-155°E), we analyze the WUE patterns from 1982 to 2006 using the process-based ecological model, Boreal Ecosystem Productivity Simulator (BEPS). The modeling results indicate that the averaged WUE was 0.85 g C/mm over the whole region, the largest being in forests and the smallest being in wooded grass and open shrub lands. Analysis of the temporal trend shows that WUE increased from 0.80 g C mm^{-1} in the early 1980s to the maximum (0.88 g C mm^{-1}) in the 1990s, and then declined continuously and fluctuated by around 0.85 g C mm^{-1} since 1998. This trend of WUE is mainly related to the changes of NDVI. Spatial analysis shows that the boreal forests at high latitudes in East Asia contributed to the highest WUE (more than 2.5 g C mm^{-1}), whilst forests in tropical zones exhibited smaller values (~1.2 g C mm^{-1}) which decreased to below 0.1 g C/mm in the arid deserts in India and northwest China. Statistical results show that WUE and NDVI had positive correlations with precipitation across the whole region, whilst WUE and temperature exhibited a negative relationship when the area 25°N-40°N is excluded. NDVI and precipitation were the main factors in regulating WUE at high and middle latitudes, and temperature overshadowed NDVI and precipitation in influencing WUE around the equator. Changes in climate and NDVI resulted in an increase in WUE in pan East Asia and the Indian Peninsula, and a decrease in the northeast East Asia and southeast China in the past 25 years.

Key words: Process-based ecological model, Net primary productivity (NPP), Evapotranspiration (ET), water use efficiency (WUE), climate change

O42

A NEW METHOD OF TERRESTRIAL ECOSYSTEM EVALUATION WITH THE PARALLEL COORDINATES PLOT

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The estimation of the carbon gas exchange in terrestrial ecosystem involves multiple variables, from meteorological variables to soil and vegetation related variables, and their correlations often vary by region and the associated climate condition. For decades many studies have been done to identify controlling parameters for carbon and water flux exchanges, yet their relations have not been fully understood even today.

Conventionally a correlation study is done with two or three dimensional plots: therefore, visual presentation is limited to three variables at most. To overcome this limitation, A. Inselberg proposed in 1981 a way to represent multidimensional information, namely the parallel coordinates plot. In contrast to Cartesian coordinate system where axes are mutually perpendicular, all axes are placed in parallel in the parallel coordinates plot. By this treatment more than three dimensions can be presented in a single plot, and most importantly points in multidimensional space are represented by a set of parallel lines drawn between histograms. With this powerful feature, one can observe signatures, irregularities, and a trend in a dataset. As a specific application to terrestrial ecosystem, this multivariable visualization enables us to compare eddy flux observation data from multiple sites at a glance, classify sites which share the same clustering trend, and find the controlling parameters in the optimal case. In addition to eddy flux observation data comparison, the parallel coordinates plot would be useful for Terrestrial Ecosystem Model (TEM) intercomparison: it can visualize proximities and deviations of predicted outputs for each TEM with respect to the observation and also help to identify the model specific characteristics in predicted values if any. In the current analysis site observation data and TEM comparisons are conducted using Asia flux observation site data so to demonstrate the clustering trend of sites in proximity. The analysis result shows that either site or model specific trends, which may not be so obvious in time series, appear as a clear signature in the parallel coordinates plot.

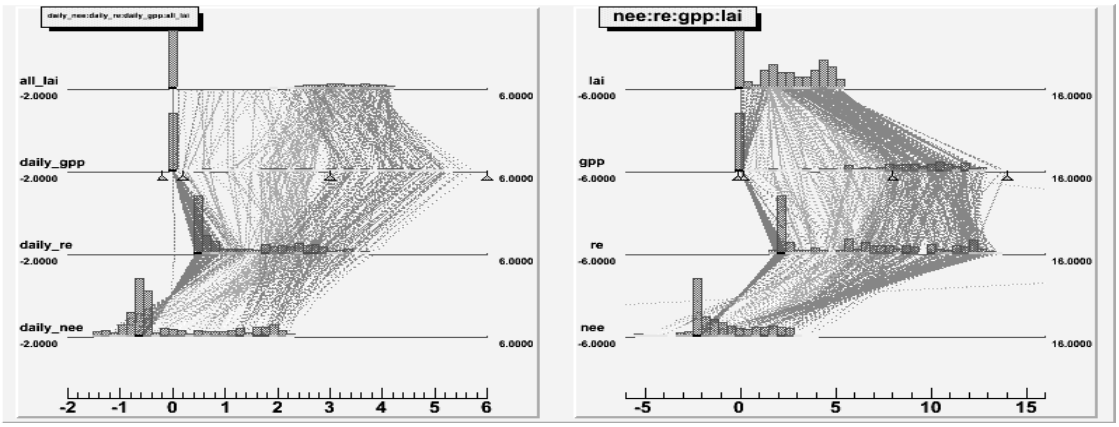

Fig.1 Parallel Coordinates plots (from top to bottom: LAI, GPP, RE, NEE) of BIOME-BGC simulation outputs (left) and SEIB-DGVM simulation outputs (right) using the Takayama observation site flux data.

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PROGRESS ON THE APPLICATION OF CYBER-INFRASTRUCTURE FOR CARBON CYCLE RESEARCH BASED ON CHINAFLUX

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Based on the observation and research network of Chinese Terrestrial Ecosystem Flux Research Network (ChinaFLUX), integrated study of ecosystem carbon cycling is not only an important part of global change research, but also a major scientific and technological task to cope with climate change. Integrated research of ecosystem carbon cycling requires multi-station observation network, multi-source data assimilation, multi-model overall analysis, and trans-regional, transdisciplinary collaborative environment. There is an urgent need for the application and demonstration studies of Cyber-infrastructure and the establishment of ChinaFLUX Cyber-infrastructure platform. This thesis discusses the objective, composition, key technologies and recent research advance of ChinaFLUX Cyber-infrastructure, and basically realizes the integration of the flux data acquisition - transportation - storage - management - processing - visualization – service sharing. With the application of high performance technology and the integration of Geographical Information System (GIS), remote sensing (RS) data and ecosystem models, it constructs a platform for regional / national scale carbon balance model simulation to support and promote Chinese terrestrial ecosystem carbon cycle research. It plays an exemplary role in leading the informationization of our field station network.

Keywords: ecosystem carbon balance, e-Science, terrestrial ecosystem, the observation and research network of China flux (ChinaFLUX), Chinese Ecosystem Research Network (CERN)

O44

SOIL CARBON SEQUESTRATION FOR 'GRAIN FOR GREEN' PROJECT IN LOESS PLATEAU, CHINA

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Conversion of cropland into perennial vegetation land can increase soil organic carbon (SOC) accumulation, which might be an important mitigation measure to sequester carbon dioxide from the atmosphere. The 'Grain for Green' project, one of the most ambitious ecological programmes launched in modern China, aims at transforming the low-yield slope cropland into grassland and woodland. The Loess Plateau in China is the most important target of this project due to its serious soil erosion. The objectives of this study are to answer three questions: (1) how is the SOC accumulation for this 'Grain for Green' project in Loess Plateau? (2) Is there difference in soil carbon change among different restoration types including grassland, shrub and forest? (3) Is the effect of restoration types on SOC accumulation different among northern, middle and southern Loess Plateau? Based on analysis of the data collected from the literatures conducted in Loess Plateau, we found that: SOC increased at 0.712 Tg C/yr in the top 20cm soil layer for 60 years under this project in whole Loess Plateau; Compared to grassland, forest significant increased SOC in middle and southern Loess Plateau; Grassland had greater effect on SOC sequestration in northern Loess Plateau than in the other climate zones with higher precipitation, while shrub had similar effect across Loess Plateau. Our results suggest that the 'Grain for Green' project can significantly increase the SOC storage in Loess Plateau, and it is recommend to expend grassland in northern Loess Plateau and forest in middle and southern Loess Plateau for enhancing the SOC sequestration in this project.

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O45

APPLICATION OF MODEL-DATA SYNTHESIS ON SIMULATING CARBON AND WATER FLUXES AT FORESTED ECOSYSTEMS IN CHINAFLUX

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Eddy covariance records hold great promise for understanding the processes controlling exchange of CO_2 (NEE) and H_2O. However, separating NEE into its components fluxes (photosynthesis and ecosystem respiration) and understanding its potential respond to climate change is a difficult problem. In this study, we used a model-data synthesis approach, with the SIPNET (Simple Photosynthesis EvapoTranspiration), a simplified model of ecosystem function, to extract process-level information from 6 years of eddy covariance data at three different forest ecosystem in ChinaFLUX. To predict the carbon and water exchange and their component processes, stochastic Bayesian (simulate annealing) parameter estimation technique has been used to generate parameter sets conditioned on the model equations and net CO_2 and H_2O fluxes measured by eddy covariance. In doing so, with the posterior distributions of the model parameters, our result quantified the extent to which eddy covariance data contain information about the ecosystem process parameters represented in the model. Primary controls (model parameters and climate conditions) over carbon and water exchanges between ecosystem and atmosphere are also determined based on the sensitivity analysis. The result show that, by applying optimized parameter set, the model prediction matched well with the observed NEE (R2>0.9), but overestimate the water fluxes at a rainy subtropical evergreen broad-leaved forest. Meanwhile, the posterior distribution of the parameter also showed that none of the data are effective at constraining fine root or soil C pool dynamics, suggesting that these should be targets for future measurement efforts.

Keywords: Eddy covariance, Parameter estimation; SIPNET, Metropolis simulating annealing, ChinaFLUX, Forest ecosystem

O46

NET ECOSYSTEM PRODUCTIVITY USING BIOMETRIC AND REMOTE SENSING TECHNIQUES IN TROPICAL RAIN FOREST

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Net ecosystem productivity (NEP) is one of the essential ecology components which determine the ability of carbon sequestering in forest ecosystem. As of NEP, the carbon sequestration in particulars forested area is able to be identified under two circumstances either carbon sink (+ve) or carbon source (-ve). Theoretically, NEP is the alteration of forest ecosystem from the difference between net primary productivity (NPP) and heterotrophic respiration (R_h). Consequently, the amount of carbon lost or gained by the ecosystem is able to estimate through the definition as given. Presently, landscape biometric inventories and remote sensing are among common techniques that efficiently been utilized for monitoring and reporting the current status of carbon in forest ecosystem. Indeed, biometric technique is generally referred to the observation of plot scale to the individual tree biomass in forested area not exceeding 50 hectares with respect to the appropriate published protocol. Recent advance technology, remote sensing technique is a satellite based measurement that has capability in modeling and map forest components as temporally, spectrally and spatially over local scale extended to global scale. Thus, in this study both techniques will be applied to estimate NPP for Pasoh Forest Reserve (PFR), N. Sembilan, Malaysia, as well as to identify the status of carbon sequestration. Therefore, series to the census of biometric data conducted by Forest Research Institute Malaysia (FRIM) in primary forest experimental plot will be used to calculate the total aboveground biomass with employ the summation method established by Kato et al., (1978). Instead, Moderate Resolution Imaging Spectroradiometer (MODIS) images using three spectral different bands; visible band, near infra-red band, ocean bands (band 11 and band 12) have been utilized to the 600 hectares core area of PFR based on meteorological data using "continuous field model" developed by Rahman et al., (2004). As a result, 6 annual of NEP's for PFR since 2000 to 2005 from biometric and remote sensing techniques, respectively have been successfully estimated in this study. The result shows that the annual NEP from biometric technique are increased with range from -4.912 t ha^{-1} yr^{-1} to -12.809 t ha^{-1} yr^{-1}, similarly to the remote sensing technique as well whereby increased from -8.575 t ha^{-1} yr^{-1} to -14.728 t ha^{-1} yr^{-1} during 2000 to 2005. As conclusion, the pattern of annual carbon sequestration at PFR is determined as carbon source from 2000 until 2005 using biometric and remote sensing techniques, respectively.

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THE NECESSARY AREA IN A PLOT FOR CO_2 EFFLUX MEASUREMENT - THE CASE IN COMMON AND IMMATURE FOREST SOIL -

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Introduction: CO_2 Efflux from a forest floor has large special variations even in a small scale. This means that any observation rates include errors caused by the spatial variations. It is effective solution to increase the number of collars or measurement area to decrease the errors caused by the spatial variations. However, it is impossible to increase the measurement area without the limitation. Thus in this study, the required measurement area is calculated to perform the observation including the acceptable error caused by the spatial variations with the coefficient variations in the data for 24 collars in each plot.

Materials: Data obtained in Yamashiro forest hydrology research site (YMS) and Kahoku experimental watershed (KHW) was used in this study. Both observation sites include each 4 plots. CO_2 Efflux from the forest floor was observed for 24 collars in each observation time in each plot with the IRGA enclosed chamber in manual. The calculation was performed with 15 cases in each plot in YMS from June, 2002 to May, 2003 and 10 cases in KHW from August, 2005 to August, 2006. Thus, total date was 60 cases in YMS and 40 cases in KHW.

Theory: Kimmins (1973) used the Eq. (1) to express the relation between the acceptable error (AC) caused by the spatial variations and the coefficient of variation (CV) within the observed rates from each collar in each case. AC is defined the ratio of error on the averaged rates from each collars.

$$n = \frac{t^2_{(\alpha, n-1)} CV^2}{AC^2} \qquad (1)$$

Where, n is the required number of the collars, $t_{(\alpha, n-1)}$ is student's value for a desired confidence interval at a given probability level (α) and degree of freedom (n^{-1}). In this study, α is 0.05 and required measurement area (RA) in the plots was calculated to multiple the area of soil collar ($0.0065m^2$) and n.

Results:

CV is fluctuated between 0.15-0.30 among the 100cases in YMS and KHW. Maximum CV is around 0.5. This means that RA also fluctuates among the cases. In spite the same measurement area in the same site, the included error caused by spatial variations is sometime smaller than AC, and sometimes larger.

The RA is required to be $2.4 \sim 2.9m^2$, $0.6 \sim 0.7m^2$ and $0.27 \sim 0.32m^2$ when AC is defined to be 5%, 10% and 15%, respectively, to make all errors caused by spatial variations to be smaller than AC in 100cases in this study. When RA is defined to be $1.1 \sim 1.3m^2$, $0.3 \sim 0.4m^2$ and $0.13 \sim 0.1\ m^2$, errors caused by spatial variations are smaller than AC in 80 cases. RA tends to be larger in KHW than in YMS.

The required measurement area (RA) in each plot is discussed in above. The similar analysis can show the required measurement plot number (RN) to estimate the CO_2 Efflux with the representative of a site. In this study, the plot number is too small to be 4 in each site. Thus, the calculated RN is thought to be unstable and expected to be too many. However, RN for annual flux rates is dared to be calculated to be around 41 and 18 in both sites, when errors caused by spatial variations are smaller than AC (10% and 15%, respectively).

References:

Kimmins, J. P. (1973) Some statical aspects of sampling throughfall precipitation in numerient cycling studies in british columbian coastal forests, Ecology, 54, 1008-1019.

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A REGRESSION MODEL OF NEE TIME SERIES BASED ON CORRELATION ANALYSIS AND TIME-LAG ANALYSIS

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Exchange of CO_2 between ecosystems and atmosphere is influenced by meterological and biological process at multiple temporal scales. The long-term observation data of CO_2 flux and environmental factors enable us to study how meterological variables affect CO_2 flux at different temporal scales. Correlation analysis was used to estimate the amplitude of correlations among the CO_2 flux and meteorologica variables, while time-lag analysis was used to reveal the phase difference. A combination of two methods enables us to identify the key factors at different temporal scales. We showed that 1) fluctuations of PAR and CO_2 flux were in phase at half hour period during growing season, whereas the air temperature showed 0.5-3h lags which is depended on canopy structure; 2) nocturnal air temperature and nocturnal CO_2 flux was poorly correlated at half hour period but highly at 24h hour period.

The correlation coefficients and phase-lags varied with vegetation cover. In order to integrate this seasonal change into the regression model of CO_2 flux, we used the vegetation index (VI) provided by Earth Observation System (EOS) as an annual variation.

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ENVIRONMENTAL CONTROLS OVER THE SEASONAL VARIATION OF SOIL RESPIRATION IN THREE STANDS IN A NORTH SUBTROPICAL FOREST, CENTRAL CHINA

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We measured soil respiration (R_s) in three stands of central China (Loblolly pine, Masson pine, and Oak) over the course of one year and the objective was to examine how the environmental variables, especially the drought event, influence the variation of R_s. Our results show that the seasonal variation of R_s during study period in all stands followed a bell-shaped curve, absolutely paralleling to that of soil temperature at 5cm depth except two exceptionally drought (November 2009 and July in 2010). These trends suggested that soil temperature was the most important regulating factor. Soil temperature can account for 61, 57, and 63% of seasonal dynamic in R_s for Loblolly pine, Masson pine, and Oak, respectively (Fig 1bcd). When drought-affected data were excluded from analysis, the R^2 values increased markedly for three stands, indicating that drought or soil moisture was another vital regulating factor. In addition, we found that Q_{10} values increased from 1.82 to 2.27 in Loblolly pine and from 2.03 to 2.18 in Masson pine after remove the drought-affected data. Interestingly, the increase in Q_{10} value didn't be observed in Oak (Fig 1d). The possible explanation is that the response of R_s to drought differs between conifer forest and deciduous broad-leaf forest. Our results suggested that drought play an important role in regulating R_s and the sensitivities of R_s to temperature.

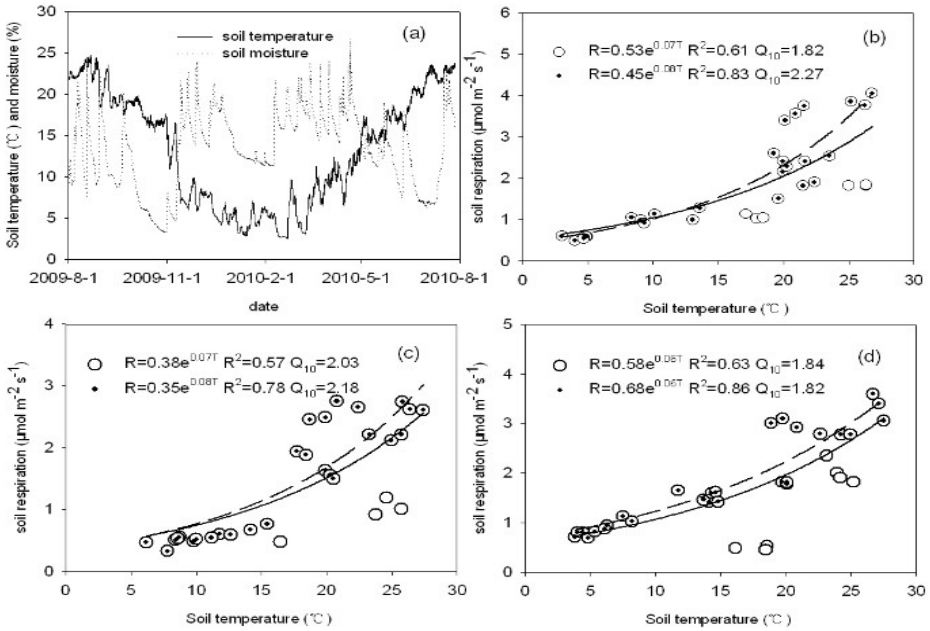

Fig 1. The seasonal variations in soil temperature and soil moisture (a), and the relationship between soil respiration and soil temperature in Loblolly pine (b), Masson pine (c) and Oak (d). The open cycle represents all measured data and the dot represents the measured data excluding drought-affected data (November 2009 and July 2010).

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CONTINUOUS MEASUREMENT OF HEAT AND CARBON DIOXIDE FLUXES IN AN URBAN AREA

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Introduction: In urban area, properties of heat and energy exchanges are altered by human activity. In addition, a huge amount of carbon dioxide is released from urban area. It is necessary to understand process in urban landscape, since long-term measurement of these in urban area is limited. In this study, we have conducted a year-round continuous measurement of energy, water, and CO_2 fluxes at Sakai city (the population: more than 800,000) in Japan in order to improve our understanding of the urban processes.

Methods: We have applied an eddy covariance method to measure the sensible heat, latent heat, and carbon dioxide fluxes at the top of the city office building; the height was 111 m from the street. A sonic anemometer (SAT-550, Kaijo) and open path gas analyzer (LI-7500, Li-cor) were installed at the top of the building. The turbulent fluctuations were sampled at 10 Hz. For the flux calculations, trend removal and coordinate rotation were applied as a preprocessing. To evaluate net radiation, net shortwave radiation (S) was from measured $S\downarrow$ and satellite-derived albedo, whereas net long wave radiation (L) was from measured $L\downarrow$ and surface temperature. The flux footprint of the city was examined by an analytical footprint model (Kormann and Meixner, 2001) (Figure1). The footprint included industrial, commercial and residential area with a little vegetation but not sea.

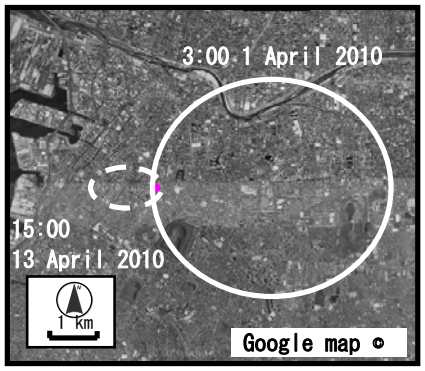

Fig. 1. 50% source area of the city site estimated for a typical condition, in unstable daytime (dash) and stable nighttime (solid)

Results and discussion: The wind comes from west of the city in the daytime and from east in the nighttime due to land and sea breeze. Based on the 50% of source area (Figure1), daytime and nighttime footprint had a different size of the area because of difference of the atmospheric stability. Figure2 shows seasonal variations of net radiation (R_n), sensible heat flux (H), latent heat flux (LE) and residual flux (ΔS) from April 2009 to April 2010. Both H and LE did not have distinct seasonal pattern, compared with Rn and ΔS. ΔS was positive in summer and negative in winter, which varied with R_n, suggesting that ΔS played a major role in urban heat exchange.

