AsiaFlux Workshop 2008

Re-Thinking Global Change Science: From Knowledge to Policy

AsiaFlux celebrates 10 years of Science, Service, and Stewardship

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Re-thinking Global Change Science: From Knowledge To Policy

17-19 November 2008
Korea Press Center, Seoul, Korea

AsiaFlux Workshop 2008

Re-thinking Global Change Science:

From Knowledge to Policy

In many parts of the world already facing unreliable food and energy supplies, the future stress for people, plants and soil is aggravated by an uncertain climate and its coupling with biogeochemical cycles of carbon and water. In recognition of the significant contribution and urgency, the Nobel Peace Prize for 2007 was awarded to science, Intergovernmental Panel on Climate Change (IPCC). Yet, claims are fuelling controversy that IPCC has seriously underestimated the challenge and costs of stabilizing greenhouse-gas emissions in the 21st century. Global energy consumption continues to grow, producing more greenhouse gases and squeezing already scarce water resources. Truly, we are standing at the crossroads where the risks can be minimized by developing and transferring the right scientific knowledge to society. Maintaining a basic research program and interaction between science and policy is critical for success.

During 17-19 November 2008, the AsiaFlux celebrates its 10 years' science, service & stewardship by hosting 7th International Workshop (entitled "Re-thinking Global Change Science: From Knowledge to Policy") at the Press Center in Seoul, Korea. The "AsiaFlux" is a science community with a mission to "bring Asia's key ecosystems under observation to develop and transfer scientific knowledge to ensure quality and sustainability of life". It is one of the GEOSS components and the Asian arm of the global FLUXNET which has been one of the critical assets of IPCC reports and global change science.

The workshop is co-hosted by "CarboEastAsia", a subset of the A3 Foresight Program that has been implemented to support international collaboration among global change scientists from China, Japan and Korea. "CarboEastAsia" is aiming for the capacity building among ChinaFlux, JapanFlux and KoFlux to cope with climate change protocols by synthesizing measurement, theory and modeling in quantifying and understanding of carbon fluxes and storages in East Asia. The workshop will provide a great opportunity for scientists, policy-makers and the public to better understand the latest scientific achievements, and to help develop educational, technical, and socio-economic resolutions to prevent and mitigate the risk of human-induced climate change associated with carbon, water and energy cycle in Asia.

Joon Kim, Professor
Chair of AsiaFlux

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AsiaFlux Workshop Schedule

Date/Place			8	9	10	11	12	13	14	15	16	17	18
17-Nov	International Conference Hall (20F)		Registration (08:00-)	Welcoming Session (09:00-09:25) Opening Session (09:25-09:50) Regional Report (10:00-12:15)					Special Session I – CarboEastAsia C01 – C21 (13:20-18:30)				Banquet Koreana Hotel (18:30-20:30)
	Press Conference Hall (19F)	Oral Session					Press Conference (12:20-13:00)						
		Poster Session							Poster Session I P01 – P20 (14:00-18:00)				
18-Nov	International Conference Hall (20F)			Regular Session I & II O01 – O11 (09:00-12:00)					Regular Session III O12 – O21 (13:30-16:10)			Synthesis & Discussion (16:30-17:40)	Young Scientists Meeting Kukje Hotel (18:20-21:00)
	Press Conference Hall (19F)	Oral Session			Special Session II – HydroKorea H01-H08 (9:30-12:20)				Special Session III- ACTSociety A01-A05 (13:30-16:20)				
		Poster Session		Poster Session II P21-P40 (09:00-12:00)					Poster Session III P41 – P58 (14:00-18:00)				
19-Nov	Field Excursion		Field Excursion Option A – Gwangneung Field Excursion Option B – Jeju(19-20 Nov)										

AsiaFlux Workshop 2008 Program

November 17, 2008 (Monday)

Morning Session

International Conference Hall (20F) **November 17, 2008 09:00 – 13:00**

Moderator: Hyojung Kwon

Welcoming Session

09:00 – 09:05	Welcoming Addresses from AsiaFlux Chair	J. Kim
09:05 – 09:25	Welcoming Addresses from Celebrities	

Opening Session

09:25 – 09:35	History of AsiaFlux	S. Yamamoto
09:35 – 09:45	Vision Casting	J. Kim
09:45 – 09:50	Appreciation to Contributor	
09:50 – 10:00	***Break***	