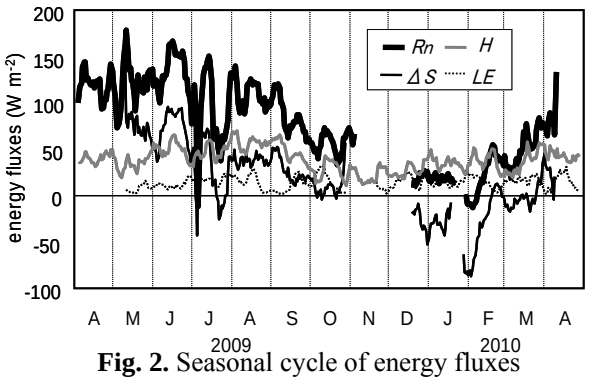

Fig. 2. Seasonal cycle of energy fluxes

CO_2 flux showed a clear diurnal cycle (Figure3). All months had a peak around noon. This graph shows the Sakai city area was CO_2 source all day. It's because there was heavy traffic and a little vegetation in this area. The peak in February was the largest during the measurement period. But there were little differences of seasonal variations. The magnitudes of the peak were comparable to results from Kugahara, residential area in Tokyo (Moriwaki and Kanda, 2004), but the diurnal pattern was different. The Kugahara site had double peaks of 1.2, 0.8 mg m^{-2} s^{-1} in morning and evening in December, respectively.

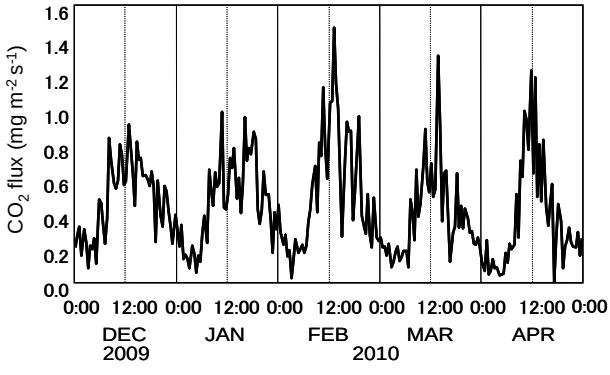

Fig. 3. Diurnal cycle of CO_2 flux

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CARBON GASES EXCHANGE IN NORTHERN PEATLAND OF CHINA

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Purpose: Northern peatlands contain approximate one-third of the world's soil carbon (C) pool, and equal to the C pool in aboveground plant biomass. A slight change in this large C pool may have an important influence on global C budget, and hence the Earth's climate system. Moreover, a large fraction of northern peatlands were located at high latitudes, where warming is expected to be the greatest. Therefore, there is a need to better knowledge about the amount of C fluxes in northern peatlands, and how the fluxes of carbon dioxide (CO_2) and methane vary with climate factors.
Site description: The flux measurement was conducted in an oligotrophic bog, located in Tuqiang Town, Mohe county, Heilongjiang Province, Northeast China (52.94°N, 122.86°E). The study site is situated in the continuous permafrost zone. The annual mean temperature in the study site is -4.3°C, mean annual precipitation is 435 mm(30-year mean; 1971-2000). Dominant species in the study site are *Sphagnum spp., B. fruticosa, V. uliginosum, E. polystachion* and *S.rosmarinifolia.*
Methods: We measured CO_2 and CH_4 exchange with static closed chambers by weekly during growing seasons. Soil temperature (-5 cm, -10 cm, -15 cm and -20 cm) was measured by a thermoelectric thermometer (JM624, Jinming Instrument CO., Ltd) , ground water table was automatic recorded by a water level logger (Odyssey), and active layer were simultaneously measured by a steel rod. Air temperature and relative humidity was monitored by an automatic meteorological station.
Results: In the present study, we found no obvious seasonal cycle of CO_2 and CH_4 emissions. Mean CO_2 flux was 301.56 mg $m^{-2} h^{-1}$ for hummocks, and 349.05 mg $m^{-2} h^{-1}$ for hollows. In addition, mean CH_4 flux was 0.11 mg $m^{-2} h^{-1}$ for hummocks, and 0.80 mg $m^{-2} h^{-1}$ for hollows. CO_2 fluxes showed a well correlation with soil temperature, whereas CH_4 fluxes only showed a positive correlation with active layer. The amount of ecosystem respiration was 868.5 g m^{-2} for hummocks, and 1005.3 g m^{-2} for hollows. Our results suggested that peatland in Northeast China was a net source of CH_4, and the total CH_4 emission during the whole growing season was 0.3 g m^{-2} for hummocks, and 2.3 g m^{-2} for hollows. In our study, the value of CH_4 emission in peatland was lower than those in other regions. It implies that vascular path channel may play an important role in carbon gases emissions. Moreover, increased active layer depth and soil temperature induced by global warming may stimulate CO_2 and CH_4 emissions in peatlands and produce a positive feedback to climate warming.
Acknowledgments: This study was funded by the National Natural Science Foundation of China (No.40930527 and 40771189), the National Basic Research Program of China (No. 2009CB421103) and the Knowledge Innovative Program of The Chinese Academy of Sciences (No. KZCX2-YW-JC301).

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CHARACTERISTICS OF N_2O FLUX AND THE RELATIONSHIP BETWEEN N_2O AND CO_2 EMISSION IN THE MARSH WETLAND OF NORTHEAST CHINA

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Through 4 years of continuous field original observations in the freshwater marsh wetland of Sanjiang Plain northeast China, the results showed that marsh wetland was N_2O source in winter, but for the whole year, it was still the source of N_2O emission. The main period for N_2O emission was from May to August. Soil temperature was the important environmental factor affecting the seasonal variation of N_2O flux. Water level and soil temperature during the growing season would affect the interannual variation of N_2O flux. There was significant correlation between N_2O and CO_2 emissions from the marsh, and the factors that led to the internal relation including temperature, plant roots, correlation action of decomposition of organic matter and the adjustment of stomatal behavior of plants.

Key words: freshwater marsh wetland, N_2O flux, environmental factors, CO_2 emission

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LEAF PHENOLOGY IN A TROPICAL MONSOONAL EVERGREEN FOREST AT SAKAERAT, THAILAND, DETECTED BY FIXED VIEW CAMERA IMAGES - ANALYSES ON THE INDIVIDUAL SCALE -

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Basing on the numerical method to objectively detect seasonal variations of phenology of forest canopies by a series of daily fixed view photographs (Maeda and Gamo, 2004, JP Patent 4280823), the leaf phenology of the tropical monsoonal evergreen (dry evergreen) forest around the flux monitoring tower in Sakaerat (SKR), Thailand (14°29'33"N, 101°54'59"E) was analyzed. The photo images were taken at noon time every day by a fixed view digital camera with a fish eye lens which is located on the top of the tower (about 40m high) looking down the forest canopy dominated by *Hopea ferrea* trees. The photo images were processed by making the time series of the normalized intensities (*r*, *g*, and *b*) i.e., the monochromatic intensities of respective channels of RGB, normalized by the panchromatic intensity. According to the preliminary analysis on the community scale already presented at the previous Asiaflux workshop[1)], the analysis method is applicable to detection of the phenological changes even in the evergreen forest that seemed to show only small seasonal changes of its canopy's color. It was also found that the largest change in the canopy's color occurs in from June to August, middle of the rainy season when satellites cannot observe the land surface due to clouds. Fig. 1 is the result previously presented[1)].

In this presentation, some more analyses using the method above are discussed. While the analysis on the community scale showed relatively clear seasonal patterns of *r*, *g* and *b* compared to that of a mixed deciduous forest in Thailand[2)] because the community is almost dominated by one species, the trajectories of *r*, *g* and *b* in the greening-up period are dull compared to the deciduous forest in Japan. Also, there is the period that the trajectories of *r*, *g* and *b* have large scattering in the middle of the year. In order to clarify the reason of them, the analyses on the individual scale were conducted. As the result, it was found that the dull greening up was because the timing when new leaves emerged was different between individuals. And the large scattering of *r*, *g* and *b* around 120-180 DOY seemed to be caused by that occurrences of events on the canopies such as flowering were different by individuals. Further detailed investigation of these phenomena found from the fixed view images would be conducted using physiological measurements.

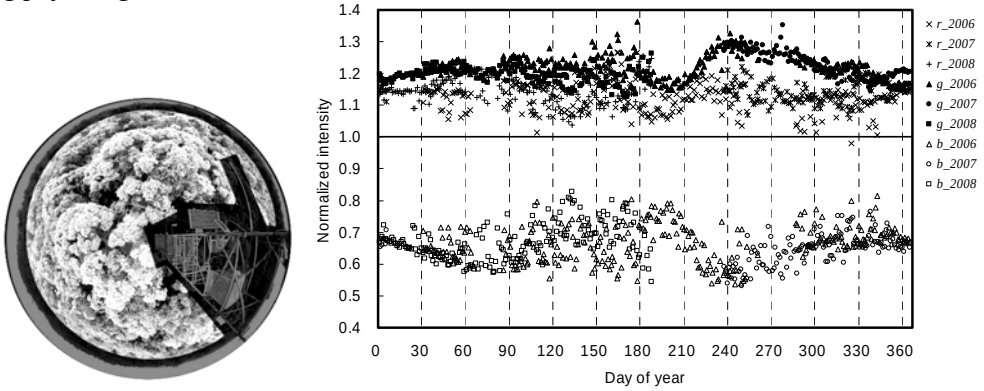

Fig. 1. The field of the view of the photo taken at the Sakaerat (SKR) flux monitoring tower in a dry evergreen forest (left), and the seasonal variation of the normalized intensities averaged over the whole field of view for red (*r*), green (*g*) and blue (*b*) channels during 2006-2008.[1)]

References: 1) Maeda et al., Proceedings of AsiaFlux Workshop 2009(P144), 2009.
2) Maeda et al., Tropical Forestry Change in a Changing World, 3, 167-181, 2009.

P108

FREQUENCY RESPONSE OF A LOW-POWER CLOSED-PATH CO_2 AND H_2O EDDY COVARIANCE SYSTEM

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Accurate measurement of CO_2 and H_2O eddy covariance fluxes requires an analyzer with good frequency response. Closed-path analyzers offer improved rain performance and the option of automatic zero and span, but their frequency response is generally worse than open-path analyzers due to the residence time in the sample cell and mixing along intake tubes and in the sample cell. H_2O frequency response can suffer additional losses due to interactions with the surface of the intake tube and sample cell. The traditional approach to maintain good frequency response in a closed path system is to use a high sample flow rate and/or reduced pressure in the sample cell. This approach requires a relatively high power pump that makes it difficult to operate without access to AC mains power.

A new, small, closed-path CO_2 and H_2O Eddy Covariance System (CPEC200, Campbell Scientific, Inc.) achieves good frequency response (5.8 Hz half-power bandwidth) at low power (12 W total). The analyzer resides close to the sonic path to keep the intake tube short (0.6 m) and reduce mixing in the intake tube. The sample cell volume is small (5.8 ml) to minimize residence time (50 ms at 7 LPM sample flow). The entire system is designed for low pressure drop to reduce pump power.

The frequency response of the CPEC200 was measured by injecting an impulse of CO_2/H_2O at the system inlet. This measured impulse response was then Fourier transformed and normalized to give the frequency response. This frequency response was compared to a simple model that included a term representing ideal plug flow through the sample cell and an exponential mixing term. The results showed good agreement between the physical sample cell residence time (50 ms) and the modeled residence time (52 ms). The modeled exponential mixing time constant (18 ms) was much smaller than the residence time, indicating little mixing in the intake tube or the sample cell. No difference was observed between CO_2 and H_2O.

P109

SEASONAL VARIABILITY OF WATER VAPOR AND HEAT FLUXES OVER TYPICAL SURFACES IN THE HAIHE RIVER BASIN

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The transportation of water vapor and heat fluxes is the crucial process in land-atmosphere interactions. Water vapor and heat fluxes can impact the boundary layer development and atmospheric dynamics. The study of the characteristics of water vapor and heat fluxes over different surfaces has great scientific significance and practical value.

The Haihe river basin is one of the main food and agricultural production areas, with 10% population of the China including mega cities such as Beijign and Tianjin. However, the Haihe river basin suffers from a serious shortage of water resources. To investigate water resources in Haihe river basin, three sites were installed namely Miyun (Beijing, 2006.08-), Daxing (Beijing, 2008.05-), and Guantao (Hebei province, 2007.08-), whose underlying surfaces are orchards (mountainous areas), vegetable & fruit (suburb) and cropland (plain). The three sites have represented typical underlying surfaces in the Haihe river basin.

All the three sites contain an eddy covariance (EC) and a large aperture scintillometer (LAS) as well as an automatic weather station (AWS) respectively, and the instruments had well maintenance all the year round. The processing schemes of EC and LAS were formed, and the footprint models of LAS and EC were also established. Based on the measurements conducted in Haihe river basin, the characteristics of water vapor and heat fluxes over different surfaces were analyzed.

The source areas of EC and LAS had great difference among the three sites. The source areas of LAS stretched along its path length, and the width had a little difference with the prevailing wind direction in each month. The distributions of EC's source area were consistent to the local prevailing wind direction. Characteristics of water vapor and heat fluxes among these sites have great differences: Sensible heat flux varied throughout the year at all sites, with double peak at Miyun site (appearing in April and September), triple peak at Guantao and Daxing (appearing in March, June and September). Latent heat flux presented single peak at Miyun site, with the peak value in July and August, and double peak at Guantao and Daxing sites, appearing in May and July, respectively. The monthly ET reached the peak value in July, May and August, and the annual ET is 582.1/602.1mm, 650.0/729.3mm and 515.6/645.7mm for Miyun, Daxing and Guantao site in the year of 2008/2009, respectively. The surface energy imbalance was observed at these sites, and the energy imbalance ratio is about 9%-23%.

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P110

DEVELOPMENT OF CH_4 AND BVOC FLUX MEASUREMENT SYSTEM IN A DECIDUOUS BROAD LEAVED FOREST

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Methane (CH_4) is an important greenhouse gas, contributing about 20% of current radiative forcing, and is a key compound governing the concentration of hydroxyl radicals, a strong regulator of atmospheric chemistry. Regarding the overall circulation of CH_4, upland forests are considered to be net sinks for CH_4 through consumption by methanotrophs in soil. However, some studies have suggested that upland forests may be larger sources of CH_4 than previously believed. In the most recent study, we measured CH_4 flux along a mountain stream in the Yamashiro Experimental Forest (YEF) to evaluate spatial and temporal variations in CH_4 emission and found some large CH_4 emission points in the stream and the riparian zone.

In addition, many kinds of trees, fungi and bacteria emit biogenic volatile organic compounds (BVOC) in the forest. Emission inventories show that isoprenoid is the most prominent compound of BVOC. The amount of carbon emitted by plants as isoprene (C_5H_8), which is probably the 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 needed.

However, the characteristics and mechanisms of CH_4 and BVOC flux have not been sufficiently evaluated in forests, mainly due to the difficulty of continuously measuring the CH_4 and BVOC flux. To evaluate mechanisms, the measurement system should measure the soil flux on a riparian zone, upland area and forest level above the canopy at the same time. Therefore, we developed a new system for continuously measuring the CH_4 and BVOC flux for forests and conducted preliminarily flux measurements using a Fast Methane Analyzer (FMA, DLT-100, Los Gatos Research, U.S.A.) and Proton Transfer Reaction Mass Spectrometry (PTR-MS, High-Sensitivity type, IONICON Analytik, Austria) in YEF.

The Yamashiro Experimental Forest (YEF) is located in a valley in a mountainous region of western Japan (Kidugawa City, Kyoto Prefecture; 34°47'N, 135°50'E; 220 m a.s.l.). The hillslope between the ridge top and the valley bottom is steep (about 30°), but the slope of the main river channel is gentle (about 5°). The valley is underlain by weathered granite, and the soil is generally thin, immature, and sandy. The annual mean temperature in 2002 was 15.5°C, and the hourly maximum and minimum temperatures in August and January that year were 34.8°C and 3.9°C, respectively. Annual mean precipitation was 1449 mm; the rainy season was from late June through early July, and typhoons occurred during the summer and fall. The forest consists of more than 50 deciduous (mainly *Quercus serrata Thunb* ex. Murray) and evergreen (mainly *Ilex pedunculosa* Miq) broadleaf species. The forest canopy is closed, and the canopy height is about 12 m on average.

In the present study, we measured soil flux for a mountain stream and the upland forest in YEF to evaluate spatial and temporal variations using the automated multi closed chamber method. We also measured forest level flux using the Relaxed Eddy Accumulate (REA) method. The value of soil CH_4 flux increased after the day of flooding when the temperature was high. However, no remarkable time series variations were observed in forest level CH_4 flux measurement. On the other hand, clear negative CO_2 flux and positive isoprene flux were observed at around noon using the same REA measurement system. The wet area accounts for only 0.7% of YEF which may be too small to affect the forest level CH_4 flux.

P111

EFFECT OF DIFFERENT NITROGEN SOURCES AND STRAW ADDING ON N_2O EMISSION FROM VEGETABLE SOIL

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A laboratory incubation with soil water content of 75%（water-filled pore space）and 25℃ was conducted to study whether the straw adding or not nitrous oxide (N_2O) emission under different nitrogen (Calcium nitrate, CN; Ammonium bicarbonate, AB; Ammonium sulfate, AS; Urea, U) from Facilities vegetable soils. The results showed that in all kinds of fertilizers, adding straw or not, the blank (CK) and nitrate fertilizer emission peak first appeared, ammonium nitrogen fertilizer appeared later. In the case of whether adding the straw or not, ammonium bicarbonate (AB) have the highest cumulative emissions were 4.206±0.899 and 2.159±0.256 μg g^{-1} dry soil. The emission of N_2O from ammonium nitrate fertilizer was significantly higher than nitrate fertilizer. In addition, the N_2O emissions were increased about 1 time after adding the straw comparing with no straw (CN treatment excluded). Each treatment (CK excluded) was observed that cumulative N_2O emissions with time can description by $y=a\mathrm{Ln}(x)+b$ ($P<0.001$). It was also found that no matter what kind of fertilizer can lead to soil acidification, but straw can improve soil acidification phenomenon.

Key words: Greenhouse soil, N_2O, Incubation, Nitrogen species, straw

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P112

PRESENT AND FUTURE STUDIES OF HEAT, CO_2 AND WATER FLUXES IN VIETNAM

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Forest biomes are major reserves for terrestrial carbon. The most extensive forest biomes are the boreal, temperate and tropical forest. Originally Vietnam is forest country. Monsoon tropical forests basically are most typical kind of vegetation on the territory of eastern Indochinese Peninsula and in Vietnam. In the present time, forested areas of Vietnam are 13,118,773 ha (38.7% of land territory), 78.9% of them are natural. 69 Natural reserve areas, 30 National parks, 45 Landscape reserve areas and 20 reserve forests for scientific research (total more than 2 million ha - 3% of mainland area) are located in the country. Most of them are primary forests. Vietnam's forests are characterized by 14 types of forest vegetation canopy included 11,373 plant species. The trees in Vietnam forests are presented by more of 3,000 species. The height of 320 species is below 5m; height of 2400 species is 5-25m and height of 330 species is 25-55m. The tropical forests of Vietnam certainly influence on the water and carbon balance of the region. But in present time Vietnam is one of 5 regions in the world which will suffer risks from climate changes.

To investigate the carbon, water and energy fluxes in forest ecosystems in Vietnam Joint Vietnam-Russian Tropical research Center has plan to establish first flux site on the base of eddy covariance technique in Cat Tien National Park, in a typical tropical forest of Southern Vietnam ($11^{o}26'30$ N; $107^{o}24'05$ E). Cat Tien National Park consists of evergreen tropical and deciduous forest, dominated by Dipterocarpaceae, Fabaceae and Lythraceae (especially Lagerstroemia spp.), with 40% of the park comprising bamboo woodland, and the remaining 10% farmland, wetlands and grassland. The climate of the region is monsoon tropical (mean annual air temperature - 25,4 ^{o}C; mean annual precipitation - 2894 mm).

In 2009 year first studies of soil CO_2 fluxes were conducted in Cat Tien NP in six ecosystems during dry and wet seasons. Soil CO_2 fluxes were measured by a closed chamber method using gas analyzer Li-Cor 820 (Li-Cor Inc., USA). Soil CO_2 fluxes were rated for soil covered tree waste and without it. Soil was separated into layers and common descriptions of soil profiles to depth of 50 cm were made and soil moisture, soil temperature were measured after CO_2 fluxes were determined, soil properties, microbial respiration were identified in laboratory within few month. Average soil CO_2 fluxes during period of measurements varied between 60 - 260 mg C m^{-2} h^{-1}. The contribution of CO_2 because of tree waste decomposition in common soil flux was rated from 1 to 37%. No relationship was found between soil temperature and CO_2 emission rates. The variability of soil CO_2 fluxes was mainly explained by soil moisture.

P113

METHANE EMISSION FROM WET AREA IN THE TEMPERATE FOREST -CONTRIBUTION OF WATER AND TEMPERATURE TO METHANE EFFLUX-

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Methane is a kind of green house gasses. Carbon dioxide, which is also a kind of green house gasses, is absorbed by photosynthesis and emitted by respiration in forests. However, the process on uptake and emission of methane is under mystery! Forest soil absorbs methane in many cases, but wet soil emits methane occasionally. Methane emission in wet area has largely temporal variation and can not be negligible to methane uptake.

This study was conducted in Yamashiro Experimental Forest located in central Japan (34º47'N 135º50'E). This forest is secondary forest mixed of deciduous and evergreen trees. A 0-order valley runs through this site and soil around the stream is wet. Hourly methane emission or uptake rate was measured near the stream using fast methane analyzer (DLT-100, Los Gatos Research Inc.) automatically.

After constantly lower emission rate was observed from May to June, methane emission rate suddenly increased in late June (Fig.1). Methane emission rate was low when air temperature was less than 15 °C, whereas methane emission rate was high when air temperature was higher than 15 °C (Fig. 2).

What happens in warm season?

Methane emission rate was not correlated with air temperature in case air temperature >15°C because methane emission rate has a lot of variance. Methane emission decreased to zero while raining and increased after raining. Hourly change in methane emission was smooth unless on raining or within 48 hours after raining. Diurnal change in air temperature was not contributed to the change in methane emission. Suitable environment for methane emission does not depend on air temperature if it is higher than 15°C.

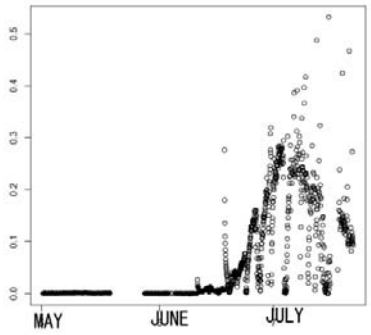

Fig. 1 Seasonal change (spring-summer) in methane emission ($\mu gCH_4\ m^{-2}\ s^{-1}$) from wet area in the temperate forest.

What happens in cool season?

Methane emission was almost zero in spring, but tiny methane emission could be detected when air temperature was higher than 15°C. It got warmer in daytime but it decreased to <15°C in nighttime. Large diurnal change in air temperature rather than air temperature itself prevents high methane emission in cool season. Continuous warmness might be needed for large methane emission.

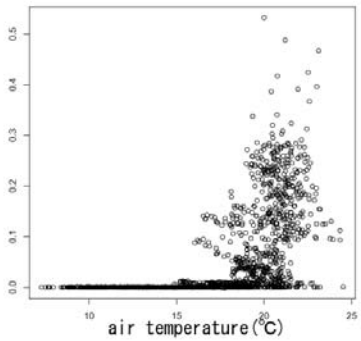

Fig. 2 Relationship between methane emission ($\mu gCH_4\ m^{-2}\ s^{-1}$) and air temperature.

Conclusion

If it is not continuously warm, methane emission rate is low although daytime air temperature is sufficiently high. If it is constantly warm, methane emission rate is high regardless of diurnal change in air temperature. Temporal change in methane emission does not follow timely change in environmental factors.

P114

THE EFFECT OF SUBSTRATE CHARACTERISTICS AND WATER CONTENT ON LEAF LITTER RESPIRATION

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Introduction:

Soil respiration is sum of CO_2 efflux from leaf and root litter, SOM (soil organic matter), CWD (coarse woody debris) and live root. Each material has various characteristics, including species, texture, size and quality. Therefore, water content in CO_2 efflux caused by these characteristics have the potential to differently respond to environmental factors (temperature and water content) and time scale to differently contain water content. It is one of cause of temporal and spatial variability of soil respiration.

Leaf litter on forest soil surface has drastic change in water content than other materials. And, leaf litter respiration (R_{LL}) is strongly affected by environmental factors (especially, water content). Increases in CO_2 efflux from soil after rain is mainly caused by rapid microbial responses to water availability. Moreover, the variation of water content in surface leaf litter layer would affect the variation of R_{LL}. To examine effect of water content and tree species characteristics on R_{LL}, we measured CO_2 efflux from 1 deciduous species and 3 evergreen species in botanical garden.

Site and method:

Observation was performed at Botanical Gardens, Faculty of Science, Osaka city University located in western Japan (34^o 76' N, 135^o 68'). This botanical garden contains 11 forest types, including 3 deciduous forest, 5 evergreen broadleaf forest and 3 coniferous forest types. Annual precipitation is 1,262 mm, and averaged temperature is 16.3 degrees. Measurement was done on 9 days from June to September, 2010. We measured leaf litter respiration of *Quercus serrata* (deciduous species) and *Castanopsis sieboldii* and *Machilus thunbergii, Lithocarpus edulis* (evergreen species). To clarify the spatial position in leaf litter layer, a set of leaf litter (10 pieces) was placed in a pile, and 20 sets were fixed to forest floor using wire pin. Leaf litter water content (*H*) was calculated as H (g g^{-1}) = (Fresh mass – Dry mass / Dry mass). The system comprises an infrared gas analyzer (IRGA, GMP343; VISALA) attached to a small cylindrical chamber (0.28L).

Results:

Deciduous species leaf litter respiration (R_{LL}) increased in response to increasing water content. R_{LL} of 3 evergreen species also increased with increasing water content, but it decreased in high water content. Water contents of leaf litter in deciduous species ranged 0 - 3 g g^{-1}. On the other hand, water content in evergreen species ranged 0 - 14 g g^{-1}.

In 16, 18 and 19 August, it has no rain since 5 days before. So mean diurnal R_{LL} decreased with decreasing water content. Also, variability of diurnal R_{LL} was lower with low variability of leaf litter water content. Whereas, because water content of leaf litter in deciduous species was low, they did not show any CO_2 efflux from leaf litter.

P115

CARBON DIOXIDE EXCHANGE AT SINGLE AND DOUBLE CROPPING FIELD IN JAPAN

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Eddy-covariance CO_2 fluxes have been continuously measured at a single rice paddy field and a barley-rice double cropping field located in western Japan. Data for four years in both sites were analyzed to investigate CO_2 exchanges between air and different agro-ecosystems, and their responses to environmental factors. Annual accumulated NEE (net ecosystem exchange) were also estimated.

At the single rice site (HCH), rice is seeded in early May and harvested in mid-October. At the double cropping site (OKY), barley is seeded in early December and harvested in end of May, and rice is transplanted in late June and harvested in late October. At both sites, the periodic irrigation water management, 3 days flooded and 4 days drained, is customarily conducted.

Half-hourly fluxes of CO_2, water vapor, sensible heat, and momentum were calculated and tested with several quality control processes suggested by Mano (2007). Missing and rejected fluxes were filled by non-liner regression method. RE (ecosystem respiration) was formulated by the function of air temperature during whole span of cultivated seasons for each crop. Figure 1 shows RE as a function of air temperature. GPP (gross primary production) was formulated by the function of PAR (photosynthetic active radiation) during every growth stage, 10 days in concrete terms. Figure 2 shows seasonal variation of P_{max}. Annual accumulated NEE between 2007 and 2009 were summarized in Table 1.

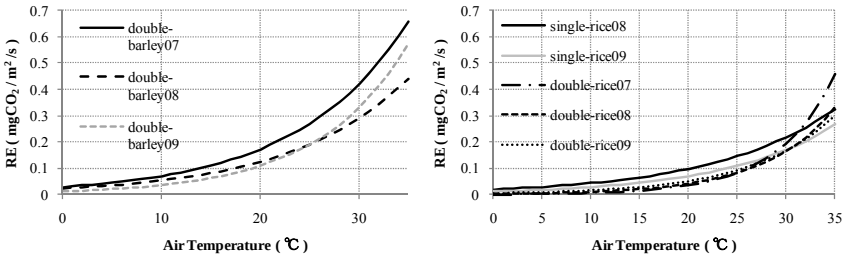

Fig.1 Relationship between RE and Air temperature

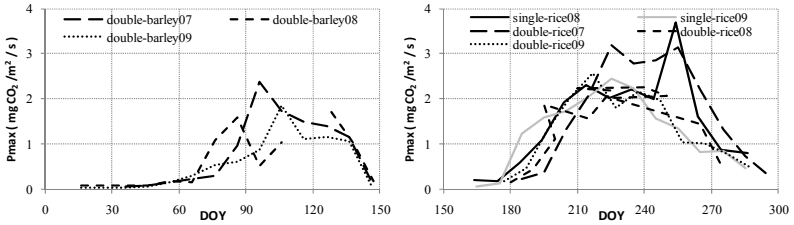

Fig.2 Seasonal variation of Pmax

Table 1 Annual accumulated NEE between 2007 and 2009

			$gCO_2/m^2/s$			DegC	mmol/m2/day		$gCO_2/m^2/s$			DegC	mmol/m2/day
Site	Year	Vegetation	RE	GPP	NEE	Tair-ave	PAR-ave	Vegetation	RE	GPP	NEE	Tair-ave	PAR-ave
HCH	2008	rice	1941	2977	-1188	25.3	19.3						
	2009		1046	2308	-1289	24.6	17.7						
OKY	2007		1334	2761	-1427	26.1	18.4		1133	1856	-722	10.4	12.2
	2008	rice	1187	2595	-1408	25.3	18.6	barley	871	1529	-658	10.4	11.2
	2009		1015	2538	-1513	24.3	16.2		733	1447	-714	11	13.5

P116

SURFACE-ATMOSPHERE EXCHANGE OVER TROPICAL TURF GRASSLAND USING EDDY COVARIANCE

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Fluxes over tropical turf grass have not been widely investigated, but they are the most extensive vegetation type in many cities, including Singapore, and cover significant areas of many countries (for example, 2% of the total land surface of the USA). Surface-atmosphere exchange of carbon dioxide, water and energy over tropical turf grassland in Kranji, Singapore was investigated from October to November 2010. Our other aim in this study was also to test a solar power system providing electricity and to power all the micrometeological instruments including during nightime. The following instruments were installed on a 2 m tall aluminium mast and on the ground of the turf grassland: a tipping bucket rain gauge, a temperature and humidity probe installed inside an aspirated radiation shield, and a mechanical anemometer and wind vane were used to measure precipitation, temperature, humidity, wind speed and direction. Upward and downward short-wave and long-wave radiation were measured using a pyranometer, Eddy covariance data were logged at 10 Hz and other measurements were logged every 10 minutes. We present our results for one month of measurements over tropical turfgrass at an unused telecommunications site.

P117

SEASONAL DYNAMICS OF SOIL RESPIRATION IN A RUBBER PLANTATION ECOSYTEM

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This research aim to quantify diurnal and seasonal dynamic of soil respiration in a 16-year-old rubber plantation in 2010, Soil respiration was investigated at the Chachoengsao Rubber Research Station which located in Phanom Sarakham district, Chachoengsao province (13 41 N, 101 04 E), Thailand. The observation site was planted with a monoclonal stand of rubber trees clone RRIM 600. Tapping for latex production began when the trees were 9 year-old. Annual soil CO_2 efflux from April 2009 to March 2010 was about 1.65 k C m^{-2}. Soil respiration exhibited seasonal variations but not clearly. It was high in rain season (June) and low in dry season (November). During study period, averaged soil CO_2 efflux, soil temperature and soil volumetric content ranged from 2.5-7.4 mol CO_2 $m^{-2}s^{-1}$, 23.1-28.5 C and 3.5-27.95%, respectively.

P118

TREE SURFACE TEMPERATURE IN A PRIMARY TROPICAL RAIN FOREST AND RUBBER PLANTATION IN SOUTHWESTERN CHINA

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Canopy dominant trees which have high abundance and biomass are the main contributors to the carbon /water pool, nutrition bank and energy pool of the forest ecosystem. The variations of the leaf temperature could be used as one of the quantitative indicators for evaluating carbon sequestration and water use of a whole tree. Xishuangbanna region, located in north end of southeastern Asia tropical rain forest area. Now extensive primary tropical rain forest in Xishuangbanna are changing to rubber plantation. Major characteristics of the three typical seasons (foggy-cool season, hot-dry season and rainy season) in the region are low temperature and fog, high temperature and low rainfall and high temperature and high rainfall. We report canopy leaf temperature distribution over space and time assessed over a primary tropical rain forest and a rubber plantation in SW China by means of towers and two high resolution thermal cameras (Flir P25, USA) in the three seasons. Across all the tree species, we found significantly different temperatures in the primary tropical rain forest and rubber forest. Our results illustrate the importance of tree species composition for the local climate.

P119

ALLOCATION OF ASSIMILATED C IN TIBETAN MONTANE PASTURE REVEALED BY $^{13}CO_2$ LABELING

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Since 1959 settle programs change the grazing activity on the Tibetan Plateau. Near the villages grazing pressure increases, leading to land degradation. The opposite effect is visible in remote areas where grazing pressure decreases and thus leads to changes in vegetation pattern, e.g. tall grasses become more abundant. To clarify the effect of land use changes on carbon (C) cycle on the Tibetan Plateau, it is necessary to characterize the differences in belowground C allocation of both grazed and ungrazed grassland to ascertain if the system functions either as C source or sink.

In situ $^{13}CO_2$ pulse labeling was accomplished on 1) a montane *Trigoella-Kobresia* grassland that is used as winter pasture for yaks, and 2) on a grazing exclosure plot simulating decreasing grazing pressure where large grazers are excluded since 2002, both on the Tibetan Plateau in 3440 m a.s.l. The average partitioning pattern of assimilated C was chased from July 27 until August 22, 2009.

At the end of the chase period the percentage of labeled C incorporated into structural shoot components did not differ significantly, amounting for 43% ^{13}C of recovery in the grazed grassland and for 38% ^{13}C of recovery in the ungrazed grassland. However, in contrast to the aboveground, the ^{13}C allocation in all belowground pools was significantly different. The grassland under grazing pressure allocated 40% ^{13}C of recovery belowground which is twice the amount of the ungrazed plot. The least portion was incorporated into structural root components in both cases amounting for 2% in the grazed and 0.6% in the ungrazed grassland. Within the belowground pools, 20% ^{13}C of recovery in the grazed plot and 9% ^{13}C of recovery in the ungrazed plot was mineralized to CO_2 within 27 days. In the soil of the grazed plot 18% ^{13}C of recovery was not decomposed but remained in soil, which is significantly more than that of the ungrazed plot amounting for 10% ^{13}C of recovery, which is in accordance to the significant higher soil C content and stock in the layer 0 – 5 cm of the grazed grassland. The amount of newly assimilated ^{13}C lost via shoot respiration was significantly higher in the ungrazed grassland amounting for 42% ^{13}C of recovery compared to 17% ^{13}C of recovery in the grazed grassland. The dynamics of assimilate allocation in shoots show an exponential decrease within the chase period in both plots. ^{13}C recovery did not differ significantly between grazed and ungrazed grassland in any sampling step indicating that the dynamics of C allocation in shoots is similar for both grazed and ungrazed grassland. Total quantity of ^{13}C that was allocated from shoots to subsequent carbon pools amounted to 36% ^{13}C of recovery in the grazed plot and 52% ^{13}C of recovery in the ungrazed plot over 27 days. In the grazed plot however, significantly less C is lost by shoot respiration and significantly more is translocated to belowground pools. The combined decomposition rate of rhizodeposits and organic substances used for root respiration was determined by fitting first-order kinetics to the intensity of $^{13}CO_2$ efflux from soil within the chase period. Decomposition rate amounted for 0.36 ± 0.09% of assimilated ^{13}C d^{-1} and 0.18 ± 0.04% of assimilated ^{13}C d^{-1} for grazed and ungrazed grassland, respectively.

Since belowground ^{13}C allocation and the amount of ^{13}C remaining in soil of the grazed plot was significantly higher than in the ungrazed plot combined with the higher soil C content in the layer 0 – 5 cm, a positive effect of grazing on C sequestration in soil was revealed.

Keywords: ^{13}C pulse labeling, carbon partitioning, montane *Kobresia* pasture, grazing, SOC, Tibetan Plateau

P120

TURBUENT FLUXES OF AIR-SEA EXCHANGE MEASURED AT YONGXING ISLAND, XISHA, CHINA

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During January 19 and March 5, 2006, an experiment on the sea-air exchange was carried out at Yongxing Island (16°50′N, 112°20′E), Xisha, South China Sea. Locating in tropical zone, this island is warm with annual mean temperature about 26.4 °C, and with frequent precipitation, high wind speed and fast evaporation. The area of Yongxing Island is about 2.1 square kilometers, the largest in Xisha archipelago. As a remote island over sea, it is ideal for measurement of turbulent fluxes to reveal characteristics of air-sea exchange.

Sensible heat, water vapor and CO_2 were measured, using DA600 three-dimensional supersonic wind and temperature anemometer (KAJIO, Japan), LI7500 type CO_2/H_2O analyser (LI-COR, USA). Data were collected by a system developed in Peking University. The sampling frequency was 20 Hz, three components of wind speed, temperature, CO_2 concentration (ppmv) and specific humidity were measured. Data was stored every 60min as a file, 823 hours' data of observation was obtained.

After a procedure of data quality control, turbulent statistics were calculated, using the software SPEC (Statistics Processer for Eddy-Covariance, which was developed in Peking University). Integral turbulent characteristics were used to assess if the turbulence observing the Monin-Obkhov similarity. Sensible and latent heat fluxes as well as CO_2 flux were calculated, and their diurnal variation were shown.

In order to exclude the influence of the island surface and to draw out true fluxes of the air-sea exchange, a footprint model FLEM (Footprint for LAS and Eddy-covariance Measurement, developed in Peking University) was employed for further analysis. Flux footprint correspondent to each set of turbulence measurement were calculated. A high-resolution of satellite image was used to assess each grid within the footprint area is over water surface or over island. Eventually all measurement of fluxes were classified into types of different influence of the island surface. By setting a criteria, those part of the flux measurement results with less island influence were used to characterize the air-sea exchange in this region.

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THE EFFECT OF A THREE-SIDE-OPEN AUTOMATED CHAMBER ON GHG MEASUREMENT

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In compare with traditional open-at-top chamber, the effect experiment of a three-side-open automated chamber on greenhouse gases measurement in maize field was conducted. The experiment was to test the three-side-open chamber's character on ambient temperature, ambient relative humidity, soil temperature, soil moisture, crop growth and greenhouse gases emission. The results showed that: In compare with traditional open-at-top chamber, the three-side-open chamber can significantly alleviate the influence of chamber on ambient temperature, ambient relative humidity and soil temperature. It can drop ambient temperature 0.90℃ with chamber closed and 0.74℃ with chamber opened. It can also drop air relative humidity by -1.36% and 5.69% when the chamber is opened and closed respectively. It also can decrease soil temperature by 2℃ during maize seeding stage, but not significant after seeding stage. It can also have some influence on soil moisture. but It is not significant. The three-side-open chamber can also alleviate the maize height dramatically which influenced by chambers. The GHG monitor showed that the three-side-open chamber can trade off average CO_2 flux and N_2O flux by 6.85% and 3.68%, but almost have no influence on CH_4 average flux.

Keywords: three-side-open automated chamber, greenhouse gases measurement, application effect

P122

THE EFFECT OF FERTILIZATION ON THE PARTITION AND ACCUMULATION OF CARBON AND NITROGEN IN RICE PLANTS

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The partition and accumulation of carbon (C) and nitrogen (N) in rice plants were investigated in two long–term fertilization trials of paddy ecosystems from Ningxiang and Taojiang counties of Hunan Province, China. The fertilization treatments for both trials were no fertilizer application (CK), straw-retained (STW), chemical fertilizer (NPK), chemical fertilizer plus a low rate of organic manure (LOM, organic N accounted for 30% of total applied N), chemical fertilizer plus a high rate of organic manure (HOM, organic nitrogen accounted for 60% of total applied N). Except for the CK treatment, each treatment for Ningxiang and Taojiang trials received 158 kg N ha^{-1} and 150 kg N ha^{-1}, respectively. The results showed that chemical fertilizer plus low organic manure (LOM) could promote effectively the distribution of C in the rice plant. The average N content of stem–leaf and grain under LOM and HOM treatments was 9.6 $g.kg^{-1}$ and 13.0 $g.kg^{-1}$ respectively, which was 13-63% and 10-18% higher than that under NPK treatment, and 27-86% and 20-44% higher than that under CK treatment, separately. The highest N content of root was observed 9.4 $g.kg^{-1}$ under the HOM. Most of the photosynthesized C and up-taken N were accumulated in grain and stem-leaf organs. The largest storage of C and N in grains under LOM and HOM treatments was 3320-4324 kg C ha^{-1} and 120-135 kg N ha^{-1}, respectively, 5-29% and 6-39% higher than STW, and 13-23% and 26-45% higher than NPK, separately. In addition, the storages of C and N in stem-leaf under these two organic-inorganic treatments was 2120-2411 kg C ha^{-1} and 50-66 kg N ha^{-1}, respectively, higher than those under other treatments. This study indicates that organic-inorganic fertilization in rice ecosystems can effectively favor N translocation from the belowground to the aboveground, and improve the accumulation of C and N in the rice plant.

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DYNAMICS OF NET ECOSYSTEM CARBON DIOXIDE EXCHANGE AND ITS ENVIRONMENTAL FACTORS IN INNER MONGOLIA DESERT STEPPE

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The long-term observation of CO_2 flux between vegetation and atmosphere is important for understanding ecosystem carbon cycle and its control mechanisms, analyzing the conversion mechanism of carbon source and carbon sink, and assessing the response of ecosystem carbon cycle to future climate change. Desert steppe in Inner Mongolia is an important part of China's desert steppe. The study of the land-atmosphere carbon exchange process in this area is important for quantitative understanding the interaction between the desert steppe ecosystem and the atmosphere.

Based on the measurements of eddy covariance system and microclimate gradient observation system in Inner Mongolia desert steppe from 2008 to 2009, the diurnal and seasonal dynamics of net ecosystem carbon exchange and it's environmental factors of *Stipa klemenziii* steppe were analyzed.

Main results are summarized as follows:

1) Each component of ecosystem carbon exchange (*NEE, GEP,* R_{eco}) appeared a significant daily variation. The ecosystem absorbed CO_2 during the day, and released CO_2 at night. The absorption peak appeared around midday. The carbon absorption in the morning was higher than that in the afternoon. *GEP* showed a single peak or double peak curve distribution. The fluctuation of R_{eco} was in relatively gradual. R_{eco} decreased from the evening until the next morning.

2) Each component of carbon flux in Inner Mongolia desert steppe also appeared a significant seasonal variation. The monthly cumulative *NEE* were mostly negative. This meant the ecosystem absorbed carbon. In2008, the total sum of *NEE* for the entire growing season was -45.5g CO_2m^{-2}, and it was -83.9g CO_2m^{-2} in 2009. The trend of *GEP* was similar to the trend of *NEE*. R_{eco} showed a more stable single peak curve.

3) The most important environmental factor affecting the daily cumulative *NEE* was 10-20cm soil water content. The most important environmental factor affecting the half-hour average *NEE* was photosynthetically active radiation (*PAR*).

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ROCK FRAGMENT LAYERS INHIBIT SOIL RESPIRATION RESPONSE TO PRECIPITATION PULSE

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Soil respiration shows a notable increase after precipitation events. The magnitude of the carbon loss by precipitation pulses is comparable to the annual net carbon exchange of many terrestrial ecosystems, especially in arid and semiarid regions. The presence of rock fragment layers in soil profile can change soil moisture, soil temperature, microbial community, root distribution, plant response to precipitation, soil pore-size distribution, and soil pore connectivity. These soil abiotic and biotic factors and soil structure properties regulate soil heterotrophic and autotrophic respiration and highly influence the transport of water and gases in soil. Therefore, we hypothesized that the presence of rock fragment layer may trigger a different soil respiration precipitation pulse pattern and change the respired carbon efflux. Field measurements were carried out in reconstructed soil profiles without rock fragment layer and with rock fragment layers in 20-30 and 20-40 cm horizon, respectively. Soil respiration measurement began two days after alfalfa cutting and finished after the aboveground organs withered. Rock fragment layer delayed the precipitation pulse peak of soil respiration, and the time lag increased with the increase of precipitation. However, rock fragment layers changed the precipitation pulse magnitude and rhythm of soil respiration during the alfalfa growth season, not during the period before alfalfa shooting up and after aboveground organs withered. This result suggests that the effects of rock fragment layers on soil respiration response to precipitation pulse are mainly caused by the changes of soil autotrophic respiration. The presence of rock fragment layer did not change the seasonal variation pattern of soil respiration. Monthly soil respiration of July and August were significantly larger than that of September and October for the soil profiles with and without rock fragment layers. The presence of rock fragment layers in soil profile significantly decreased the magnitude of soil respiration over the study period. Compared with rock fragment layer appearance in 20-30 cm horizon, rock fragment layer appearance in 20-40cm horizon had a significantly lower monthly soil respiration in August. The difference of soil respiration between treatments with and without rock fragment layers was likely attributed to the differences in root biomass and precipitation pulse magnitude of soil respiration. However, variations in soil respiration between treatments with different thickness of rock fragment layer were highly related to the different precipitation pulse magnitude of soil respiration. The findings in this study would be useful in developing a greater understanding the highly spatial heterogeneous of terrestrial ecosystem carbon efflux.