Regional Report

10:00 – 10:05	AmeriFlux	D. Baldocchi
10:05 – 10:20	OzFlux, the Australian Flux and Ecosystem Research Network	R. Leuning
10:20 – 10:35	AsiaFlux, the Agora for Re-thinking Global Change Science	J. Kim
10:35 – 10:50	ChinaFLUX, Network-Based Observation and Study of Carbon Exchange Over Major Terrestrial Ecosystems in China	S.-G. Li
10:50 – 11:05	IndoFLUX, Flux Observations over Diverse Terrestrial Ecosystems in India	S. Triphati
11:05 – 11:15	***Break***	
11:15 – 11:30	JapanFlux	K. Tamai
11:30 – 11:45	KoFlux Activities	H. Kwon
11:45 – 12:00	TaiwanFlux	Y.-J. Hsia
12:00 – 12:15	ThaiFlux	P. Kasemsap

Press Conference – Press Conference Room (19F)

12:20 – 13:00	Press Conferences	

Special Session I: CarboEastAsia

International Conference Hall (20F) **November 17, 2008 13:20 – 18:10**

Chair: Nobuko Saigusa

13:20 – 13:30		Introduction to A3 CarboEastAsia Program *D. Lee*
13:30 – 13:42	C01	Seasonal Variation of Photosynthetic and Respiratory Parameters of Larch Forests in East Asia *K. Takagi, R. Hirata, T. Hirano, N. Saigusa, J. Asanuma, S.-G. Li, T. Machimura, Y. Nakai, T. Ohta, Y. Takahashi, and H. Wang*
13:42 – 13:54	C02	Comparison of CO_2 and CH_4 Emission in Boreal, Temperate, Subtropical, and Tropical Old-Growth Forest Soils in Eastern China *H. Fang, G. Yu, S. Cheng, T. Zhu,Y. Wang, D. Zhang, M. Wang, and M. Cao*

13:54 – 14:06 C03 Water, Temperature, and Vegetation Regulation on Carbon Dioxide Fluxes over Three Grassland Ecosystems in China
Y. Fu, Z. Zheng, G. Yu, Z. Hu, X. Sun,P. Shi, Y. Wang, and X. Zhao

14:06 – 14:18 C04 Seasonal Variation in Carbon Dioxide Exchange in an Alpine Wetlands Meadow on the Qinghai-Tibetan Plateau
L. Zhao, S. Xu, H. Zhou,Y. Li, S. Gu, and X. Zhao

14:18 – 14:30 C05 Application of Micrometeorological Methods for Flux Measurements during Rainfall
J. Hong, D. Lee, H. Kwon, J.-H. Lim , and J. Kim

14:30 – 14:42 C06 Carbon Budget Patterns of Forest Ecosystem in Poyang Lake Basin from 1901 to 2001
S. Wang, J. Liu, W. Wu, and Y. Yan

14:42 – 14:54 C07 Isoprene Emission Characteristics of Japanese Oak in a Deciduous Broad-Leaved Forest
M. Okumura, A. Tani, Y. Kominami, T. Miyama, S. Takanashi, Y. Kosugi, K. Nakagawa, and S. Tohno

14:54 – 15:04 ***Break***

Chair: Yuling Fu

15:04 – 15:16 C08 Multi-Model Analysis of Terrestrial Water and Carbon Cycles in Japan: First Results from Japan-MIP
K. Ichii, T. Suzuki, T. Kato, A. Ito, T. Sasai, M. Ueyama, T. Hajima, R. Hirata, N. Saigusa, Y. Ohtani, K. Takagi, H. Hashimoto, and R. Nemani

15:16 – 15:28 C09 Model Estimate of Annual NEE and Uncertainty over Mixed Forest in Complex Terrain
Y.-H. Lee and H.-J. Lim

15:28 – 15:40 C10 Estimated Carbon Residence Times in Three Forest Ecosystems of Eastern China: Applications of Probabilistic Inversion
L. Zhang, Y. Luo, G. Yu, and L. Zhang

15:40 – 15:52 C11 An Integrated Upscaling Approach Based on Spatial Pattern Identification and Scale Effect Analysis for Annual Net Primary Productivity
N. Zhang

15:52 – 16:04 C12 Inversely Modeling the Impact of Drought on Regional Carbon Fluxes
W. Ju, S. Wang, G. Yu, and H. Wang

16:04 – 16:16 C13 Toward High Resolution Regional Land Surface Carbon Balance Mapping over East Asia Using Top-Down Modeling and Flux Tower Observation
T. Machimura and T. Oda

16:16 – 16:28 C14 Simulating Carbon And Water Cycle at Larch Forests in East Asia by BIOME-BGC Model with AsiaFlux Data
M. Ueyama, K. Ichii, R. Hirata, K. Takagi, J. Asanuma, Y. Nakai, T. Ohta, N. Saigusa, and T. Hirano

16:28 – 16:38 ***Break***

Chair: Jinkyu Hong

16:38 – 16:50 C15 Impact of Meteorological Anomalies in Summer, 2003 on Gross Primary Productivity in East Asia
N. Saigusa, R. Hirata, K. Ichii, T. Sasai, R. Ide, S.-F. Tian, J. Asanuma, S.-J. Han, S.-G. Li, T. Ohta, S.-Q. Wang, and G. Yu

16:50 – 17:02 C16 The Influence of an Unprecedented Snow Storm in 2008 to Carbon Stock of Forest Ecosystem in Southern China
H. Wang, Z. Ma, S. Wang, Q. Li, Y. Wang, and H. Wang

17:02 – 17:14 C17 Seasonal Drought Effects on Ecosystem Carbon Exchange of a Subtropical Planted Forest of Southeastern China
X.-F. Wen, X.-M. Sun, G.-R. Yu, H.-M. Wang

17:14 – 17:26 C18 Responses of Carbon Exchange of Forest Ecosystems to Asian Monsoon Climate during Summer Period
L. Zhang

17:26 – 17:38 C19 Effect of Manure Application on Carbon Balance in Four Grasslands in Japan
R. Hirata, A. Miyata1, M. Mano, T. Akira, H. Kouda, M. Shimizu, S. Matsuura, M. Niim, and R. Hatano

17:38 – 17:50 C20 Evaluation of the Effect of Global Warming on Soil Carbon Emission of Japanese Forest Ecosystems
N. Liang, K. Takagi, Y. Kakubari, K. Nakane, Q. Wang, Y. Takahashi, and H. Mukai

17:50 – 18:02 C21 Effect Estimation of Environmental Factors and Soil Property on Topographical Variation of Soil Respiration
K. Tamai

November 18, 2008 (Tuesday)

Regular Session I & II | **International Conference Hall (20F)** | **November 18, 2008 09:00 – 12:00**

Chair: Walter Oechel

09:00 – 09:30 O01 *Keynote Speech*: Lessons Learned from a Decade of Flux Measurements across a Global Network of Regional Fluxnetworks
D. Baldocchi and R. Vargas

09:30 – 09:42 O02 The Seasonal and Diurnal Patterns of Net Ecosystem CO_2 Exchange in a Subtropical Montane Cloud Forest
H.-S. Chu, C.-W. Lai, C.-C. Wu, J.-Y. Lin and Y.-J. Hsia

09:42 – 09:54 O03 Carbon Budgets Responses of *Leymus Chinensis* Grassland to Precipitations in Inner Mongolia
F. Bao and G. Zhou

09:54 – 10:06 O04 Carbon Flux of Typical Steppe Ecosystem in Inner Mongolia and Its Environmental Control
G. Zhou and Y. Wang

10:06 – 10:18 O05 Uncertainty Analysis of CO_2 Flux Components at Alpine Grassland of Tibetan Plateau
M. Liu, H. He, X. Sun, G. Yu,and Y. Fu

10:18 – 10:35 ***Break***

Chair: Shenggong Li

10:35 – 11:00 O06 *Invited Speech*: Impact of Climate Change and Water Table Manipulation on Arctic Ecosystems: Lessons for Tropical Peatlands
W. Oechel and D. Zona

11:00 – 11:12 O07 The Effect of Changes in Solar Radiation on Ground Surface with Cloudiness on Net Ecosystem Exchange of Carbon Dioxide of Two Forest Ecosystems in China
M. Zhang, G. Yu, L. Zhang, X. Sun, X. Wen, S. Han, and J. Yan

11:12 – 11:24 O08 Quality Control of Field Measurements and Climate Data Analyses
P. Campbell and X. Lin

11:24 – 11:36 O09 Carbon Storage of Bamboo Forest Ecosystem in China
B. Wang, W. Wei, S. Li,H. Guo,M. Zhou, and X. Bai

11:36 – 11:48 O10 Plants Improve Methane Uptake by a Winter Wheat Field
Withdraw
J. Li, Q. Yu, X. Lee, and X. Tong

11:48 – 12:00 O11 Quality Control of Large Sets of Soil CO_2 Efflux Time Series Data
Withdraw
D. McDermitta, L. Xua, R. Madsena, M. Furtawa, D. Scobyb, and T. Arkebauer