Keywords: soil respiration, precipitation pulse, rock fragment layer, root biomass, layer thickness

P125

PATTERNS AND DRIVING FACTORS OF WUE AND NUE IN NATURAL FOREST ECOSYSTEMS ALONG NORTH-SOUTH TRANSECT OF EASTERN CHINA ------BASED ON ISOTOPE AND STOICHIOMETRY ANALYSES

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Global change impacts on the key processes such as water, carbon, and nitrogen cycles in natural ecosystems, which has been paid more attention than ever before. Water use efficiency (WUE) and nitrogen use efficiency (NUE) are important physiological and ecological indexes in reflecting not only the use potential of environmental resources but carbon, water, and nitrogen cycle coupling. Study on the patterns and driving factors of WUE and NUE along a transect with environmental gradients is helpful to deeply understand the impacts of global change and its related ecosystem adaption. Based on 72 leaf samples from 22 dominant species in natural forests along North-South Transect of Eastern China (NSTEC), we studied the geographical distribution patterns of vegetable WUE and NUE and their relationship with environment factors. The results showed: (1) WUE, ranging from 2.13 to 28.67 mg C/g H2O, increased linearly from south to north, while NUE, ranging from 12.92 to 29.60 g C/g N, decreased with increasing latitude along NSTEC; (2) WUE and NUE were dominantly driven by climate and significantly affected by nutrient factors; (3) there was a trade-off relationship between vegetable WUE and NUE along NSTEC, which was a balanced strategy for vegetation in resource utilization. This study suggests that global change would impact resource use efficiency of forest ecosystems. However, vegetation could adapt to those changes by increasing the use efficiency of shortage resource while decreasing the relatively ample one. But extreme impacts, such as heavy nitrogen deposition, would give a dramatic disturbance to the ecosystem biogeochemical cycle.

Keywords: WUE, NUE, isotope, stoichiometry, North-South Transect of Eastern China (NSTEC)

P126

EFFECTS OF TIDAL REGIME ON NET ECOSYSTEM EXCHANGE OF TWO SUBTROPICAL MANGROVE ECOSYSTEMS IN CHINA

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Characteristics of CO_2-C exchange of two mangrove wetland in different tidal regime were studied from June 1, 2009 to May 31, 2010. The Yunxiao mangrove was situated in a semidiurnal tide regime area, while Gaoqiao site located in a diurnal tide regime area. Net ecosystem exchange of carbon dioxide was calculated from the CO_2 fluxes measured by the eddy-covariance technique in two sites. The results show that: (1) the mangrove wetland was a large net CO_2 sink for each month throughout the year; (2) the annual net uptake of CO_2-C was 520 and 764 g C m^{-1} yr^{-1} of Yunxiao and Gaoqiao, respectively; (3) tidal regime and environmental factors exerted major controls on the carbon balance; (4) lack of knowledge of the POC, DOC and DIC transport to nearby estuaries limited deeper understanding of carbon balance in mangrove ecosystems. Thus, lateral carbon transport will be conducted in our further study.

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CONSTRASTING ENERGY BALANCE BETWEEN TWO SUBTROPICAL MANGROVE ECOSYSTEMS WITH DISTINCT TIDAL REGIMES

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The energy balance and regulating factors were compared between two subtropical mangrove ecosystems (Yunxiao-S1 and Zhanjiang-S2) with distinct tidal regimes (S1: semidiurnal tide, S2: diurnal tide) during one year continuous measurements. The results showed that the seasonal changes of the energy fluxes were greatly affected by the incoming shortwave radiation and tide. The mean annual incoming shortwave radiation at S1 (113.06±62.29 $W \cdot m^{-2}$) and S2 (162.09±82.67 $W \cdot m^{-2}$) were partitioned into 21.7210% and 15.4995% sensible heat, 60.6336% and 47.2221% latent heat, -0.0042% and -0.6620% ground heat, respectively. There was still 17.6496% and 37.9405% of mean energy balance deficit at S1 and S2. Tide is acting as an energy source or sink, and the tidal energy advection plays an important role in the energy balance deficit. In winter, the Bowen ration (β) changed significantly from the tidal flooding days to the exposure days at S2. However, the β variation was much larger than that at S1. And the magnitude of variation became smaller in summer at both sites. The β variation between two sites highlighted the impact of the distinct tidal regimes on energy balance.

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PROJECTING THE DISTRIBUTION OF VEGETATION IN CHINA IN RESPONSE TO CLIMATE CHANGE

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Climate change may exert large impacts on plant physiology and the distribution of vegetation types. The current distributions of 27 biomes were modeled using the processed-based equilibrium terrestrial biosphere model BIOME4 revised based on current plant functional type-climate relationships in China. The validation of model from Kappa statistic showed that the results of these modeling were able to capture the geographical patterns of vegetation in China. The revised BIOME4 was then adopted to predict the distribution of vegetation of China under future climatic scenario derived from Regional Circulation Model forced by A_1B global warming scenarios. The projection results showed that during the 21st century, the climate change would potentially lead to big changes of vegetation systems in China. There were obvious northward shifts of the boreal, temperate deciduous and evergreen and tropical forests and alpine meadow. The most vulnerable regions to climate changes in priority conservation areas were also discussed based on the simulation results.

P129

MODELING EVAPOTRANSPIRATION AND ITS COMPONENTS IN SUBTROPICAL CONIFEROUS FOREST BASED ON REMOTE SENSING AND METEOROLOGICAL DATA

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Reliable estimation of regional evapotranspiration (LE) and its components are necessary for the study of the coupling relationship between water and carbon fluxes and modeling of global climate change. In this study, based on Priestley-Taylor equation and the evapotranspiration model considering the limiting factor of environment variables, we simulate the LE and its components (soil evaporation, canopy transpiration and interception evaporation) of the planted coniferous forest ecosystem at Qianyanzhou (QYZ) during 2003 and 2008 by using remote sensing data from MODIS and meteorological data. The estimated LE is compared with the observation from eddy flux tower sites, which can lay a foundation for the further scaling up of evapotranspiration estimation. The results show that the simulated annual LE is about 2.4% lower than measurement, with a decision coefficient value(R^2) of 0.83 and root mean square error of 17W•m^{-2} (0.61mm•d^{-1}). Most (above 80%) LE simulation of daily LE range from 40W•m^{-2} (1.44mm•d^{-1}) to 150W•m^{-2} (5.40mm•d^{-1}). As to the LE components, soil evaporation is 12% of simulated LE with relative stability at seasonal and interannual scale. With obvious seasonal and interannaual variability, interception evaporation contributes 23% of the LE and with the same change tendency as precipitation. Canopy transpiration is about 65% of LE with obvious seasonal variation and interannual stability. During the heat and drought season, with the increasing of drought condition, there is an obvious decline of canopy transpiration when it appears no rain during continuous 16 days, which demonstrate that the physiological activity of vegetation is limited by the water deficit.

P130

UNDERSTANDING WATER BALANCES IN KOREAN LANDSCAPES

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In forest ecosystems, the water balance depends on topographic gradients that affect precipitation, evapotranspiration and runoff, both directly and indirectly through modifications in forest structure and function. As a first step in understanding the water balance in the forested watershed in Haean Basin in Gangwon Province of S. Korea, water vapor and CO_2 exchange characteristics of deciduous forest, which make up ca. 50% of the land cover of the basin, have been defined by combining information from KoFlux forest site measurements including eddy covariance data, from local sapflow measurements, with remote sensing data, and with process-based simulation models. While eddy covariance measurements at flux tower sites provide much new information about micrometeorology and ecosystem function, generalization of the data for use in spatial models is an important spin-off from land surface flux network measurements.

Forest water use at the Seolmacheon mixed forest site (ca. 20-30 years average tree age) and Gwangneung old natural deciduous forest site (ca. 90-200 years average tree age) are compared with estimates in the Haean Basin, adjusting for the cooler highland climate. Accurate estimation of forest water use in the Haean Basin is extremely important in order to aid in calibration of basin hydrological models. Canopy CO_2 exchange from two KoFlux sites is characterized by inverting the single layer process-based canopy model PIXGRO with respect to eddy covariance data and local climate, in order to obtain the seasonal course of carboxylation capacity (Vc_{uptake}). It is related to Haean Basin by consideration of probable differences in water use efficiency. Remote sensing data are being examined in order to adjust gas exchange characteristics along the elevation gradient within the Haean Basin, and to obtain independent estimates of canopy water use and carbon uptake via remote sensing algorithms.

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WATER REGULATED EFFECTS OF PHOTOSYNTHETIC SUBSTRATE SUPPLY ON SOIL RESPIRATION IN A SEMIARID STEPPE

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Soil respiration is an important part of the global carbon (C) cycle and the largest component of C flux from terrestrial ecosystems to the atmosphere. Here, we investigated possible effects of photosynthetic substrate supply on soil respiration in a semiarid ecosystem. A field experiment combining water addition and shading (low and high shading) treatments was conducted to manipulate photosynthetic substrate supply in a temperate semiarid steppe in two growing seasons. Our result showed that water addition and/or low shading significantly increased net primary productivity (ecosystem-level photosynthetic substrate supply) and soil respiration in both two growing seasons. However, the effects of high shading on net primary productivity and soil respiration depended on soil water condition, which were negative in wet year (2008) but positive in dry year (2009). On the diel timescale, soil respiration was out phase of soil temperature and leaf net photosynthesis, but in phase with leaf sugar and starch content (leaf-level photosynthetic substrate production). The results indicated that photosynthetic substrate supply was an important factor in regulating soil respiration on both daily and seasonal timescales. Moreover, its effect on soil respiration increased with increasing water availability in this region. The predominant role of C assimilate supply on soil respiration indicates that the predicted positive influence of rising temperature on soil respiration will be simultaneously mediated by substrate supply and water availability in semi-arid steppe ecosystems.

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PHOTOSYNTHESIS CHARACTERISTICS OF *STIPA PURPUREA* UNDER IRRIGATION IN NORTHERN TIBET AND ITS RESPONSE TO CLIMATE CHANGE

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Under the background of climate change, we used a portable gas exchange system (LI-6400) to measure net photosynthetic rate (Pn), stomatal conductance(Gs), intercellular CO_2 concentration(Ci), transpiration rate(Tr), water use efficiency(WUE) of *Stipa purpurea* grown under different irrigation practices in northern Tibet responded to the elevated CO_2 concentration, [CO_2], and temperature. [CO_2], temperature and soil moisture was observed to have affected photosynthesis parameters of *Stipa purpurea* significantly, and there were apparent interactions among the three factors. Rising [CO_2] would gradually increase photosynthetic rates until a dreasing trend was observed when [CO_2] is very high. Increasing temperature would cause photosynthetic rate to be dreased, but sufficient water supply could partially offset the high temperature limit. Sufficient water supply could increase photosynthetic rate , and this relationship was more obvious with elevated [CO_2] and temperature. With a rising [CO_2], intercellular CO_2 concentration increased, transpiration rate decelerated, water use efficiency rised, stomatal conductance reduced, thereinto, high temperature caused stomatal conductance declining faster. The photosynthesis characteristics were impacted by the combined actions of humid and temperature. stomatal conductance was maximized at 20°C, and sufficient water supply further increase stomatal conductance. Intercellular CO_2 concentration riesed when temperature went up, and this response was more obvious under sufficient water. Transpiration rate was positively correlated with temperature and soil water, the direct proportion between transpiration and soil water was more evident under lower temperature. The rised temperature or sufficient water made water use efficiency decline. We concluded that warm and humid climate tend to promote *Stipa purpurea*'s photosynthesis, and it would have a positive effect on the productivity of *Stipa purpurea* grassland in Northern Tibet.

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AN EVALUATION OF THE RHESSYS MODEL TO A SUBTROPICAL WATERSHED

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The regional Hydro-Ecological Simulation System (RHESSys) is a coupled hydroecological model that is designed to be able to simulate integrated water, carbon and nutrient cycling and transport over spatially variable terrain at small to medium scales. In south China, there is mostly subtropical climate and precipitation is mainly distributed in wet monsoon days. RHESSys has previously been applied to many climate types and forest types. However, it has not been yet applied to conifer forest in subtropical regions of south China. This study investigated whether the RHESSys model is a suitable tool for studying interactions between hydrology and ecosystem processes in south China. We performed a validation of RHESSys using daily, monthly and yearly data on gross photosynthesis production and streamflow. The simulation results generally agreed well with observations and estimates from other models. Furthermore, utilizing RHESSys can predict future response of ecosystem in climate scenarios similar to past or estimated by climate modeling. Finally, our validation confirmed that RHESSys is suitable for studying the water, carbon and nutrient cycle in forest ecosystems in south China.

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CHARACTERISTICS OF NATURAL ABUNDANCE OF SOIL ^{15}N ON THE QINGHAI–TIBETAN PLATEAU OF CHINA

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Soil stable nitrogen (N) isotope composition is the indicator of N cycle in most ecosystems. This study explores the regional pattern of soil ^{15}N abundance ($\delta^{15}N$) in a zone approximately 1,875km long by 200km wide on the Qinghai-Tibetan Plateau and their relationship with environmental factors (e.g. climate, soil characteristics, topography). Results indicated that soil total N (TN) content (0-40cm) along whole transect was averaged to 0.26 ± 0.21%, increasing from west to east in study area. The N concentrations in soil of meadow types were larger than steppe types. Therefore, mountain meadow and alpine desert steppe have the maximal and minimal soil TN content, respectively. To our study, natural abundance of soil ^{15}N (0-40 cm) ranges from -7.64 to 7.47‰, with an average value of 2.69±3.09‰. Geographically, soil $\delta^{15}N$ depth to 40cm decreased from south to north but no longitudinal trend can be observed. Due to the complicated climate and topography conditions on the Qinghai-Tibetan Plateau, soil $\delta^{15}N$ values increased with increasing mean annual precipitation (MAP) (R^2=0.257, p=<0.01, n=29) in relatively low mean annual temperature (MAT) region (0.3 ± 3.7 ℃); while, MAT (R^2=0.205, p=<0.01, n=36) and altitude (R^2=0.253, p=<0.01, n=36) were the main factors controlling of soil $\delta^{15}N$ in relative high MAT region (4.6 ± 4.1 ℃). In addition, there has a quadratic relationship between soil TN and $\delta^{15}N$ (R^2=0.180, P<0.01, n=65) along the whole transect. The analysis on vertical distribution showed that soil TN exhibited a declining trend from surface layer to deeper layer, while the tendency of soil $\delta^{15}N$ with depth depended on vegetation types. Otherwise, soil $\delta^{15}N$ values were enriched from sand to silt and clay content which was consistent with the general pattern.

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IMPACT OF OPEN BURNING AND BIOMASS DECOMPOSITION ON CARBON BUDGET IN CROPPING FIELD

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Paddy field is one of the most important eco-system in monsoon Asia, and takes a great important role in CO_2 uptake. Carbon budget in agricultural field is influenced by some artificial management. After the harvest, residual biomass is burned on the fields, brought out from the fields, or remained and harrowed into the fields. If open burning was conducted in a field, one part of biomass carbon is emitted into atmosphere as CO_2, and the other part is harrowed into soils.

In this study, quantity of lost carbon according to burning of residual biomass were investigated at the double cropping field in western Japan, in which long-term continuous CO_2 flux measurement by the eddy-covariance technique was conducted. Sampling survey of residual biomass was carried out during interval periods twice a year, in early June and early November on 2009 and 2010. One survey is composed three times sampling – whole plant sampling before harvest, residual biomass before burning, and non-burned residuals after burning. Crop yield and quantity of lost carbon were calculated from their differences. Each sample was collected from 7 plots in the field and weighed after drying by the oven with 90degC for 48hours. Each sample was fractionated into plant regio and carbon content ratio for each regio was also measured. Table 1 shows carbon content of NPP (net primary production), yield, burning loss, and soil input for 3 cultivated season, 2009-barley, 2009-rice, and 2010-barley. The ratio of burning loss to NPP for 3 seasons was 19.5%, 22.0%, and 34.0%, respectively.

Table.1 Distribution of NPP to harvest, burning and input in soil [gCm^{-2}]

season	NPP	harvest	burning	input in soil
2009-barley	473(100)	230(47)	94(19.5)	161(33.5)
2009-paddy	650(100)	268(42)	138(22)	226(36)
2010-barley	541(100)	258(45)	199(34)	94(21)

The decomposition rate of large residual biomass of harrowed into soil was estimated during barley season between beginning of December 2009 and early June 2010. 6 soil samples collected from the field every three weeks, and large residual biomass of the last rice plants more than 1 mm in size was extracted by washout. Then, dried matter weight and carbon content were measured. Figure 1 shows time series of large residual biomass matter in soil for 183 days after harrowing. Lost carbon content from large biomass during half a year until next transplanting of rice was estimated as 177gCm^{-2}.

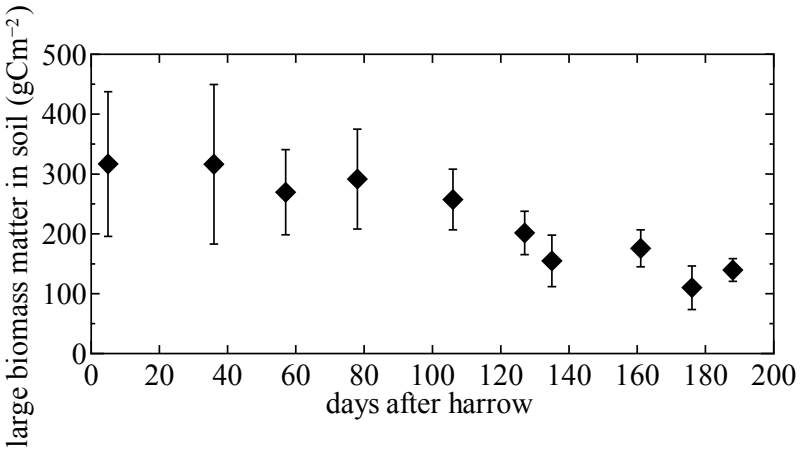

Fig.1 Residual biomass in soil during 183days after harrow in 2010-barley season

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ESTIMATION OF PHOTOSYNTHETICALLY ACTIVE RADIATION IN GRASSLAND ECOSYSTEM USING MODIS PRODUCTS

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PAR (photosynthetically active radiation) is one of the most significant factors in the research of carbon cycle and its driving mechanism in land ecosystem of China, which plays an important role in carbon cycle study. Firstly, based on the present research and radiation transferring theory, the total transmittance was simulated with MODTRAN (Moderate spectral resolutionatmospheric Transmittance algorithm and computer model) using atmosphere and land products of MODIS in this paper.After that, the photosynthetically active radiation was acquired with the total transmittance and the maximum PAR on top of atmosphere. At last, the method was applied to the grassland ecosystem in Inner Mongolia of China, and then the results estimated were validated using the measured data in Xilinguole station of CERN and the achievements of previous studies. It shows that the method proposed in this paper is feasible for the PAR estimaion in regional scale. This study has significance for regional carbon cycle studies.

Key words: Photosynthetically Active Radiation (PAR), Moderate Spectral Resolution Atmospheric Transmittance Algorithm and Computer Model (MODTRAN), Total Transmittance, Grassland Ecosystem

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RESPONSES OF CANOPY CONDUCTANCE TO ENVIRONMENTAL FACTORS AND ITS SIMULATION OVER THE INNER MONGOLIA TEMPERATE DESERT STEPPE

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Canopy conductance (g_s) plays an important role in the terrestrial ecosystem-atmosphere water and carbon dioxide exchanges, and hence simulation of terrestrial ecosystem responses to the future climatic change necessitates reliable parameter of g_s. In this study, measurement and simulation of g_s over the temperate desert steppe were carried out in Inner Mongolia, China, in the growing seasons from 2008 to 2009, with more dry soil moisture in 2009 than in 2008 for the analysis period. g_s was calculated by inverted Pemman-Montaith equation, and regarded as the measured g_s. Eddy covariance technology was used to measure the evapotranspiration. Half-hourly g_s showed diurnal variation pattern with values gradually increasing until around 9:00, and compared higher and relative calm from 9:00 to 18:00, then gradually decreasing after 18:00. The nighttime g_s fluctuated severely. The peak g_s of 0.0059 m s^{-1} occurred in 2008. Averaged g_s from 9:00 to 18:00 were 0.0010 and 0.0009 m s^{-1} for 2008 and 2009, respectively. Half-hourly g_s responses to environmental factors (e.g. photosynthetic photon flux density, Q; air temperate, T; vapour pressure deficit, D; soil water content, θ; leaf area index, L) were examined, and showing g_s response to Q in the Gaussian fashion, to T and D in the exponential decay manner, to θ in the exponential growth manner, to L in linear increase manner. The environmental response functions of g_s were different from the previous results. Jarvis model was used to simulate the response of g_s to environments, and a modified g_s model for the temperate desert steppe could be expressed as following:

$$g_s = k_0 \exp\left(-0.5\left(\frac{Q-k_1}{k_2} \right)^2 - k_3 D - k_4 T + k_5 \theta \right)\left(k_6 L + k_7 \right)$$

where the $k_{0\text{-}7}$ were the fitted parameters. Two circumstances (single-year and integrated-years) were taken accounted to the fitted parameters applicability for different hydrological years. The result suggest that there is not obvious difference in g_s simulation performance under two circumstances, and g_s could be expressed suitably by just one parameter set for different years. The modified g_s model could be effective for half-hourly g_s simulation for the temperate desert steppe.