Special Session II: HydroKorea

Press Conference Hall (19F) **November 18, 2008 09:30 – 12:20**

Chair: Sanghyun Kim

09:30 – 09:50		Introduction to Sustainable Water Resources Research in Korea *S. Kim*
09:50 – 10:00	H01	Overview of HydroKorea *J. Kim*
10:00 – 10:12	H02	Evapotranspiration Mapping over East Asia Using Korea Land Data Assimilation System *Y.-J. Lim, K.-Y. Byun,and T.-Y. Lee*
10:12 – 10:24	H03	Mapping Actual Evapotranspiration across Gwangneung Watershed Using High-Definition Geospatial Data and SiB2 *U. Chung, J.-H. Yi, and J. Kim*
10:24 – 10:36	H04	Mapping Evapotranspiration Using MODIS Images *S. Kang, K. Jang, and J. Kim*
10:36 – 10:48	H05	Estimating Spatial Distribution of Evapotranspiration in Eco-Hydrological Systems with Different Types of Land Cover *E. Kim, D. Lee, and J. Kim*
10:48 – 11:03		***Break***

Chair: Dongho Lee

11:03 – 11:13	H06	Continuous Estimates of Evapotranspiration over Forest and Farmland in Korea *H. Kwon, M. Kang, J. Yoo, B. Malla Thakuri, J. Jang, and J. Kim*
11:13 – 11:23	H07	A Soil Moisture Upscaling Technique Using Measured Data from a Hillslope *S. Kim and Y. Kwak*
11:23 – 11:33	H08	Validation of Model and Satellite-Derived Evapotranspiration Using Long-Term Water Budget in the Han River Basin, Korea *D. Lee, S.J. Kim, and J. Kim*
11:33 – 11:43	H09	Synthesis of ET Mapping and Its Application *S. J. Kim, S. Kang, U. Chung, Y-J. Lim, H. Kwon, D. Lee, and J. Kim*
11:43 – 12:20		Discussion

Regular Session III

International Conference Hall (20F) **November 18, 2008 13:30 – 17:40**

Chair: Sinkyu Kang

13:30 – 14:00	O12	*Keynote Speech*: Land Surface Models and the Global Fluxnet Dataset *R. Leuning, G. Abramowitz, M. Williams, A. Richardson, P. Stoy, R. Stockli, and Y. Wang*
14:00 – 14:25	O13	*Invited Speech:* Regional Estimation of CO_2 Budget Using MODIS-Visible Bands: Application to an Arctic Tundra *Y. Harazono, N. Nishida, M. Ueyama, Y. Kitaya, and W. Oechel*
14:25 – 14:37	O14	Phenological Eyes Network: Long-Term Ground Validation of Satellite Remote Sensing of Ecosystems *K. Nasahara, and S. Tsuchida*
14:37 – 14:49	O15	Tibetan Observation and Research Platform (TORP): A New Base for the Study of Fluxes Exchange over the Tibetan Plateau *Y. Ma*
14:49 – 14:59		***Break***

Chair: Yue-Joe Hsia

14:59 – 15:11	O16	$CH_4MOD_{wetland}$ – A Model for Simulating Methane Emission from Natural Wetland *T. Li, Y. Huang, W. Zhang, and C. Song*
15:11 – 15:23	O17	Temporal and Spatial Variability of Soil Respiration among Forest Ecosystems in China-Controlling Factors and Quantitative Evaluation Model *Z.-M. Zheng, G.-R. Yu, X.-M. Sun, Y.-S. Wang, and Y.-H. Wang*
15:23 – 15:35	O18	The Topographic Effect on the Distribution of Potential Surface Solar Radiation *Y.-J. Lai, M.-D. Chou, and P.-H. Lin*
15:35 – 15:47	O19	Roughness Length's Effects on Fluxes Simulation and Its Determination Methods *Y. Zhou, X. Sun, W. Ju, Y. Liu, and D. Guan*
15:47 – 15:59	O20	Estimation of Net Ecosystem Exchange (NEE) in South Korea *Y.-H. Lee, M.-S. Suh, J. Kim, S. Kang, and H.-J. Lim*
15:59 – 16:11	O21	Evaluation of Eco-Physiological Model for Determination of Net Primary Production in Tropical Area Using ASTER Data *M. Faidi, A. Ibrahim, and W. Rasib*
16:11 – 16:30		***Break***

Moderator: Ray Leuning

16:30 – 17:40		Synthesis & Discussion

Special Session III: ACTSociety

Press Conference Hall (19F) **November 18, 2008 13:30 – 16:20**

Chair: John Tenhunen

13:30 – 13:45		Introduction to ACTSociety *J. Kim*
13:45 – 14:15	A01	*Keynote Speech*: The Role of Ecosystem Flux Measurements in Bridging between Environmental Science, Environmental Policy and Natural Resource Management *J. Tenhunen and S. Kang*
14:15 – 14:35	A02	Carbon Debits and Credits: A View from the Ground Floor in America *P. Campbell*
14:35 – 14:55	A03	Carbon Neutral Program in Korea: An application to AsiaFlux Workshop *E. Yang, S. Im, J. Yoo, and H. Shin*
14:55 – 15:10		***Break***
15:10 – 15:30	A04	UK Response to Climate Change *T. Clemson*
15:30 – 15:50	A05	Ecosystem Carbon Study for the Society: System Approach and Global Forest Carbon Monitoring System *Y. Yamagata and A. Ito*
15:50 – 16:20		Panel Discussion

P01 Analyzing a Relationship between Terrestrial Carbon Flux and Meteorological Parameter in Far East Asia
T. Sasai, R. Hirata, N. Saigusa, K. Nasahara, Y. Ohtani, K. Takagi, and Y. Yamaguchi

P02 The Impact of Carbon on Wetland Ecosystem of Climate Change
Withdraw
G. Li and G. Zhou

P03 Tidal Effects on Net Ecosystem Exchange of Carbon in an Estuarine Wetland
Y. Gao, H. Guo, B. Zhao, and J. Chen

P04 Carbon Budget at Barley-Rice Double Cropping Field in Japan
T. Takimoto , S. Kikkawa, Y. Hanaoka, T. Iwata, and S. Yamamoto

P05 Carbon Budget in Double-Rice Cropping Paddy Field in Northern Bangladesh: Does Multiple Cropping Promote Ecosystem Carbon Accumulation?
A. Miyata, M Mano, A. Baten, M. Huq, S. Hossen, B. Khan, R. Khatun, H. Nagai, and K. Ono

P06 Rubber Flux, Progress in CO_2, Water Budget Evaluation of Rubber Plantations in Thailand
P. Thaler, P. Siripornpakdeekul, P. Kasemsap, S. Kunjet, O. Roupsard, F. Gay, A. Chantuma, S. Thanisawanyangkura, K. Sangkhasila, J. Sathornkich, and J.-M. Bonnefond

P07 Characteristics and Effects of "Carbon Lake" in the Tropical Mountainous Region of Xishuangbanna, SW China
Y. Zhang, N Liang, Y. Yao, Z. Tan, L.Sha,J. Gao, Q. Song, M. Zhang,Z. Li, and Z. Yang

P08 Annual and Seasonal Variability of Evapotranspiration and Its Controls over a Reed Marsh (*Phragmites australis*) in Northeast China
Withdraw
L. Zhou amd G.-S. Zhou

P09 Long-Term Water-Level Monitoring as a Basis for Tracking Water from the Air to the Subsurface
H.-A. Lee and N. Woo

P10 A Study on Evaluation of Heat and Water Vapor Flux between Land Surface and Atmosphere of Upo Wetland
M.-H. Park, H.-D. Kim, H.-Y. Kim, and J.-S. Ahn

P11 Preliminary Study on Air Temperature and Relative Humidity Observation around Forest with Wireless Sensor Network in Taiwan
Y.-J. Lai, C.-R. Chiou, T.-H. Wey, C.-S. Chang, C.-W. Shen, and Y.-N. Wang

P12 Estimating Water Use by Main Tree Species in the Natural Deciduous Forests of S. Korea
B. Lee, S. Kang, E. Jung, D. Otieno, and J. Lim

P13 Drought Effects on Sap Flow and Stand Transpiration in a Temperate Deciduous Forest
N. Laiju, S. Kang, E.-Y. Jung, and D. Otieno

P14 Heat Budget of Regeneration Process of Landslide Disaster Place at Sitou Region, Central Taiwan
T.-H. Wey, Y.-J. Lai, and Y.-L. Wang

P15 Observational Study on the Change of Micro-Meteorological Environment due to Deforestation
J.-S. Lim, H.-D. Kim, S.-J. Hwang, and H.-S. Koo

P16 The Study on the Soil Respiration under Primary Forest Types in Dagangshan Mountain in Jiangxi Province
B. Wang and Y. Jiang