Key words: Canopy conductance, Environmental factors, Simulation, Temperate desert steppe, Inner Mongolia

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METHODS IN QUANTIFYING THE VARIATION OF WATER USE EFFICIENCY: BASED ON OBSERVATIONS OF CHINAFLUX

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Water use efficiency (WUE) is useful in representing the coupling between carbon and water cycles. It has some conservative at different spatial or time scales, while in most cases WUE shows robust variations, including diurnal, seasonally, annual variation and variations on other time scales variation. So quantifying the variation of WUE is strongly needed for the following reason: The whole observation period can be separated into two ranges through quantifying: conservative period and variable period. Then different periods have distinct strategies in investigating WUE: during conservative period, we just need to know its mean value, while the regulation of WUE under various environments should be focused on during period with large variability. And different strategies were also addressed in applying it: WUE can be safely used during conservative period- as the close coupling between carbon and water- in calculating the carbon budget from water resource, while using it should be cautiously during another period.

While the way-quantifying the variation of WUE- is still unclear as we can refer. So three ecosystems of ChinaFlUX -two forests (Changbaishan temperate broad-leaved Korean pine mixed forest and Dinghushan subtropical evergreen broadleaved forest, abbreviated as CBS and DHS) and one cropland (Yucheng cropland, abbreviated as YC)- were taken as our objectives, two different ways were compared. One is the graphic method- a traditional way. It used a fitting tool between GPP and ET to judge whether WUE was conservative. If the fitting was linear, WUE was considered as conservative, the reverse was also true. Another was the statistical way, using the coefficient of variation (CV) of WUE during the observation or a special period.

Results showed that the fitting between GPP and ET at CBS and YC were both linear, CV of WUE were 32.95-36.45% and 44.15-49.11%, respectively. The fitting was nonlinear and CV of WUE was 22.06-30.36% at DHS. Results from two methods drew contradict conclusions, and we supported the latter as the scientific basis of the result: the water and heat were sufficient at DHS, so WUE would vary little. While those in northern ecosystems such as CBS and YC can not meet the need of ecosystems at some times of a year, so the variation would be larger.

Besides that, if we wanted to analyze the dynamic of WUE variability in a year, the time length for calculating the CV was needed. We also compared the difference among different lengths. Results showed that a month was strongly suggested as it was simple and reasonable.

Acknowledgments

This research was supported by the National Key Research and Development Program (2010CB833504), National Natural Science Foundation of China (projects 31061140359, 30590381 and 30800151). We gratefully acknowledge the data provider for their excellent technical support.

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THE DIURNAL TRENDS OF SENSIBLE AND LATENT HEAT FLUXES OF A SUBTROPICAL EVERGREEN CONIFEROUS PLANTATION SUBJECTED TO SEASONAL DROUGHT

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The diurnal trends of sensible and latent heat fluxes are signatures of atmospheric and physiological process. Continuous measurements of the influence on diurnal variation range and diurnal centroid of sensible and latent heat fluxes during seasonal drought were made at Qianyanzhou in 2003. The main results are as follows: temperature and water conditions are main limited-factors on diurnal trends of sensible and latent heat fluxes. Seasonal drought increases the diurnal variation range of sensible heat flux and the relative change between sensible heat flux and latent heat flux while decreases latent heat flux. Temperature and water vapor pressure deficit are the major factors on diurnal variation range of sensible heat flux and relative change between sensible heat flux and latent heat flux. Temperature dominates diurnal variation range of sensible heat flux during seasonal drought and diurnal variation range of latent heat flux during non-drought. During seasonal drought period, the deep water content is more significant on diurnal variation range of sensible heat flux and relative change between sensible heat flux and latent heat flux, while diurnal variation range of latent heat flux has no relationship with environmental factors. Seasonal drought makes diurnal centroid of sensible heat flux and relative change between sensible heat and latent heat flux weighted more toward the afternoon. Diurnal centroid of latent heat flux weighted after the afternoon, seasonal drought has no impact on it. During non-drought period, diurnal centroid of sensible heat flux and relative change between sensible heat flux and latent heat are negatively correlated with air temperature, and vice versa during seasonal drought. Environmental factors have no impact on diurnal centroid of latent heat flux. The seasonal distribution of precipitation dominates the relative change between diurnal centroid of sensible heat flux and latent heat flux. Precipitation is more important during seasonal drought. The relative change between diurnal centroid of sensible heat and latent heat flux are subject to the coupling between vegetation and atmosphere.

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SOIL UPTAKE OF SOME ATMOSPHERIC CONSTITUENTS

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Some atmospheric constituents such as CH_4, H_2, CO, OCS, and CH_3Br that have important roles in atmospheric chemistry and then in global climate, are biologically absorbed by soil, although the oxidizers in soil are different from gas to gas. In this presentation, information is given for the studies. At the first place, classification of the gases is given based on uptake properties of each gas and brief summary of the relevant studies are introduced. Among the relevant gases, we introduce experimental results about CH_4, H_2, and CO uptake by soil. Both laboratory and field studies to make clear factors to control the soil uptake of the gases were conducted. Among them, a newly-developed system to measure bulk-soil gas exchanges, gas uptake by soil as well as gas emission is introduced. Finally, how fluxes of these gases can be obtained using infrastructure in Asiaflux sites is shown.

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EFFECT OF FERTILIZATION AND WATER ADDITIONS ON PRODUCTIVITY AND ECOSYSTEM CARBON EXCHANGES OF A TYPICAL SEMIARID STEPPE OF INNER MONGOLIA, CHINA

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Water was the most primary limiting factor controlling ecological processes in the semiarid regions. Moreover, nutrient availability was also important in changing biomass, functioning and service of semiarid ecosystems. To understand how these two factors influence ecosystem processes, we carried out a manipulative field experiment to reveal the response patterns of typical steppe to the addition of water (100mm/yr, added in winter as snow and summer as water) and nutrient (10g nitrogen (N), phosphorus (P) and potassium (K) /m2/yr, respectively). Our primary results showed that aboveground biomass was significantly enhanced by water and nutrient additions, especially for N and P addition treatments. Aboveground biomass increased more to adding water in summer treatment than adding snow in winter. Root biomass did not show significant changes under all treatments. Compared with adding snow in winter, adding water in summer could increase net ecosystem exchange (NEE). However, adding water and nutrient had no significant effects on both gross ecosystem productivity (GEP) and ecosystem respiration (Re). Regression analysis showed that NEE increased significantly with topsoil temperature (0-10cm), while GEP and Re decreased significantly ($P < 0.001$). Considering that adding water in summer could decrease topsoil temperature significantly ($P < 0.001$), we can deduce that adding water in summer would favorite NEE. Our results suggests that N and P might be the two most important nutrient that limiting ecosystem biomass, adding water might accelerate nutrient absorption and favor net ecosystem carbon exchange.

Keywords: fertilization, biomass, net ecosystem carbon exchange, gross ecosystem productivity, ecosystem respiration

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THE RESEARCH OF RELATIONSHIP OF VEGETATION COMMUNITY DIVERSITY AND SOIL ORGANIC CARBON CONTENT IN MUUS SANDY LAND DURING RESTORING 30YR

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MuUs sandy land representative area has an important role in eco-restoration research, as the restoring-year increasing, the characteristics of sandy land vegetation community diversity and soil organic carbon content totally have dynamic changes. The paper collected vegetation community characteristic indexes and soil samples in different sandy land, analyzed the relationship of sandy land vegetation community diversities and soil organic carbon content in the process of restoring 30yr, via quantitative ecology and statistics methods. The research results displayed that: for sandy land vegetation community diversities, Communities in restoring for 20yr was sensitive with similar changing modalities of Shannon-Wiener index and Simpson index; Pielou index had a great fluctuation with peak value at 15yr and valley value at 20yr; the average soil organic carbon content is 0.58%, the maximum arrived at restoring for 25yr with 1.25%, and that of minimum at restoring for 15yr with 0.09%; for the research of relationship between vegetation community diversity and sandy land soil organic carbon content, both of which reached peak value at restoring 25yr, then descending in the next years. The research reveals that after restoring for 25yr, the vegetation community diversity and soil organic carbon content have restored in a comparatively sound condition. During this phase, the pasture could moderately grazing to arrive the manageable effect which could accelerate grassland plant species upgraded and promote soil nutritive elements content.

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COMBINED MODEL FOR FORECASTING OF URBAN WATER DEMAND UNDER CHANGING ENVIRONMENT

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For the past decades, the dramatic climate changes and human activities have had a profound impact on the supply and demand system of water resources. It raised a particular challenge for the water supply department. Though the influence of climate change on water resources has always been kept a important issue by global research institution, and the relationship between water demand and climate change has been demonstrated, few studies have attempted to quantify the impact that climate change have on water consumption under changing economic background.. Concentrating on the city of Dongguan, China, we selected various climate and social-economical factors as the influence factors of water requirement, and analyzed water requirement response relationship of influence factors. And then introduced many Forecasting technologies such as Error Back Propagation Artificial Neural Networks (EBPANN), Radial Basis Function Artificial Neural Networks (RBFANN) and Support Vector Machine (SVM), established the water demand forecast models upon these analysis and technologies. In order to improve the forecast accuracy, a minimum variance combined forecast method was applied to integrate those results of all the forecast models. Study that took Dongguan city as example, proclaimed the circumstances and reasons of water demand changes of Dongguan city, and revealed the variation tendency, provided a theoretical foundation for Dongguan City water resources management.

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POTENTIAL CARBON SEQUESTRATION BY FOREST ECOSYSTEM IN JIANGXI AND ZHEJIANG PROVINCE

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The research took Zhejiang and Jiangxi province as study regions. Based on the sixth countries forest inventory (CFI), the potential carbon sequestration of forest ecology system in two provinces was estimated according to forest-growth curve of different tree species. The results showed that the amounts of potential carbon sequestration in Jiangxi province and Zhejiang province would be 11.41TgC•a^{-1}, 4.34TgC•a^{-1} during 2004-2014, respectively. Meanwhile, we used the 1030 plot of data subtropical zone to estimate how much the potential carbon sequestration of forest ecology system would be increased by three forest management. Among these results, it is showed that interplanting would be the most effective forest management to increase carbon sink of forest in future, followed by thinning and fertilization. Based on three forest management, the potential carbon sequestration by forest ecosystem would increase by 6.54±3.9TgC·a^{-1}, 3.81±2.02TgC·a^{-1}, 2.35±0.6TgC·a^{-1}, respectively, in Jiangxi province and 2.64±1.28TgC·a^{-1}, 1.90±1.11TgC·a^{-1}, 1.44±0.35 TgC·a^{-1}, respectively, in Zhejiang province. At present, there were some uncertainties in calculating the forest potential carbon sequestration based on lacking of long-time monitoring data and some hypothesis factors, which needed to be more in-depth studied.

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AN ANALYSIS OF RANDOM ERROR IN TOWER-BASED MEASUREMENT OF CARBON AND LATENT HEAT FLUXES

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Flux data has uncertainty which is largely due to random measurement error. Quantification of flux uncertainty is essential for the model-data fusion and the statistical evaluation of modeled and measured fluxes. To estimate uncertainty of CO_2 flux and latent heat flux measured at Gwangneung deciduous forest, we used flux measurements made on two successive days. The measurements pair was considered valid only if both measurements were made under similar conditions, defined here as at the same time of day and under nearly identical environmental conditions such as solar radiation, air temperature and wind speed. The used data were collected from 2004 to 2007. We examined probability distribution function (PDF) for the difference of fluxes between measurement pairs and investigated relationship between flux uncertainty and other variables such as flux magnitude, wind speed, air temperature and season.

Frequency analysis indicates that PDFs of the random flux errors are double exponential distribution rather than a normal distribution. The uncertainty of the two scalar fluxes shows a strong seasonal variation which is high during the growing season and low during the dormant season. Moreover, the uncertainty for these two fluxes scales with the magnitude of the flux well. The CO_2 flux uncertainty is negatively correlated with wind speed and positively correlated with temperature and the latent heat flux uncertainty is positively correlated with net radiation. Characteristics of estimated flux uncertainty at this site have been discussed in comparison with those at other sites.

Acknowledgement

This research was supported by "CarboEastAsia - A3 Foresight Program" of National Research Foundation of Korea.

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ENERGY BALANCE COMPONENTS AT THE FLOOR OF DECIDUOUS AND CONIFEROUS FORESTS IN GWANGNEUNG, KOREA

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The role of energy partitioning at the forest floor is important for the whole canopy energy balance and it depends on not only the hydrometeological factors (e.g., precipitation) but also forest structure and phenology (e.g., forest type, leaf emergence and senescence). Although many studies have been reported the forest floor energy balance components, the study sites are located in various climate at different latitudes with a short measurement period. This hinders the understanding of exclusive effect of forest type on the forest floor energy balance. The measurements of energy balance components were conducted from June 2008 to May 2009 using eddy covariance systems below (3 m) and above the canopy (40 m) at the two different forest types in Gwangneung National Arboretum in central Korea: a deciduous forest (GDK) and a coniferous forest (GCK). The GDK site is located on a hilly slope with approximately 18 m of the average canopy height and the maximum plant area index (PAI) of 6 whereas the GCK site is relative flat near the downstream with canopy height of 23 m and the maximum PAI of 7. Characteristics of the two forest floor are different, showing thick litter and organic layers with various understory plants at the GDK site whereas almost no litter and organic layers with little understory plants at the GCK site. In this presentation, we examine the seasonality of the energy partitioning near the forest floor and the couplings between above- and below-canopy in the two different forest types.

Acknowledgements

This study is supported by a grant (code:1-8-3) from Sustainable Water Resource Research Center of 21st Century Frontier Research Program and 'CarboEastAsia' A3 Foresight Program of National Research Foundation of Korea.

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AN EXPERIMENTAL STUDY OF IN-SITU CHEMICAL OXIDATION USING A QUASI-MULTIDIMENTIONAL SYSTEM

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Although dense chlorinated solvents known as "dense non-aqueous phase liquids" (DNAPLs) have been produced and utilized widely since the beginning of the 20th century, their importance as soil and groundwater contaminants was not recognized until 1980s. Early efforts to remediate groundwater contaminated by DNAPLs like pump-and-treat were difficult to totally remove contaminants due to slightly solubility of DNAPLs. So this opened an opportunity for creativity, leading to the development of innovative remediation technologies. Recently there are many biological, physical, and chemical technologies available for dealing with groundwater contaminated with DNAPLs. To successful treatment of a contaminated site depends on proper selection, design, and adjustment of the remediation technology's operations based on the properties of the contaminants and soils.

In the last 20 years, In-situ Chemical Oxidation (ISCO) has become a promising in situ remediation technique. Among the oxidants that have been used, potassium or sodium permanganate ($KMnO_4$, $NaMnO_4$) have been widely employed and relatively intensively studied. In this study, modified 1D columns experiments (quasi-multidimensional setting of parallel column connection) is utilized to study the mass flux and flow flux change of TCE chemical oxidation by $KMnO_4$. Low concentration of permanganate was used as oxidant for limited time interval to mimic actual field condition. The water flux of the source area decreased during $KMnO_4$ flushing but increased again right after the flushing is ceased. The precipitation and flocculation of MnO_2 formed as a result of TCE-$KMnO_4$ reaction reduce the permeability of source area for a limited time and a range. The mass flux of the $KMnO_4$ flushed column was decreased during $KMnO_4$ flushing, while rebound again after $KMnO_4$ flushing. The mass flux of the $KMnO_4$ flushed column was increased after short time $KMnO_4$ flushing. This result implied that the TCE source zone can be stimulated by low concentration $KMnO_4$ flushing.

Keywords: DNAPL, TCE, mass flux, mass reduction, flow reduction.

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EFFECTS OF SOIL MOISTURE AND TEMPERATURE ON CO_2 AND CH_4 SOIL-ATMOSPHERE EXCHANGE OF VARIOUS LAND USE/COVER TYPES IN XILIN RIVER CATCHMENT

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Aim of this study was to investigate the combined effects of soil moisture and temperature as well as drying/re-wetting and freezing/thawing on soil-atmosphere exchange of CO_2 and CH_4 of the four dominant land use/cover types (typical steppe, TS; sand dune, SD; mountain meadow, MM; marshland, ML) in the Xilin River catchment, China. For this purpose, intact soil cores were incubated in the laboratory under varying soil moisture and temperature conditions. Land use/cover generally had a substantial influence on CO_2 and CH_4 fluxes, with the order of CH_4 uptake and CO_2 emission rates of the different land use/cover types being TS ≥ MM ≥ SD > ML and MM > TS ≥ SD > ML, respectively. Significant negative soil moisture and positive temperature effects on CH_4 uptake were found for most soils, except for ML soils. As for CO_2 flux, both significant positive soil moisture and temperature effects were observed for all the soils. The combination of soil moisture and temperature could explain a large part of the variation in CO_2 (up to 87%) and CH_4 (up to 68%) fluxes for most soils. Drying/re-wetting showed a pronounced stimulation of CO_2 emissions for all the soils - with maximum fluxes of 28.4±2.6, 50.0±5.7, 81.9±2.7 and 10.6±1.2 mg C m^{-2} h^{-1} for TS, SD, MM and ML soils, respectively - but had a negligible effect on CH_4 fluxes. Enhanced CO_2 emission and CH_4 oxidation were observed for all soils during thawing periods. In addition, a very distinct vertical gradient of soil air CH_4 concentrations was observed for all land use/cover types, with gradually decreasing CH_4 concentrations down to 30 cm soil depth. The changes in soil air CH_4 concentration gradients were in accordance with the changes of CH_4 fluxes during the entire incubation experiment for all soils.

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EFFECTS OF PLANT INVASION ON CARBON CYCLE OF ESTUARINE WETLAND: AN EDDY COVARIANCE APPROACH

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Plant invasion can potentially alter ecosystem functioning and process. Based on measurements of three eddy covariance towers and analysis of remote sensing imagries, we evaluated the changes of carbon (C) flux and pool across an advancing invasion of *Spartina alterniflora* on an estuarine wetland. In our study area, *S. alterniflora* experienced rapid expansions, increasing by 10~30% from 2005 to 2006, and spread of which was subject to an Allee effect. The relatively faster expansion of *S. alterniflora* in seaward fetch than in landward was mainly accounted for by the strong adaptivity to flooding compared to native species. Its invasion strongly increased fluxes in 2006 compared with 2005. Specifically, during June-September, 10% coverage increase of *S. alterniflora* would lead to 62.9, 34.8 and 96.5 g C m^{-2} increase in net ecosystem production, ecosystem respiration and gross primary production, respectively. Its invasion also altered the responses of C fluxes to the environment by improving ecosystem light use efficiency, increasing the light saturation point, and altering the temperature sensitivity of ecosystem respiration. The above altered functioning and process resulted in 5~13% increases in upper 50 cm soil C stock, implying the potential of plant invasion to sequester more C.

P204

ASSESSMENT OF POTENTIAL LANDSLIDES ON NAERIN WATERSHED: LINKING ECO-HYDROLOGY MODEL AND SLOPE STABILITY MODEL

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Water and carbon cycles in forests are closely related in multiple pathways. Precipitation is partitioned into soil and leaf surface evaporation, plant transpiration, and soil water drainage into groundwater, respectively. Ecological and hydrological models have been developed to simulate water processes among atmosphere, vegetation, and soil. A few models were designed to simulate carbon and nitrogen processes simultaneously. In particular, process-based models that simulate biogeochemical cycles of water and carbon provide useful tools to investigate impacts of climate change and diverse anthropogenic effects on the water and carbon cycles in forest ecosystem.

In this study, RHESSys (Regional Hydro-Ecologic Simulation System) model was utilized to simulate water and carbon processes in complex terrains. The model was further applied to investigate adaptive effects of forest management practices to reduce forest disasters including land slide and forest fire under changing climate regimes. As a first step, we connected results from RHESSys simulations on soil water content and root development with a slope stability model. By combining two types of models, it was possible to produce a potential map of land slide and to simulate future change of the stability regime of land slide under changing climate conditions. Our potential map of land slide was compared with historical maps of land slide events, which showed reasonable agreements.

(This research is supported by Innovative Forest Disasters R&D Center from Korea Forest Research Institute (KFRI) project no.C1002313-02-03)

P205

EVALUATION OF THE IMPACTS OF DEFOLIATION BY TROPICAL CYCLONES ON A JAPANESE FOREST'S CARBON BUDGET USING FLUX DATA AND A PROCESS-BASED MODEL

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Tropical cyclones ("typhoons") affect ecosystem processes by disturbing the ecosystem's biogeochemistry, population dynamics, and services. The impact of 10 typhoons that struck the Japanese Islands in 2004 was studied using a process-based ecosystem model (VISIT: Inatomi et al. 2010) and by interpreting deviations in the carbon budget observed at the Takayama forest site in central Japan. The site-calibrated model appropriately simulated gross and net CO_2 fluxes in most years, but could not capture the clear depression of CO_2 uptake in 2004, probably because it neglected the impact of defoliation on the canopy's carbon gain due to strong typhoon winds. The defoliation intensity caused by each typhoon event was inversely estimated from the flux measurement data and using a Monte Carlo approach (Ito, in press). Accounting for the repeated 10% to 20% defoliation that occurred in 2004 lowered the canopy carbon gain by nearly 200 g C m^{-2} yr^{-1}, resulting in better agreement between the estimated and observed flux values. Comparison of the estimated defoliation pattern with satellite-based estimates of leaf area index indicated that such moderate defoliation from mid-summer to autumn was plausible. The influence of CO_2 emissions from typhoon-generated debris on the carbon budget in subsequent years was estimated to be tiny. These results have implications for regional carbon accounting studies because both devastating and moderate defoliation caused by tropical cyclones can have a marked effect on the regional carbon budget, especially when defoliation occurs repeatedly within a single growing season.

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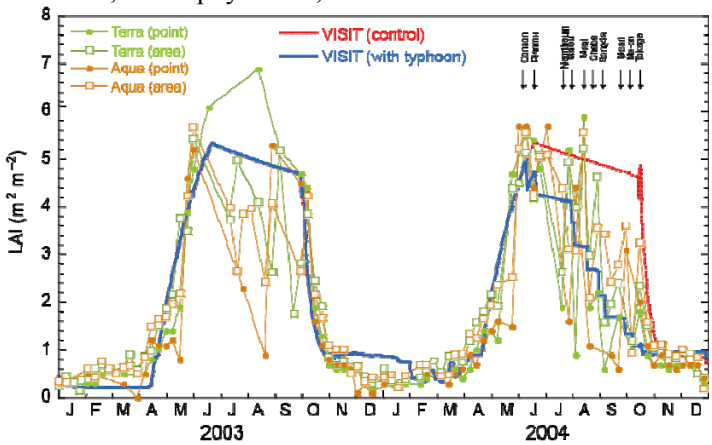

Figure: Temporal changes in the leaf area index (LAI) based on satellite observations (MOD, Terra and Aqua MODIS values) and the model-based estimated (trees + understory plant leaves) in 2003 (a year with low typhoon frequency) and 2004 (a year with frequent typhoons). In the MODIS data set, the point (nearest 1 pixel) and area-averaged (7 x 7 pixels) values at the Takayama site from the Terra and Aqua satellites used only data flagged as "good quality".

P206

ASSESSING VULNERABILITY AND ADAPTATION RESPONSES TO RAINFALL-RELATED LANDSLIDES IN CHINA, A CASE STUDY OF ENSHI PREFECTURE IN HUBEI PROVINCE

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Based on the questionnaire inquiring of landslide disaster in Enshi Autonomus Prefecture in Hubei province, the biophysical, socio-economic, experience, and emergency preparedness and adaptation strategies to disasters characteristics were classified by using SPSS clustering analysis method. Also the impacts of rainfall on underground water table, soil stress and landslides stability were analyzed. It aimed to ascertain landslide prone areas in China and assess their vulnerability to flooding and landslide. The results showed that landslide disasters were affected not only by the landscape and also caused by meteorological factors, especially for precipitation values. It can predict and give landside warns by forecasting climate change on Web-GIS.

P207

COMTINUOUS MONITORING OF ECOSYSTEM PRODUCTION AND SOIL RESPIRATION USING AUTOMATIC FIELD MOVING CHAMBER

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To understand of carbon cycle dynamics of various agroecosystems, accurate determination of seasonal and daily CO_2 flux related to various environmental factors is required. We developed newly the automatic sliding canopy chamber (ASCC) system from principal of open flow method for measuring soil CO_2 efflux. The ASCC can measures continuously net ecosystem productivity (NEP) over full growing season under the natural meteorological rhythm. The ASCC is composed mainly two parts which is sliding part for measuring NEP, and automatic opening and closing chamber (AOCC) for measuring heterotrophic respiration (HR) on soil surface. In field test with barley (*Hordeum vulgare*), NEP was calculated with 78.2 mg $CO_2\,m^{-2}\,h^{-1}$ for full growth season, without any introducing measuring error due to the representative of measuring term selection. Also, the net primary productivity (NPP) calculated from NEP was 3.02 ton ha^{-1} for full growth period and it was similar to value in harvest method (2.81 ton ha^{-1}). Unlike other small scale chamber system, installation on cropping-field made it possible to pick any changes up which might be due to natural environmental condition.

Acknowledgement

This research was supported by "CarboEastAsia - A3 Foresight Program" of National Research Foundation of Korea.

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INTER ANNUAL VARIATION OF CLIMATIC, SOIL MOIST CONDITIONS AND EVAPOTRANSPIRATION –THE CASE IN THE LOWLAND EVERGREEN FOREST IN CAMBODIA-

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Introduction:

Lowland Evergreen forest once dominated the Indochina peninsula. However, most of them forest has been replaced by agricultural land or deciduous forest as a consequence of reclamation or timber cutting, and only a small area of the original forest now remains in Cambodia. This remaining forest is under development pressure, despite the conservation policies of the Cambodian government.

This study shows the inter annual variations of evapotranspiration and climate factors in the lowland evergreen forest in central Cambodia.

Site and Method Descriptions:

The data was used in this study observed at the weather observation tower with 60m height in O Thom I watershed (12^{O} 44'N,105^{O} 28'E、88mASL) in Kampong Thom Province, central Cambodia from 2004 to 2008. The forest around the tower was evergreen forest. Tree density is 1,600 stems ha^{-1}. The averaged height of canopy surface is 27.2m.

Evapotranspitration rate was calculated with bowen ratio method in 10 minutes interval. Daily potential evaporation rate was calculated with Penman equation.

Results:

The monthly mean of ground water level, solar radiation, air temperature, vapor pressure deficit, potential evaporation rate and evapotranspiration rate and monthly precipitation were calculated in 2004-2008. Moreover, the averaged rates (AR) and standard deviations (SD) were calculated with these monthly rates in each month. The inter annual variations of each monthly mean or monthly precipitation was estimated in the comparison with AR and SD.

Monthly precipitation was smaller in 2005 and larger in 2007 than those in other years. Monthly mean of ground water level was lower in April, 2005 – July, 2006, much lower in especially in April - June, 2005 and higher in May, 2007 - May, 2008 than those in other years.

On the other hand, Monthly means of air temperature and vapor pressure deficit was much larger in October, 2004 – May, 2005 and smaller in slight in July, - December, 2005 and April - December, 2007 than those in other years. The monthly mean of air temperature was also much hotter in October, 2004 – May, 2005 than those in other years. These variation leads that the monthly means of potential evaporation was calculated to be much larger in October, 2004 – May, 2005 and smaller in slight in July, - December, 2005 and April - December, 2007 than those in other years.

Monthly Evapotranspiration was calculated with Bowen ratio method to be larger in October, 2004 – May, 2005 and smaller in July, - December, 2005 and April - December, 2007 than those in other years.

Discussion:

Evapotranspiration rate is slightly smaller in July, - December, 2005. In this period, both of ground water level and potential evaporation were lower and their influences can't be judged individually. However, both rates of evapotarnspiration and potential evaporation were much larger and ground water level was lower in October, 2004 – May, 2005. Moreover, both rates of evapotarnspiration and potential evaporation were smaller and ground water level was higher in April - December, 2007. This means that evapotranspiration rate depends deeper on climate condition than on soil moisture condition. Soil drought does not decrease the evapotranspiration rate in this study.

P209

SOIL WARMING IN A COOL-TEMPERATE MIXED FOREST ENHANCES HETEROTROPHIC AND BASAL RESPIRATION RATES BUT Q_{10} REMAINS UNCHANGED

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We conducted soil warming experiment in a cool-temperate forest of northern Japan during the snowless seasons of 2007-2009. Overhead heaters were installed to increase soil temperature by 3°C at 5cm deep. Multichannel automated chamber system was used to measure soil CO_2 effluxes. Trenching was also carried out to separate microbial respiration from the total soil respiration. Fifteen chambers were set-up and were divided into warmed-trenched, unwarmed-trenched and a control (neither warming nor trenching) with five replications. Three years experiment revealed that heterotrophic respiration rate contributed 71% of the total respiration with the remaining 29% accounted to autotrophic respiration. Warming enhanced heterotrophic respiration rate (mean 6.11 μmol $m^{-2}s^{-1}$) by 74% (P<0.001) compared with the unwarmed-trenched treatments (mean 3.52 μmol m^{-2} s^{-1}). In addition, increased basal respiration rate (heterotrophic respiration rate at 0°C; 5 cm soil depth) were 1.21 and 0.93 μmol m^{-2} s^{-1} for warmed and unwarmed treatments, respectively. However, no distinct difference was observed in the Q_{10s} between warmed (2.79) and unwarmed (2.74) treatments. Our result showed that using the soil heterotrophic respiration regression model obtained at present condition to predict soil microbial respiration in future warmer environment will result to underestimation of carbon respired by soil microbial components caused by the stimulation of the basal respiration rate at warmer environment, despite a very slight change in Q_{10}. However, many previous studies showed that the effect of warming decreased after several years of experiment, thus we need to continue this study to check how long this effect will lasts.

P210

GUI-BASED EDDY FLUX CALCULATION AND ANALYSIS SOFTWARE

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Introduction: As the eddy flux data has been used for multi-site synthesis, it become recognized that standardized processing of the eddy covariance data is necessary, which includes pre-processing, quality control, gap-filling, determination of the u_*-threshold, and flux partitioning. We have developed an eddy flux calculation and data analysis software by using Visual C++ 6.0, which has a GUI-based interface with an open source framework.

Flux calculation software: The flux calculation software calculates fluxes from raw turbulent fluctuation data (Figure 1). The software calculates turbulent fluxes, means, standard deviations, high-order moments, storages, variables for stationary and integral turbulent characteristic, variables for the relaxed eddy accumulation method, and spectral characteristics by the FFT. In the flux calculation, users can apply several pre-processing, such as de-spiking, detrending, coordinate rotations (double, planar-fit, and triple rotations), high-frequency loss corrections, lag-time corrections, and crosswind and water vapor corrections for virtual air temperature.

Figure 1 Flux calculation software

Flux analysis software: The flux analysis software determines empirical physiological parameters (Figure 2); maximum photosynthesis, initial slope of a light-photosynthesis curve, dark respiration, ecosystem respiration (RE) at a reference temperature, and temperature sensitivity coefficients of RE (Q_{10} and E_0). Those parameters can be determined at user-specified time scales. The nighttime u_*-threshold is determined based on a method by Reichstein et al. (2005). The software provides the several gap-filling procedures (Falge et al., 2001); look-up-table (LUT), non-linear regression (NLR), mean diurnal variation (MDV), and linear interpolation methods. Those gap-filling can be applied at user-specified window, and the window style can be chosen from moving or block window. The flux-partitioning from net ecosystem exchange (NEE) to gross primary productivity (GPP) and RE can be applied based on the difference between NEE and modeled RE from air temperature.

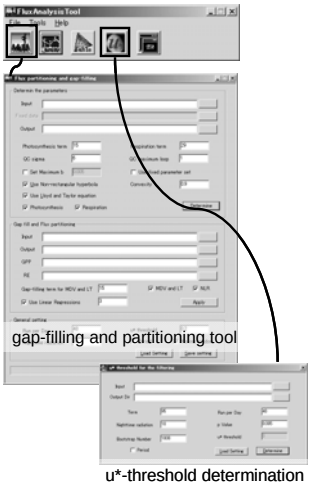

Figure 2 Flux analysis software.

Future plan: We have intensively tested the software by using several flux tower sites, prepared the manuals and tutorials, and applied those software for several scientific projects. Once it will be published as a suitable reference, we will open executable programs, source codes, and ancillary resources through a web-site. The software will be updated to incorporate with new methods that will be necessary for precise flux analyses.

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SIMULATION OF CARBON CYCLE PROCESSES IN TYPICAL FOREST AND GRASSLAND ECOSYSTEMS

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By using modified carbon-water cycle model EPPML (ecosystem productivity process model for landscape), the carbon absorption and respiration in 2003 and 2004 for the broad-leaved Korean pine (*Pinus koranensis*) forest ecosystem in Changbai Moutain, artificial masson pine (*Pinus massoniana*) forest ecosystem in Qianyanzhou and *Leymus chinesis* steppe ecosystem in Inner Mongolia were simulated, respectively. The results showed that EPPML could effectively simulate the carbon cycle process of different types of typical ecosystem including natural and artificial forests and grassland. The simulated annual values and the seasonal variations for gross primary productivity (GPP), net ecosystem productivity (NEP), and ecosystem respiration (R_e) not only fitted well with the measured data, but also reflected the major impacts of environmental factors (or extreme weather) on carbon flows.

The broad-leaved Korean pine ecosystem was a strong carbon sink in 2003 and 2004. The annual NEP values were similar when there were similar seasonal variation patterns in different years, that is, 290.7 g C m^{-2} yr^{-1} in 2003 and 307.2 g C m^{-2} yr^{-1} in 2004, respectively. The peak value of NEP occurred in June with lower precipitation and more sunlight, and the peak value of R_e occurred in July with higher temperature and moisture. At monthly scale, more soil water could enhance soil heterotrophic respiration (R_h) if temperature condition was suitable.

The artificial masson pine forest ecosystem was also a strong carbon sink in 2003 and 2004. The annual NEP in 2003 (481.8 g C·m^{-2}·a^{-1}) was lower than that in 2004 (516.6 g C·m^{-2}·a^{-1}) because of the coupling of high temperature and severe drought during the growing season in 2003. The key climatic factors giving important impacts on the seasonal variations of carbon cycle were solar radiation during early growing season, drought during peak growing season, and precipitation during post-peak growing season. Autotrophic respiration (R_a) and net primary productivity (NPP) had the similar seasonal variations. R_h was mainly affected by soil temperature at yearly scale, and by soil water content at monthly scale. During wet growing season, the higher the soil water content, the lower the R_h was; during dry growth season, the higher the precipitation during the earlier two months, the higher the R_h was.

The NEP values for *Leymus chinesis* ecosystem during the growing season was -11.9 g C m^{-2} in 2003 and 9.9 g C m^{-2} in 2004, respectively, mainly affected by precipitation. The conversion season between carbon source and sink differed in different years because of different seasonal climate conditions. More frequent small rainfall events could enhance carbon absorption and respiration. Three-mm precipitation or more might inhibit R_h, while less than three-mm precipitation could enhance R_h. R_h also had strong response to temperature.

The maximum RuBP carboxylation rate at 25 (V_{m25}), specific leaf area (*SLA*), maximum leaf nitrogen content (LN_m), average leaf nitrogen content (*LN*) and conversion coefficient from biomass to carbon (*C*/*B*) had the strongest influence on annual NEP. Different carbon cycle processes could have different responses to sensitive parameters. However, the most sensitive parameters derived from annual carbon fluxes were not completely the same as those derived from growing season or non-growing season carbon fluxes.

Uncertainty analysis showed that the determination of parameter range was one of the important factors that affect simulated results. Different parameters had different error contributions to the uncertainty of simulated results. Among the most sensitivity parameters, total growth respiration fraction gave the greatest error contribution to the uncertainty of simulated carbon absorption and respiration.

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DETECTION OF VARIABILITY OF LAKE SIZE IN MONGOLIA USING LANDSAT IMAGERY

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Mongolia consists of semi-arid or arid regions due to remoteness of water bodies and topographical barriers. Mongolia with limited rainfall and high evaporation is vulnerable to severe desertification in a changing climate as the demand of water resources for agricultural crops and livestock increases. In this study, variability of lake size in Mongolia over the last several decades was examined based on Landsat satellite imagery and surface observed precipitation and temperature records and statistical livestock record. Analyses of precipitation data showed that Mongolia experienced worst summer droughts from 1999 to 2002. The local changes of lake size were estimated from Landsate imagery. Because of differences in regional distribution of elevation, climate (temperature and rainfall), vegetation cover, and size of livestocks, the temporal changes of lake size resulted in different patterns depending on the regional characteristics. In the central Mongolia, more severe changes were found than the eastern and western regions. In overall, both central and eastern regions showed decreasing patterns of lake size but those in the eastern region were not distinct. The southern region is dryer than other regions and the decrease of lake size of the region was more vulnerable than other regions.

Keywords: Mongolia, desertification, lake, Landsat

(The research is supported by CarboEastAsia Foresight (A3) project.)

P213

HYDROLOGICAL RESPONSES CHARACTERIZED BY A RAINFALL-RUNOFF MODEL USING KOREA LAND DATA ASSIMILATION SYSTEM (KLDAS)

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The interaction between land surface and atmosphere is essentially affected by hydrometeorological variables including soil moisture. Accurate estimation of soil moisture at spatial and temporal scales is crucial to better understand its roles to the weather systems. The KLDAS (Korea Land Data Assimilation System) is a regional, specifically Korea peninsula land surface information systems. As other prior land data assimilation systems, this can provide initial soil field information which can be used in atmospheric simulations. For this study, as an enabling high-resolution tool, weather research and forecasting (WRF-ARW) model is applied to produce precipitation data using GFS (Global Forecast System) with/without KLDAS soil moisture information. The produced precipitation data will be employed for simulations of Hydrological Models such as HEC (Hydrologic Engineering Center) - HMS (Hydrologic Modeling System) as predefined input data for selected regional water responses.

The purpose of this study is to show the impact of a hydrometeorological variable such as soil moisture imbedded in KLDAS on hydrological consequences in Korea peninsula. The Chongmi located in the middle of Korea peninsular is selected as a tentative research location and continuously studied for getting hydrological effects from land surface information. Simulations for a real regional storm case (June 17~ June 25, 2010) are executed. Results and discussions on accuracy of prediction using formerly mentioned manners are going to be presented in 2010 EastAsia Workshop.

Acknowledgement:

This research was supported by "CarboEastAsia - A3 Foresight Program" of National Research Foundation of Korea.

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VALIDATION OF ENERGY AND WATER FLUX USING KOREA LAND DATA ASSIMILATION AND FLUX TOWER MEASUREMENT

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The accurate assessment of water and energy fluxes, including water storage, is essential to understand the complex interactions between land surface and the atmosphere. For better understanding, we need to make a comparison between field observations and forecasting data of Soil-Vegetation-Atmosphere Transfer (SVAT) model built on water and energy cycle.

The measurement system of CO_2, water vapor and energy cycle on the basis of eddy covariance system at measurement tower (http://daac.ornl.gov/FLUXNET/) called as Flux Network is operated all over the world. In Korea, Korea Flux Network (KoFlux) offers measurement data of CO_2, water, soil moisture, net radiation, sensible heat, latent heat, and hydrological initial/enteral factors for validation of SVAT model. Recently, Korea Land Data Assimilation System (KLDAS) was developed as a useful tool which computes optimum land surface fluxes and variables using satellite and observed data. These satellite and observed data are based on a field proven land model and a data assimilation method.

Despite of this development, validations of Common Land Model (CLM), one of the most advanced SVAT models, are not actively performed yet. In this study, we examined hydrologic outputs from CLM by using KLDAS and measured Flux data at various locations (i.e., Seolmacheon, Cheongmicheon, Gwangneung, and Haenam) in Korea.

The results show that all CLM simulation tendencies using KLDAS and KoFlux are highly comparable with the observations. From this we may say KLDAS and KoFlux have substantial factors for accurate prediction of water and energy fluxes in Korea.

Acknowledgement

This research was supported by "CarboEastAsia - A3 Foresight Program" of National Research Foundation of Korea.

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P215

COMPARISON OF GAP-FILLING PROCEDURES FOR SYNTHESIZED DETERMINATION OF ANNUAL CARBON BUDGETS OF CARBOEASTASIA DATA SET

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Unified gap-filling procedure is crucial to synthesize annual carbon budgets obtained at many tower flux sites for understanding regional carbon budget. However, it is also true that the annual carbon budget often changes by several hundred gC m per m^2 per year depending on the procedures. In order to assess the difference in the annual carbon budgets evaluated by different gap-filling procedures, we applied two gap-filling procedures to flux data registered in CarboEastAsia database, and compared the annual carbon budgets with those evaluated by principal investigators of each site.

The first gap-filling procedure is developed by Ueyama & Hirata (2010). Their software can determine empirical physiological parameters of light-photosynthesis curve and temperature-respiration curve. The nighttime u_*-threshold is determined based on a method by Hirata et al. (2008). The software tries to fill the gap of NEE using look-up table, then remained gaps are filled with non-linear regression using the empirical physiological parameters, then with mean diurnal variation interpolation. GPP is evaluated as the difference between NEE and modeled RE.

The second procedure is developed by Hong *et al*. (2009). The feature of their procedure is to adopt daily maximum of nighttime NEE to determine temperature-respiration relationship in a certain period, and nighttime NEE is replaced by the estimated respiration by using the relationship, following the concept proposed by van Gorsel *et al*. (2007). Then the software fills the daytime gaps of NEE using look-up table. The flux-partitioning is almost the same with the first approach. The difference in the annual NEE between the two approach was within 50 gC m^{-2} for the good case, especially at sites with ideal topography and uniform vegetation. However, the difference increased to several hundred gC m^{-2} for the site with complex terrain, caused by the difference in the determination process of the nighttime NEE.

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EFFECTS OF SOIL TEMPERATURE AND MOISTURE ON SOIL RESPIRATION ON TEMPERATE DECIDUOUS FOREST IN GWANGNEUNG, KOREA

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The effects of soil temperature and soil moisture on soil respiration were examined in a temperate deciduous forest in Korea. The soil respiration was measured using an open-flow gas exchanges system with an Auto Opening and Closing Chamber system (AOCC) from 2004 to 2009. Soil respiration exhibited pronounced seasonal variations that clearly followed the seasonal changes in soil temperature and soil water contents. Soil respiration varied markedly during the study year with high rates in summer and low rates in winter. Very high soil respiration was observed during the summer and immediately after rainfall events. The mean annual soil respiration was 354 $mgCO_2m^{-2}h^{-1}$. Soil respiration was highly correlated with temperature during spring and autumn and during summer whenever soil moisture was above 15%. The Q_{10} value for soil respirations was 3.4, which is in agreement with other studies in forest ecosystem. The Q_{10} values were always significantly ($P < 0.001$) greater in spring and autumn(2.8, 3.3 and March~May, September~November, respectively) than in summer and winter(1.8, 1.3 and June~Auguest, December~February, respectively). The relationship proposed for soil respiration with soil temperature and soil moisture is useful for understanding and predicting potential changes in temperate forest ecosystem in response to forerst management and climet change.

Acknowledgement

This research was supported by "CarboEastAsia - A3 Foresight Program" of National Research Foundation of Korea and Korea Forest Research Institute research project "Long-Term Monitoring and Ecological Studies on Forest Ecosystem (Project No: FE 0100-2004-02)"

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PRELIMINARY RESULTS ON OPTIMIZATION OF CLM3.5-DGVM USING CO_2 FLUX DATA AT GWANGNEUNG SITE

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Large uncertainties pertain to the distribution and future evolution of terrestrial CO_2 sources and sinks and their controlling mechanisms. Eddy-covariance observations of the terrestrial carbon cycle are the best source of knowledge on terrestrial carbon processes. Model-data fusion (MDF) is a range of procedures for combining sets of observations and a model incorporating uncertainties of both. A key part of MDF is model parameter estimation. We used maximum likelihood method to optimize the key parameters of process-driven land surface model (Community land model 3.5-Dynamic Global Vegetation Model (CLM3.5-DGVM)) against CO_2 flux measured at Gwangneung deciduous forest site. For optimization, half-daily averaged CO_2 flux was used to avoid fluctuations of CO_2 flux due to different footprint depending on wind direction and to focus on seasonal variation of CO_2 flux at this site. We installed Levenberg-Maquardt method to minimize cost function derived from maximum likelihood method for optimization of half-daily averaged CO_2 flux of CLM3.5-DGVM and performed preliminary test on optimization. Before optimizing the CLM3.5-DGVM, the model was slightly modified to give reasonable initial carbon pool amount and phenology pattern. Uncertainty of eddy covariance measurement was not available yet at this site and hence we used 2.1 μmol m^{-2} s^{-1} and 1.2 μmol m^{-2} s^{-1} for the uncertainty during the daytime and nighttime, respectively following literature. We selected three parameters which are sensitive to CO_2 flux and are of similar order of magnitude. They are nitrogen adjustment factor, maintenance respiration coefficient and litter decomposition rate. The preliminary results show that the model with optimized parameters simulates variability of net ecosystem exchange (NEE) well during both daytime and nighttime, gives better fit to seasonal variations of NEE and results in reasonable annual NEE at this site. The optimized parameter values were not sensitive to initial values of the parameters. Some problems in regard to optimizations and future plan have been discussed.