P17 Winter Soil Respiration in the Broadleaved-Korean Pine Forest in Changbai Mountain
Withdraw
C. Song, J. Zhang, and S. Han

P18 Soil CO_2 Efflux in NY-ÅLESUND, Svalbard Using Chamber Method
N. Chae, T. Choi, Y. Kim, and B. Lee

P19 Long-Term Measurement of Soil Respiration in Temperate Deciduous Forest in KoFlux Site Using AOCC
E.-H. Lee, J. Kim, J.-H. Lim, and J.-S Lee

P20 Feedback of Ambient Air CO_2 Concentration on Soil CO_2 Flux
Withdraw
D. McDermitt, L. Xu, R. Madsen, T. Demetriades-Shah, J. Welles, R. Garcia, and M. Furtaw

P21 Relationship between Change of Dominant Species and Soil Respiration According to Change of the Secondary Successional Stages on the Temperate Grassland
S.-H. Seo, M. Yokozawa, M.-S. Lee, and J.-S. Lee

P22 Biogeophysical Factors Influencing Spatial and Temporal Variability of Soil Respiration at a Tropical Rain Forest in Peninsular Malaysia
S.Kanemitsu, Y.Kosugi, M.Itoh,and A. Nik

P23 Effect of Respiration Characteristics of Forest Compartments to NEP for a Warm Temperate Mixed Forest in Japan
Y. Kominami, M. Jomura, M. Dannoura, T. Miyama, M. Ataka, A. Matsumoto, and Y. Kanazawa

P24 Atmosphere-Soil Exchange of Trace Gases in a Deciduous Needle-Leaf Forest
Y. Takahashi and N. Liang

P25 Responses to Drought and Heavy Rainfall of Soil CO_2 Efflux between Stands of a Needle Fir and a Mongolian Oak
M.-S. Lee, J.-W. Koo, N.-J. Noh, J. Kim, and Y. Son

P26 Evaluation of CO_2 Flux from Leaf Litter Using Multilayer Litter Sample Method
M. Ataka, Y.Kominami, M. Jomura, and Y. Kanazawa

P27 Slow Decomposition of Organic Matter due to Excess Moisture in a Fallow Paddy Soil
K. Ono, M. Mano, G. Han, Y. Kobayashi, H. Nagai, T. Yamada, A. Miyata, and Y. Inoue

P28 Review on the Influence of Different Management on Soil Organic Carbon and Carbon Density of *Ledum-Larix Gmelinii* Forests
Withdraw
M. Zhou , L. Hai, C. Song, S. Wang, J. Wei, P. Zhao, and X. Yang

P29 Hydrologic Export of Particulate and Dissolved Organic Carbon from a Mountainous Forested Watershed: Importance of Summer Monsoon Rainfalls
J.-H. Park, K.-W. Jo, and H.-J. Lee

P30 Organic Carbon Sequestration and Discharge from Korean Natural Forest Catchment
S.-J. Kim, J. Kim, J. Yoo, and K. Kim

P31 Methane Emission from the Roots of Broad-Leaved Secondary Forest
T. Hashimoto, T. Miyama, Y. Kominami, and Y. Kanazawa

P32 Methane Concentration Profiles in Warm-Temperate Upland Forest of Central Japan
T. Miyama, T. Hashimoto, Y. Kominami, M. Okumura, K. Nakagawa, and S. Tohno

P33 Measurement of Methane Flux over a Larch Forest by a Relaxed Eddy Accumulation Method at Fuji-Hokuroku, Japan
W. Nishimura, K. Hamotani, M. Ueyama, Y. Takahashi, and N. Saigusa

P34 Isoprene Flux Measurement Using Relaxed Eddy Accumulation Technique in Japanese Oak Forest
K. Nakagawa, M. Okumura, T. Miyama, Y. Kominami, A. Tani, S. Tohno, and M. Yoneda

P35 Survey on Greenhouse Gas (Methane Gas) Emission of Upo Wetland
J.-A. Lee, H.-D. Kim, B.-Y. Lee, J.-M. Cho, and S.-W. Jung

P36 Methane Emission from Leaves in a Tropical Rain Forest and a Temperate Conifer Forest
R. Nakagawa, Y. Kosugi, and M. Itoh

P37 Fluxes of CH_4, N_2O and CO_2 from Paddy Soil with Different Nitrogen Application in Xishuangbanna, Southwest China
L. Sha , W. Wu, and G. Yang

P38 Comparative CO_2 Flux Measurement with an Rea Method and Open Path, Closed-Path Method in Fuji Hokurpoku, Japan
K. Hamotani, M. Ueyama, W. Nishimura, Y. Takahashi, R. Hirata, and N. Saigusa