Acknowledgement

This research was supported by "CarboEastAsia - A3 Foresight Program" of National Research Foundation of Korea.

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CARBON DIOXIDE EXCHANGE AT THREE PADDY FIELDS IN ASIA

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Rice paddy fields are dominant agricultural land use in monsoon Asia. Although rice paddy fields are distributed from Northeast Asia to Southeast and South Asia, cropping pattern in paddy fields is not uniform across the region. In tropical and subtropical areas with sufficient water supplies, multiple (double or triple) cropping of rice is common, while in mid-latitudes with humid summer and dry winter, double cropping of rice and wheat (or barley) or single cropping of rice is practiced. Seasonality in carbon dioxide (CO_2) exchange at paddy fields changes with the cropping patterns and related cultivation practices and field management. In this study, we investigate inter-annual and inter-site variabilities in CO_2 exchange in rice paddy fields with different climate and cultivation practices in Asia.

In this study, data from three paddy field sites were used (Table 1). Mase site (MSE) is a customarily cultivated single-rice cropping field in central Japan, and one of the AsiaFlux monitoring sites. Mymensingh site (MYM) is double-rice cropping field in northern Bangladesh. Jiangdu site (JND) is rice-wheat cropping field at Jiangsu Province, eastern China. At all of the three sites, open-path eddy covariance system is employed to measure net ecosystem CO_2 exchange (NEE) and evapotranspiration rate. Micrometeorological variables and biometric parameters are also monitored. Goss primary production (GPP) and ecosystem respiration (RE) were calculated by empirical models using incoming shortwave radiation and air temperature.

Annual courses of NEE showed single or double peaks of net CO_2 uptake in accordance with the number of crops at respective sites. Differences in the maximum daily net uptake rate in rice growing season were small. At MYM in the inter-cropping period in the rainy season, NEE was maintained around zero because of suppressed soil respiration under flooded conditions and active photosynthetic CO_2 uptake by weeds and ratoon regrowth of rice. In the other inter-cropping period in winter (dry season), however, weak CO_2 emission from drained soil continued under low temperature conditions. At JND, large short-term CO_2 release was observed after harvest of wheat when fresh plant biomass was supplied to soil under high temperature conditions, but a similar release was not apparent after harvest of rice. Similar difference in CO_2 release between two post-harvest periods was also found at a rice-barley cropping field in western Japan (Takimoto *et al*., 2010). At MSE, NEE turned positive before harvest, and weak CO_2 emission continued until the beginning of the next growing season. The annual NEE observed at the multiple cropping sites (JND and MYM) was double or more the amount at MSE. The larger annual NEE at the multiple cropping sites was principally caused by longer growing season, but differences in CO_2 exchange in non-growing season has to be taken into account in discussing inter-site variabilities in annual NEE.

Table 1. Study sites

Site code	JND		MYM		MSE
Site name (Country)	Jiangdu (China)		Mymensingh (Bangladesh)		Mase (Japan)
Location	32°35'N, 119°42'E		24°43'N, 90°25'E		36°03'N, 140°01'E
Mean air temperature	15.4 °C		24.2 °C		13.7 °C
Crop	wheat	rice	rice	rice	rice
Water management	-	irrigated	irrigated	rain-fed	irrigated
Typical growing season (days)	Nov. – May (211)	Jun. - Oct. (131)	Feb. – May (117)	Aug. - Dec. (113)	May - Sep. (137)

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LONG-TERM MEASUREMENTS OF ISOPRENE FLUXES ABOVE WARM-TEMPERATE MIXED FOREST IN JAPAN

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Biogenic Volatile Organic Compounds (BVOCs) including isoprene (C_5H_8), monoterpene ($C_{10}H_{16}$), alcohols, organic acids and aldehydes are released from many plant species. It is estimated that the global emission of BVOCs ranges from 500 to 1200 Tg carbon per year. Global emission of isoprene accounts for about 50% of total BVOCs emission. Isoprene is known as substantial precursors of tropospheric ozone and organic aerosol, and for that reason, atmospheric isoprene has a significant impact, and indirectly effects to global warming. Furthermore, neglect of isoprene from vegetation causes the overestimation of carbon sequestration in the forest. While isoprene emissions may be small in terms of gross primary production (GPP) and net primary productivity (NPP), the amount of carbon lost as isoprene emissions can be significant in terms of the net ecosystem productivity (NEP) or net biome productivity (NBP), respectively. In estimating NEP and NBP, it may be important to evaluate the carbon sequestration with BVOCs including isoprene.

To estimate isoprene fluxes between the ecosystem and the atmosphere accurately, we utilized REA method to measure the isoprene fluxes from 2008 to 2010 in Yamashiro Experimental Forest (YEF), Kyoto, Japan (34°47′N, 135°50′E). YEF is in a mixed temperate forest with *Quercus serrata* (Japanese oak); one of the major tree species in Japan. The oak is a strong isoprene emitter. We have newly designed and set up battery-operated REA system in 2009. The mean daytime flux was the highest on July 23, 2009 of 2.7±2.0 mgC m^{-2} h^{-1} as shown in Fig.1. The seasonal variations of daytime isoprene fluxes have a strong relationship with the daytime ambient temperature. When the leaves turned into yellow, the isoprene flux and concentration in the air were not detected. This result can be explained by a strong relationship between photosynthesis and isoprene synthesis, which means that stopping of photonic synthesis due to chlorophyll degradation in the end of November led to the stopping of isoprene synthesis and emission. Besides, in order to estimate the ratio of the carbon re-emitted by isoprene in Japanese oak forest, the observed isoprene fluxes were compared with the observed CO_2 fluxes. The data for the 4 days from Aug. 22 to Sep. 28 in 2008 were used and the ratio was calculated to 1.2% in total. The highest ratio was 2.3% observed on Aug. 22 in 2008 when the air temperature was the highest and the soil was most desiccated due to the no rain fall before the two weeks. We considered that the ratio would be the highest in the hottest and the most dried season, which is the middle of August.

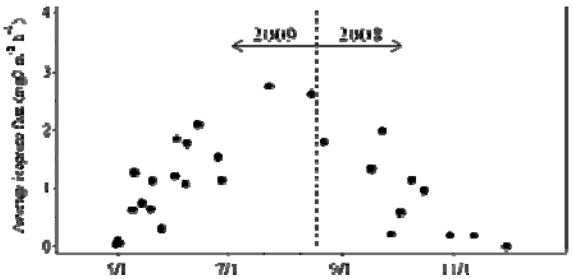

Figure1 Seasonal variation of daily averaged isoprene flux from Aug., 2008 to Aug., 2009.

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SIMULATION OF CARBON BALANCE USING JULES LAND SURFACE MODEL IN A DECIDUOUS FOREST IN CENTRAL KOREA

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In 2009, the annual average temperature was 14.0 °C, which is the fifth highest record in Korea since 1912. Furthermore, the precipitation in autumn was the fifth lowest record since 1973. Joint UK Land Environment Simulator (JULES), which is a complex process-based land surface model, is useful to study and understand the mechanism of ecosystem carbon balance. In order to assess the reproducing ability of the carbon exchange of JULES under these distinctive climate conditions of 2009 at the GDK site, we conducted the simulation of gross primary productivity (GPP) and ecosystem respiration (RE) using JULES. In this presentation, we report our assessment on the performance of JULES by comparing the modeled GPP and RE against the measured and the impact of the autumn drought on the carbon balance of this forest ecosystem. We also examine the interannual variability of the carbon balance at the GDK site by combining both the measured and modeled results from the previous years' (from 2006 to 2008).

Acknowledgements

This study is supported by a grant (code:1-8-3) from Sustainable Water Resource Research Center of 21st Century Frontier Research Program and 'CarboEastAsia' A3 Foresight Program of National Research Foundation of Korea.

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MEASUREMENT OF SOIL RESPIRATION WITH AUTOMATIC OPEN/CLOSE CHAMBER SYSTEM ON REGENERATED FOREST IN YANGGU, KOREA

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Our objectives were to quantify annul and seasonal variations of soil respiration, and to investigate the effects of daily and seasonal variations of soil temperature and soil water contents on soil respiration. In order to investigated the soil respiration at the forest floor in a regenerated forest in Yanggu, Kanwondo, Korea. We used Automatic Open/ Closing Chamber system (AOCC) that based on an closed dynamic chamber method. Also, measured soil respiration control factors (soil temperature, soil water contents and precipitation). For 7 months (April ~ October, 2010), average soil respiration in this period was 298 mg CO2 m-2 h-1. Seasonal variations of soil respiration were highly dependent on changing of soil temperature. During study period, soil respiration maintained the minimum value during April and gradually increased since May. With large increase since June, the maximum value (1,286 mg CO2 m-2 h-1) was observed during late summer (in late August ~ early September). Seasonal changes in soil moisture showed low correlation with soil respiration regardless of season. However, in case of summer with temperature above 15℃, changes in soil moisture influenced soil respiration with occurrence of rainfall.

Acknowledgement

This research was supported by "CarboEastAsia - A3 Foresight Program" of National Research Foundation of Korea.

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CLIMATE RESPONSE ANALYSIS OF TREE RING GROWTH IN EAST SIBERIAN LARCH FOREST FOR REPRODUCING LONG TERM ECOSYSTEM CARBON BALANCE

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Assessments of climate change impacts on ecosystem carbon cycles and of the counter ward feedback effects of ecosystem change to climate are indispensable for more reliable future prediction of climate change, and therefore, long term information of carbon cycles of various ecosystems is needed. However, there are yet few tower sites observing ecosystem carbon fluxes over 10 years or longer period. Tree rings retain a long term record of tree growth and environmental conditions and can provide information of past ecosystem carbon balance.

In the previous report (at AsiaFlux Workshop 2009), we showed that tree ring growth index in a mature *Larix gmelinii* stand near Yakutsk, Russia was correlated with seasonal gross primary production (GPP), ecosystem respiration (ER) and net ecosystem production (NEP) derived by the eddy fluxes over 7-year period (2000-2006) with high r^2 values of 0.71, 0.51 and 0.53 respectively. We also proposed a framework to reproduce change in seasonal ecosystem carbon balance over a long time period by combining stand inventory, soil carbon inventory and tree ring analysis, and showed the large inter-annual variability in NEP and NPP. This study tried to model the climatic response of tree ring growth in order to show the dynamic change of ecosystem carbon balance to the environmental factors over a long period.

Tree ring index of 14 stems sampled from mature *Larix gmelinii* stands near Yakutsk was measured and ensemble mean of the index was calculated yearly from 1900 to 2006. Daily air temperature and precipitation at Yakutsk Meteorology Observatory from 1950 to 2006 were used to calculate climate factors; annual, summer (May-October) and winter (November-April) average air temperature and total precipitation, growing season length (number of days with mean temperature > 5°C), and growth degree day (sum of daily mean temperature excess the over the critical temperature = 5°C). Annual and half-year potential evapotranspiration (PET) was also evaluated by the Harmon Method and then water deficit (WD=PET–precipitation) and water deficit index (WDI=WD/PET) was calculated.

First, auto-correlation of tree ring index and climate factors were tested. A significant auto-correlation was found only in tree ring index and winter precipitation by a 1-y lag (r_a=0.50 and 0.44, respectively), and in annual temperature by a 5-y lag (r_a=0.43). Next, correlation between tree ring index and climate factors was tested. A positive factor (summer precipitation) and negative factors (previous winter precipitation, annual and summer WDs and WDIs) had significant correlation with the tree ring index. This suggested that water availability in summer growing season is a controlling factor of tree growth. Winter precipitation before a growing season determines the snow thawing date and was more sensitive factor to tree ring index than growing season length or degree-day.

Change of tree ring index from 1950 to 2006 was modeled by means of multiple regression analysis of previous winter precipitation and summer WDI, however the r^2 value was not sufficiently high. The auto-correlation at 1-y lag in tree ring index suggested that high growth in a year of suitable condition may carry the physiological advantage for growth over the next growing season by accumulating the assimilated product. A dynamic modeling that employs both climate factors and growth in the previous year could improve the model fitness.

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TEMPORAL AND SPATIAL VARIATIONS IN VEGETATION INDEX IN EAST ASIA

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Evaluation of response of terrestrial ecosystem to climate is important. In the framework of AsiaFlux, studies of NEP or evapotranspiration were conducted by tower flux measurement. Recently, flux data have been used for validation of models, and model studies estimate spatial carbon flux and evapotranspiration. As the results, uncertainties of models have been reduced and accuracy of spatial map of carbon flux also has increased. However, comparison between tower observation and models showed that uncertainties still remain.

In this study, we focus on vegetation index in order to detect temporal and spatial variation of terrestrial ecosystem against climate variation because vegetation index is simple and has less uncertainty than CO_2 flux provided by model. The purpose of this study is to clarify the response of terrestrial ecosystem to climate variations using remote sensing data and reanalysis data. We use multiple data sets of remote sensing and reanalysis data in order to study robustly.

We used temperature map provided by National Centers for Environmental Prediction (NCEP) and Climate Research Unit (CRU), solar radiation provided by NCEP and Goddard Institute for Space Studies (GISS), and precipitation provided by CRU and Global Precipitation Climate Program (GPCP). We used NDVI (Moderate resolution Imaging Spectroradiometer (MODSI), Sea-viewing Wide Field-of-view Sensor (SeaWiFS), SPOT-vegetation (VGT)). They were prepared as one month data set.

In this study, we compared observation data obtained from tower with remote sensing data in order to verify them. Secondary, we analyzed the relationship between monthly vegetation indexes and climate factors. Thirdly, we analyzed what climate factors effect on monthly anomaly of vegetation indexes.

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DIURNAL AND SEASONAL VARIATIONS IN BULK STOMATAL CONDUCTANCE OF PADDY RICE CANOPY

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Bulk stomatal conductance, g_s, that represents stomatal behavior at canopy scales is generally independent from LAI development and thus more representative of the plant status than the surface conductance in big-leaf approaches. Recently, Maruyama and Kuwagata (2008) assessed diurnal and seasonal variations in g_s of rice canopy and their environmental controls. In their results, g_s showed a typical seasonal variation in accord with the rice growth and relatively symmetric diurnal patterns. At the Mase paddy site, however, the surface conductance as determined by PM equations largely decreased in the afternoon corresponding vapor pressure deficit and wind velocity (Ono, 2008). In this study, we calculated g_s by the technique presented by Maruyama and Kuwagata (2008) using the dataset collected at the Mase paddy site and further investigated daytime hysteresis of the conductances. The measurements were made at the Mase Asia Flux site. Data of three growing seasons between 2004 and 2006 were analyzed. Rice seedlings were transplanted on 2nd May for the three seasons and matured rice was harvested in early to middle September depending on weather conditions. This study focused on the stages with LAI > 1 to avoid errors in g_s calculation. Surface energy imbalance was obvious in the dataset and corrected using the Bowen ratio every half hour, which enabled us to compare the results with those in Maruyama and Kuwagata (2008). The Ball-Berry parameters that relate stomatal conductance and the assimilation rate were also explored at canopy scale using CO_2 flux data. Bulk stomatal conductance, g_s, at the Mase site showed a diurnal hysteresis in particular subperiods. The depletion in g_s was correlated with vapor pressure deficit and enhanced wind in the afternoon. However, g_s was not decreased in relatively dry and windy conditions if they occurred in the morning, suggesting that rice stomata differently responded in the morning and afternoon even under a similar environmental condition. Net canopy assimilation scaled by LAI was generally correlated with g_s, which implied that the Ball-Berry model could be used for rice canopy. However, the relationships were not affected by relative humidity.

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LONG-TERM MONITORING OF CO_2 FLUX AT A LARCH FOREST IN FOOTHILL OF MT. FUJI, JAPAN

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We have been conducting long-term integrated carbon budget monitoring program at Fuji-Hokuroku (FJH) flux research site in the north foot of Mt. Fuji (3776m) since beginning of 2006. We report the 5-year measurements (2006-2010) of micrometeorological CO_2 exchange flux over FJH site. The site is located in a Japanese Larch plantation with stand age of about 50 years. Net ecosystem CO_2 exchange (NEE) is measured by eddy covariance (EC) method using both closed path and open path CO_2 gas analyzers. Time-series of the NEE shows seasonal pattern intrinsic to deciduous forest. The net CO_2 uptake shows rapid rise in May, the period of opening-leaves of Larch. During the non-foliated season, November to middle of April, the NEE is slightly positive and with small short-term variation. NEE in the growing season has significant short-term variability. Frequent reduction of light-availability due to passage of seasonal rain front likely restrict photosynthetic CO_2 uptake at this site. On the other hands, limitation of photosynthetic CO_2 uptake due to drought stress is uncommon because of frequent precipitation during growing season. NEE, Gross primary production (GPP) and ecosystem respiration (RE) showed inter-annual variations in their seasonal pattern. Timing of opening-leaves and falling-leaves likely varies due to difference in air temperature. It causes change in foliated period of the forest, consequently affect the annual CO_2 uptake. In this workshop, we will present results from our investigation about inter-annual variations in NEE, GPP and RE, their relation to environmental controlling factors, and about comparison with other flux sites.

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NET ECOSYSTEM CO_2 EXCHANGE IN A CONIFEEROUS FOREST IN KOREA

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The Asian monsoon is an important natural disturbance that influences ecosystem carbon and water exchanges. Some studies have demonstrated that the Asian monsoon declines the capacity of a carbon sink in the growing seasons. To examine the effect of changing hydrological cycles on forest carbon sink strength, net ecosystem exchange (*NEE*) of CO_2 was measured in a coniferous forest using the eddy covariance method in 2008 and 2009 in Gwangneung Coniferous Forest (GCK) in Korea. The vegetation type is dominated by *Abies sp.* with an average stand age of about 95 ~100 years. The average canopy height is about 23 m and plant area index varies 3.7 in the winter and 7.6 in the summer. The annually integrated *NEE,* gross primary productivity (*GPP*) and ecosystem respiration (*RE*) in 2008 and 2009 were -192, 1464, and 1273 and -358, 1681 and 1323 g C m^{-2} yr^{-1}, respectively. The differences in *NEE* and *GPP* between the two years were associated with the differences in environmental conditions mainly in winter, summer and fall. *RE* showed little difference between the two years. The warmer winter in 2009 induced the onset of carbon uptake about a month earlier than in 2008. Less frequent precipitation and lower cloud cover during the summer of 2009 resulted in a higher radiation and consequently more carbon uptake (about 100 g C m^{-2} $season^{-1}$) compared to 2008. We found that canopy light use efficiency was also higher in 2009 during the growing season. Despite the fall drought in 2009, which recorded the 5th lowest precipitation in Korea since 1973, the magnitude of carbon uptake in 2009 was higher than in 2008 due to enhanced radiation and light use efficiency. The analyses of *NEE* for the complete two years showed that the coniferous forest was a moderate CO_2 sink in Asia. Our results suggest that different environmental factors constrained the magnitude of *NEE* and *GPP* at different period. The strength of carbon sink is associated with changes in hydrologic cycle (e.g., summer monsoon and drought) and the degree of its influence is subject to change by its duration, intensity, and timing.

Acknowledgements

This research was supported by "CarboEastAsia - A3 Foresight Program" of National Research Foundation of Korea, Long-term Ecological Study and Monitoring of Forest Ecosystem Project of Korea Research Institute.

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VALIDATION OF THE FEASIBILITY OF MODIS-GPP PRODUCT IN CROP FIELD OF THE NORTH CHINA PLAIN

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More and more research indicates that the carbon cycle of agricultural ecosystem takes as well an important role in global climate change as that of natural ecosystem. Gross primary production (GPP) is a key parameter of carbon cycle research. With high time-sequence, convenient download and wide range of coverage, MODIS-GPP product has been widely used in the carbon cycle of forest ecosystem. However, MODIS-GPP product is seldomly used in agricultural ecosystem research, limited by the scale effect which is very much related to low spatial resolution of almost 1 kilometers. In this paper, based on the estimation of winter wheat GPP during its growth period (2009.10~2010.6) from the observation data of eddy covariance system at Guan Tao flux station of Hebei, we validated the feasibility of the MODIS-GPP product in crop field of north china plain. Results show that the discrepancy between MODIS GPP data and estimated GPP data exists and varies in different phenological phase. MODIS-GPP value is little higher than the estimated GPP value from eddy covariance method before the period of seedling establishment, while the condition is opposite after the period of seedling establishment. Although the overall amount of MODIS-GPP during winter wheat growth period is a little higher than estimated GPP data from the eddy covariance method, the correlation coefficient is as high as 0.9227, which means that the MODIS-GPP product meets the accuracy requirements of the carbon flux research of the crop field of North China Plain.

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FOREST TYPE CONTROLS THE LANDSCAPE VARIATION OF SOIL RESPIRATION IN A HILLY REGION IN SUBTROPICAL CHINA

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In order to investigate how the environmental variables, forest types and topographic factors affect the landscape variation of SR, a study was carried out over a two-year period at 10 plots with different topographic factors among five forest types (slash pine, SP; masson pine, MP; Chinese fir, CF; coniferous and broad-leaved mixed, CB; and natural secondary forest, NS) in a hilly region in southeast China.

The results indicated that the seasonal variations of SR were mainly explained by soil temperature and soil water content (SWC). The mean annual SR, root-free SR and root-affected SR of all plots varied from 798 to 1172 g C m^{-2} yr^{-1}, 377 to 778 g C m^{-2} yr^{-1} and 200 to 577 g C m^{-2} yr^{-1} from 2008 to 2009, with a coefficient of variation (CV) of 14%, 24% and 35%, respectively. The mean annual SR of different forest types varied from 812 to 1172 g C m^{-2} yr^{-1}, with a CV of 16%. However, the mean annual SR of same forest types (SP, MP and CF) but with different topographic factors only varied from 808 to 838 g C m^{-2} yr^{-1}, 954 to 1025 g C m^{-2} yr^{-1} and 798 to 827 g C m^{-2} yr^{-1}, with a CV of 2%, 4% and 3%, respectively. The topographic and landscape variations of SR and its components were not associated with the soil temperature, SWC and soil properties. The difference of annual root-affected SR between MP and SP was significant. These suggested that forest type controlled topographic and landscape variation of SR and its components in a hilly region in subtropical China.

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FLUX FOOTPRINT AND SOURCE AREA OF RUBBER PLANTATION IN HAINAN ISLAND, SOUTHERN OF CHINA

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In order to analyze and control the quality of the rubber plantation flux observation data, based on the FSAM model (Schmid, 1994), footprint and flux source area were calculated according to the continuous flux measurement with the open-path eddy covariance system on the 50 m tower of Ministry of Agriculture Danzhou Key Field Station of Observation and Research for Tropical Agricultural Resources and Environments from Jan 1 to Jun 30, 2010. The spatial representative of flux measurement of the rubber plantation in Hainan Island, southern of China, was explained. The results showed that: (1) under unstable stratification, source areas were smaller than those under stable conditions, and source areas in the dormant season were larger than those in the growing season at the same level. (2) in the main wind direction 130°~270°, the upwind range of source areas was in the magnitude of 100~758 m and vertical upwind range was -251~251 m at a 80% level under unstable stratification in the growing season, and they were some large than those under the unstable stratification in the dormant season. The source areas of the upwind and vertical upwind ranges are 173~1858 m, -534~534 m especially under stable stratification in the growing season, and they were smaller than those under stable stratification in the dormant season. (3)In the other wind directions of 0°~130° and 270°~360°, the ranges were similar than those of the growing season in the prevailing wind direction under the same atmospheric conditions.

Keywords: flux footprint, FSAM (the Flux-Source Area Model), flux source area, rubber plantation (forest), Hainan Island.

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PORTABLE SAMPLING SYSTEM FOR BIOGENIC VOLATILE ORGANIC COMPOUNDS BASED ON RELAXED EDDY ACCUMULATION METHOD

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Introduction:

Biogenic volatile organic compounds (BVOCs) emitted from vegetation contribute to producting troposphere ozone in the presence of NO_x and sunlight. Annual BVOC emissions have been estimated to be 1150 Tg carbon per year, which is higher than the anthropogenic volatile organic compounds(AVOC) emission. Among BVOCs, isoprene (C_5H_8) and monoterpene ($C_{10}H_{18}$) are major compounds emitted from vegetation. They include 5 or 10 atoms of carbons in one molecular, and therefore BVOC emissions from forests may significantly affect the forest carbon cycle. In this study, we fabricated a portable sampling system for a relaxed eddy accumulation method to measure BVOC flux above forests. To evaluate the performance of the REA system, we measured CO_2 flux simultaneously using the REA system and widely-used eddy covariance method (EC method), and compared the calculated fluxes.

REA sampling system:

We have fabricated a portable REA sampling system. In comparison with the former device, the size was reduced to 3/4 in volume (34cm × 60cm × 30cm). The weight (about 8 kg) was a half of the former one. We reduced electric wirings as much as possible by making circuits on a base board. Number of sampling tubes set in the system is 4 each for the upward and downward samplings.

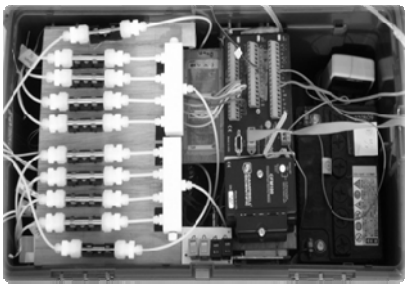

Fig. 1 REA sampling system

Study site:

We evaluated the performance of the REA system at Fuji-Hokuroku site (FHK: 35º 26' N, 138º 45' E, elevation 1050~1150m) near Mt. Fuji, Japan. Fluxes of BVOCs and CO_2 were measured above a Japanese larch plantation (tree ages: 45~50 years, canopy height: 20~25 m) using a meteorological tower built within the site.

Comparison of CO_2 flux between the REA and EC methods:

We measured CO_2 concentration sampled by the REA system using Li-6262 (Li-Cor). The flux obtained from the REA sampling system was compared with CO_2 flux determined using the existing closed-path eddy covariance system (Fig. 2). A good agreement was observed between the two fluxes, whereas the REA method tended to slightly overestimate the CO_2 flux. The relationship can be used to correct BVOC flux determined by the REA system. We are planning to measure the fluxes of isoprene oxidation products methyl vinyl ketone and methacrolein, and air pollutants such as benzene and toluene in addition to isoprene and monoterpenes.

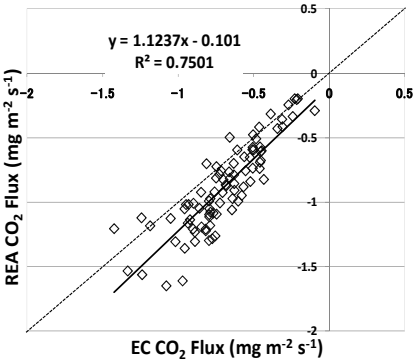

Fig. 2 Comparison of CO_2 flux determined by the EC and REA method.

P231

QUANTITATIVE PHONOLOGICAL OBSERVATIONS OF WINTER WHEAT IN NORTHERN CHINA WITH DIGITAL PHOTOGRAPHY

Lei Zhou[1,2], Honglin He[1], Min Liu[1,2], Xiaomin Sun[1], Li Zhang[1], Guirui Yu[1]

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

Vegetation phenology has a strong influence on the timing and phase of global terrestrial carbon and water exchange and is a robust indictor of climate change and variability. In this study, we tested the application of inexpensive digital visible-light cameras in monitoring phenology. A digital camera (AXIS 214) was mounted on a 5 m tall flux tower at Yucheng, an agriculture site in ChinaFLUX. Half hourly images of a winter wheat cultivated land was obtained during March-June, 2010. A quantitative signal is obtained by splitting images into separate red (R), green (G), and blue (B) color channels and calculating the different vegetation indices (e.g., G/R) for 'regions of interest' within each image to indicating the growing condition(i.e., phenological signal) for the vegetation .We considered the relationship between this observed phenological signal and broadband vegetation index (i.e. NDVI, EVI) provided by MODIS (moderate-resolution imaging spectroradiometer), leaf area indices (LAI), and gross primary productivity (GPP) inferred from eddy covariance measurements of surface–atmosphere CO_2 exchange. An uncertainty analysis was performed and demonstrated moderate impacts on color values of changing illumination conditions due to clouds and illumination angles and spatial resolution. We conclude that digital camera could offer inexpensive, spatially representative and objective information with the required temporal resolution for phonological studies, which bridge the gap between CO_2 flux measurements at ecosystem scale and satellite-based vegetation monitoring at a regional scale.

Key words: phenology, wheat, digital camera, colors channel, uncertainty, the observation and research network of China flux (ChinaFLUX), Chinese Ecosystem Research Network (CERN)

P232

ESTIMATION AND EVALUATION OF CROP GROSS PRIMARY PRODUCTIVITY USING INPUTS RETRIEVED FROM MODIS

Jihye. Lee[1], Jonghan. Ko[2], and Sinkyu. Kang[1]

[1]Kangwon National University, Chuncheon, Republic of Korea
[2]Chonnam National University, Kwangju, Republic of Korea

Monitoring of global or regional changes in carbon cycles between the atmosphere and biosphere related to the terrestrial carbon sequestration is an important task necessary for the improved projections of future atmospheric greenhouse gases associated with the ongoing global warming. Many studies have investigated the CO_2 exchange between biosphere and atmosphere at regional, continental, and global scales. Many models for estimated vegetation productivity have been developed by combining remote sensing with carbon cycle process. In particular, crop productivity is intimately associated with the food security. In this study, we estimated Gross Primary Productivity (GPP) of crops using inputs retrieved from Moderate resolution imaging spectroradiometer (MODIS) products of AQUA and TERRA satellites. Shortwave radiation is one of key variables to estimate GPP, which can be estimated by utilizing MODIS atmosphere and land product. We used 6 AmeriFlux data located in Corn Belt area including Illinois, Kansas, and Iowa, in USA, to evaluate input data derived from MODIS. MODIS-derived air temperature showed good agreements with ground-based observations. The root mean square error (RMSE) and coefficient of determination (r^2) ranged from 1.41^{o}C to 4.9^{o}C and from 0.75 to 0.94, respectively. VPD showed low agreement in comparison with tower observations (RMSE= 4.5 - 9.6hPa; r^2 = 0.52 - 0.68). MODIS-derived VPD was generally overestimated at low values of observations, whereas it was underestimated at high values of observations. MODIS-derived shortwave radiation showed a good correlation with observations, but it was slightly overestimated. Our preliminary results indicate that the use of MODIS atmosphere and land products can provide a useful tool for estimating crop GPP.

(This research is supported by CarboEastAsia Foresight (A3) project.)

P233

DEVELOPMENT OF A CROP MODELING SCHEME TO DETERMINE NET PRIMARY PRODUCTIVITY OF CORN AND SOYBEAN

Jonghan Ko[1], Jihye Lee[2], and Sinkyu Kang[2]

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[2]Environmental Sci., Kangwon National Univ., 192-1 Hyoja 2 dong, Chuncheon, Kangwon 200-092, ROK

Moderate resolution imaging spectroradiometer (MODIS) in the space and Flux Networks on the ground are reciprocally used as practical tools to monitor carbon cycles between the atmosphere and biosphere as well as ecosystem productivity. In this study, we modify the NASA MODIS Mod 17 algorithm for crops to verify more practical production estimation with classified crops as the algorithm does not distinguish different crops. We then parameterize and validate the modified crop modeling design to determine net primary productivity (NPP) of corn and soybean. For these purposes, we obtained the AmeriFlux level 4 data for Bondville (USBo1) and Fermi Agricultural (US-IB1) sites in Illinois, USA. Data for 3 years corn (2000, 2002, and 2006) and soybean (2001, 2003, and 2005) of Bondville and 1 year corn (2006) and soybean (2005) of Fermi Agricultural, respectively, are used. The simulated NPP using the modified crop modeling design are compared with those from the AmeriFlux level 4 data. Further simulations are made using a MODIS-based crop modeling design, which is a primary product of potential field and regional crop growth and production monitoring systems. We also discuss about the development of the MODIS-based crop monitoring systems.

Keywords: Crop, Flux Network, MODIS, monitoring, NPP, simulation

Acknowledgements:
This study is supported by the project of Using Satellite Information to Develop Crop Production Forecast Techniques of Major Crops.

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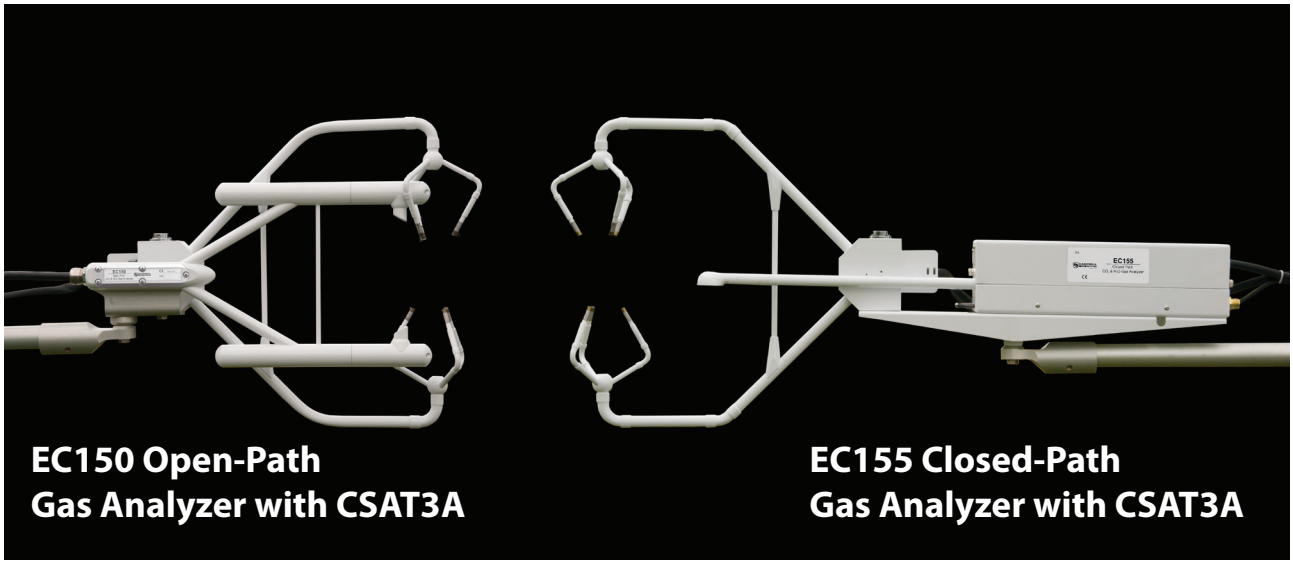

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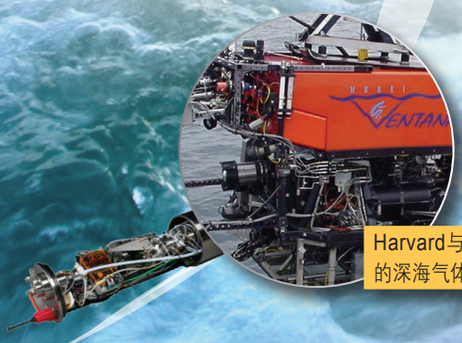

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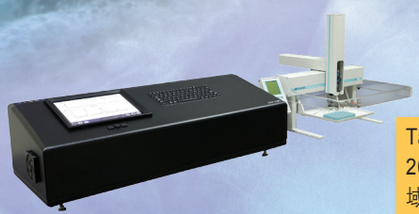

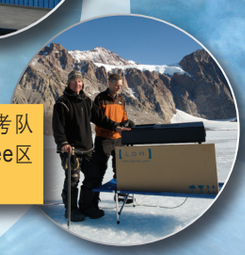

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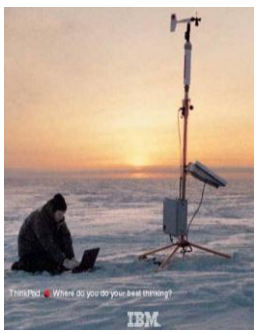
> "In contrast to *[three named competitors]*, Coastal Environmental presented a total system view of flexibility characteristics addressing hardware, software and user interface, far exceeding the minimum requirement. These features indicate that future systems upgrades and evolving interface requirements will be easily implemented with respect to price schedule unhindered by any proprietary limitations."



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LAS 大口径闪烁仪

北京天诺基业科技有限公司是一家专注于气象、地基遥感、生态环境监测等领域的系统供应商，是 Campbell、Kipp&Zonen、Sentek、Onset、Metone 等十余家国际知名仪器厂商的中国独家代理商或重要合作伙伴，拥有丰富的系统集成经验和完善的技术服务体系。公司总部位于北京，并在兰州、南京、广州等地设有分支机构，服务网络覆盖全国。在微气象研究方面，由我们提供的涡动相关系统遍布于全国各地，并被广大科研工作者认可。除中科院（ChinaFlux，CERN）、林科院（CFERN）、农科院等科研院所的各野外生态定位站外，还广泛应用于气象科研院所、气候中心及省级气象局的气象局领域。

对于通量的观测，能量平衡的闭合问题是需特别关注的，高精度、长期稳定可靠的净辐射传感器是能量平衡系统中的首选；同时，涡动相关系统作为点测量仪器，在空间代表性上有一定的局限性，而大口径闪烁仪 LAS 对较大尺度的非均匀下垫面的测量有着明显优势。

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北京澳作生态仪器有限公司
Aozuo Ecology Instrumentation Ltd.

生态地球化学测量技术

研究领域

- 陆地生态系统碳储量及固碳潜力
- 生态系统元素时空分布
- 地质碳封存

ASI 系列激光剥蚀仪器

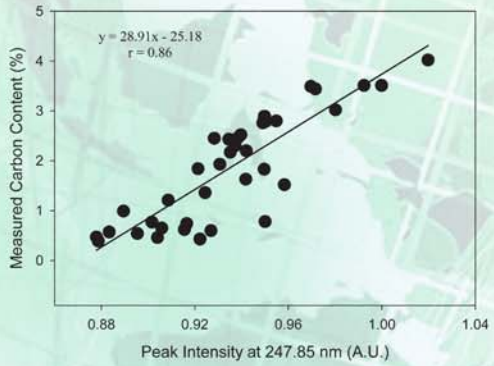
功能

快速测量陆地生态系统土壤、植物、气溶胶、岩层、矿石中的

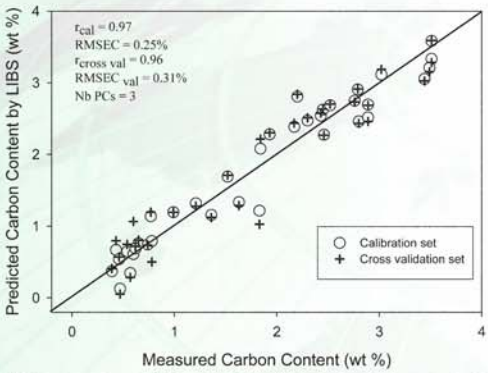
- 常量元素 N, P, K, Ca, Mg, S
- 微量元素 Fe, Cu, Mn, Zn, B., Mo, Ni, and Cl
- 土壤碳储量及固碳潜力
- 污染物检测
- 痕量元素检测

测量技术

ASI 系统激光光谱仪采用飞秒激光，在样品表面形成等离子体，光谱检测系统对等离子体的光谱进行分析，进而得到样品的元素组分和含量信息。



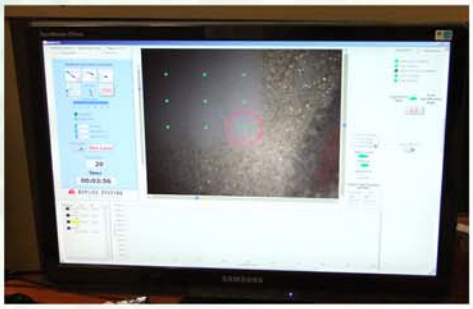
单参数模型显示的土壤样品碳含量：常规测量法与 ASI 激光光谱法



多参数模型显示的土壤样品碳含量：常规测量法与 ASI 激光光谱法
（圆圈和十字图形分别代表标定和验证样品）

特点

- 直接、无损测量
- 无需消解、样品无损耗
- 检测限达 ppm (~1ug/g)，表面测量 ~0.1ug/cm^2
- 激光测点尺寸 ~1um 至 ~1mm
- 多元素同时检测
- 带元素鉴定的光谱数据库
- 背景和基值去除
- PCA/PLS/ 多参数线性回归等数据分析工具



ASI 系列激光剥蚀仪器源自美国加州大学国家能源技术实验室 80 年 LIBS 技术的研究成果，是快速、无损、无污染分析地球化学元素的绿色解决方案。其中 LA-ICP-MS 系统的高灵敏度、高精密度、低检测限、提供同位素组成比值等功能远远优于传统的质谱仪。

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更多生态系统的研究方法，如土壤呼吸、碳氮转换、水量平衡、能量平衡、痕量气体、同位素、流域风水复合侵蚀、水质水量、富营养化等，请来电垂询。

北京华益瑞科技有限公司

土壤呼吸监测系统(SRM6)

随着商业化仪器的越来越成熟，各种标准的土壤温室气体监测设备也不断的出现，我公司可以根据用户需求设计监测系统。主要性能特点包括：

可以任意设计实验的测量内容

北京华益瑞科技有限公司拥有自主产权的土壤呼吸监测气室(已经获得国家专利授权)，可以根据各种不同需要，设计成监测土壤 CO_2 排放，CH_4 排放，NH_3，H_2S，H_2O 等监测研究的设备。

任意设计气室的数量

根据场地的代表性，面积的大小，不均一性的现场需要多个的土壤气体采样室,才能代表场地的空间可变异性，对于气室数量的上限，我们没有严格的限制。

可以设计成土壤呼吸，群体光合监测，大气廓线监测联合系统

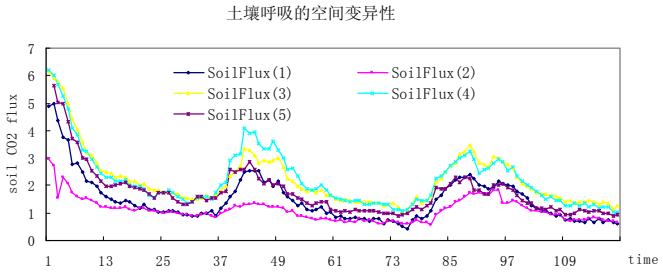
根据不同的要求，可以同时测量土壤呼吸，群体光合，及大气 CO_2 及其他痕量气体的廓线。用同一个分析仪来实现。

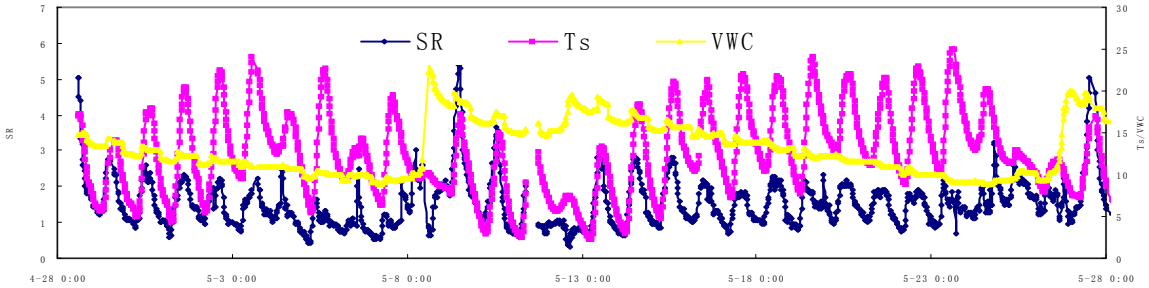
实时计算在线通量，保留原始数据

浓度的上升曲线的线性回归将给出一个实时通量，我们保留了所有的原始数据，用户可以根据自己的方法重新计算土壤 CO_2 排放量。

克服采样室高浓度的影响

通过专用的气压测量平衡装置，我们可以把内部的压力与外界保持平衡，又能保证内部的浓度不会受到扩散的影响。





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