P39 A Chamber System with Automatic Sliding Canopy Chamber for Continuously Measuring Net Ecosystem Productivity
S. Suh, G. Kim, and J. Lee

P40 Simultaneous Determination of Carbon Isotopic Signatures of CO_2 and Methane Exchanged Between the Paddy Ecosystem and the Atmosphere under Natural Conditions
G. Han, H. Yoshikoshi, H. Nagai, M. Mano, A. Miyata, and J. Kim

Poster Session III

Press Conference Hall (19F) **November 18, 2008 14:00 – 18:00**

P41 A Preliminary Study of Topographic Effect on Flux Measurement at the Chi-Lan Mountain Site in Taiwan
H.-S. Chu, N.-S. Liang, C.-W. Lai, C.-C. Wu, and Y.-J. Hsia

P42 Preliminary Study on Drainage Flow in a Sloping Forest Flux Site - Simulation Using CFD Method
Withdraw
J.-Y. Lin, H.-S. Chu, and Y.-J. Hsia

P43 Filling Data Gaps Using Look-Up Tables (LUT) at Chi-Lan Mountain Site: The Effect of Fog
C.-C. Wu, H.-S. Chu, and Y.-J. Hsia

P44 Gusty Wind Characteristics at Skyscraper Area
K.-S Lee, W. Jin, H. Zheng, and S.-H. Lee

P45 Characteristics of Soybean in Land Surface Modeling
J.-L. Tsai, B.-J. Tsuang, P.-H. Kuo, H.-Y. Lin, S. Verma, and T. Meyers

P46 AsiaFlux DB - A Vital Resource for Large Scale Studies and Collaboration
A. Ogawa, T. Hirano, R. Hirata, N. Saigusa, and B.-L. Lee

P47 A Non-Rectangular Hyperbola Model Simulating Long-Term Diurnal CO_2 Flux for Diverse Vegetation Types
M. Saito, S. Maksyutov, and R.Hirata

P48 A Comparison of Measured Energy, Water Vapor and CO_2 Fluxes Using Eddy Covariance Technique with Model Predictions for a Subtropical Forest in South China
Withdraw
J. Yan, G. Yu, X. Liu, L. Zhang, Y. Li, and G. Wang

P49 Sensitivity of Maximum LAI to Model Parameters in CLM-DGVM in Korean Climate Conditions
H.-J. Lim and Y.-H. Lee

P50 Comparing Different Global Models of Gross Primary Productivity
Y. Wang and N. Zhang

P51 The Lagrangian Stochastic Model for Estimating Flux Footprint over Inhomogeneous Surfaces
C.-I. Hsieh and G. Katul

P52 "Satellite Ecology (SATECO)" An Interdisciplinary Study for Evaluating Ecosystem Functions in a Mountainous Landscape in Takayama, Central Japan
H. Muraoka and H. Koizumi

P53 Estimating Wetness Index Using Evapotranspiration Derived from MODIS Products
K. Jang, S. Kang, H. Kwon, and J. Kim

P54 Evapotranspiration Climatology of South Korea Based on a Modified Hargreaves Equation and High Definition Digital Climate Maps
U. Chung, J. Kim, and J. Yun

P55 Estimation of Regional CO_2 Flux in Rice Paddy Field Using MODIS data
S. Kikkawa, T. Takimoto, T. Iwata, and S. Yamamoto

P56 Spatial Distribution of Flux Indices Related to Net Ecosystem Exchange Using Satellite Images of High Spatial Resolution
S.-K. Moon and J. Kim

P57 Simulating the Response of Subtropical Plantation Forest to Future Climate Change
Withdraw
M. Li, G.-R. Yu, X.-F. Wen, X.-M. Sun,and S.-S. Wang

P58 Factoring out of Interannual to Decadal Ecosystem Carbon Budget Using a Process-Based Model
A. Ito

Regional Report

OZFLUX, THE AUSTRALIAN FLUX AND ECOSYSTEM RESEARCH NETWORK

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OzFlux is a national network of flux sites that provides consistent observations at a number of key ecosystems or regional hubs (Fig. 1). The long term objective of OzFlux is to provide infrastructure essential to underpin Australia's contribution to global earth system science and to serve the land-surface and ecosystem modelling communities.

Observations obtained at these hubs are needed across time-scales from hours to decades: 1) to evaluate uncertainties in the performance of ecosystem and land surface models at key Australian ecosystems, 2) to provide parameter values for models, 3) to aid development and incorporation of better process representations in ecosystem and land surface models, 4) to develop a detailed understanding of the behavior and regulation of ecosystem function and processes, including the interaction of abiotic and biotic factors in landscape function, 5) to provide the critical flux data required for understanding local and regional water balances thereby enhancing our ability to manage landscapes for sustainable water yields. The global land-surface modelling community actively uses such data sets to test and improve their models.

A common set of core measurements and observations at each regional hub means that OzFlux is a truly national ecosystem research network providing data relevant to the wider ecosystem function and modelling communities and to those testing and developing land surface models. The measurements serve both management issues of local to regional scale plus providing data critical to continental scale climate-landscape interactions and feedbacks.

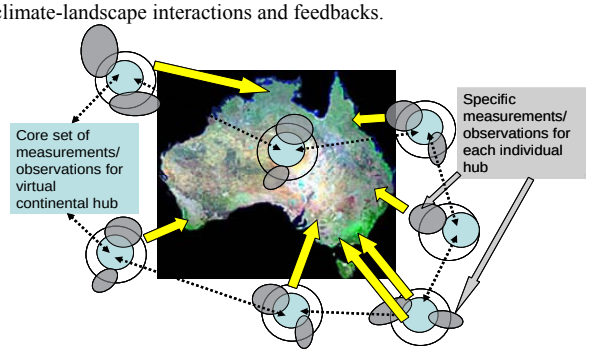

Fig. 1 Conceptual Australian terrestrial ecosystem research network. Core measurements and observations made to standard measurement protocols are shown in green, while 'constellation' measurements specific to each site are shown in gray.

ASIAFLUX – THE *AGORA* FOR RE-THINKING GLOBAL CHANGE SCIENCE

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This year AsiaFlux celebrates the 10th anniversary of science, service and stewardship. We have grown from a single country-dominated flux monitoring group in 1999 to a truly multi-national science community with a mission to bring Asia's ecosystem under observation. The AsiaFlux vision shared here is an ongoing process, and it is an invitation to re-think global change science. Why 'Re-thinking Global Change Science'? In Asia, due to rapid population and economic growth, a shortage of water and increasing emission of CO_2 are anticipated. Air pollution emissions containing aerosol particles in this region result in millions of annual deaths, decreased radiation and global dimming, altered atmospheric circulation, changed sea surface temperature, and altered regional rainfall, thereby leading to further climate change. Reaching a practical understanding of sustainability, dynamics, vulnerabilities and resilience of the complex socio-ecological systems in Asia will require a stronger push to advance trans-disciplinary scientific research with a clear vision.

Planning for the next decade, we have identified, refined, and documented our vision, i.e., to serve as the 'science frontier' in carbon, water and energy cycles in Asia by developing and transferring scientific knowledge characterized by *consilience*, *contextualization*, and *cultural diversity*. By 2011 we hope to (1) provide the report on the Asian carbon (and water) budget with its global perspective (which is an 'implication of knowledge') and (2) develop infrastructure for Asian carbon (and water) tracking system (which is an 'application of knowledge'). Reliable knowledge can become socially robust knowledge only if our society perceives the production process to be transparent and participative. In turn, this depends on a reciprocity in which the public understands how global change science works but, equally, global change science understands how the public works. Our vision will guide such an enhanced mutual understanding and we want to communicate and demonstrate it through this and future workshops.

Through the workshop, we attempt to provide opportunities to encounter these re-thinking processes such as changes in cultural boundaries and authority of global change science, its co-evolution with risk society, context-sensitive science, and the challenge of construction of narratives of expertise. These conceptual pillars guide us to enter a new community space, *agora*. (The *agora* was an open place of assembly in ancient Greek city-states, where citizens would gather for military duty, marketplace or to hear statements of the ruling king or council.) Accordingly, the present workshop is consisted of regular science sessions and parallel special sessions such as *HydroKorea*, *CarboEastAsia* and *ACTSociety*. These special sessions not only bring students, scientists, technologists, capitalists, entrepreneurs, diplomats, and policy-makers together, but help us cross cultural, disciplinary, geographic, and hierarchical boundaries. Welcome to the *AsiaFlux agora!*

FLUX OBSERVATIONS OVER DIVERSE TERRESTRIAL ECOSYSTEMS IN INDIA

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In the present climate change regime the scientific monitoring of biospheric CO_2 exchange from forests is imperative, considering that forests accounts for about 20% global CO2 emission. India with an area of 328 m ha comprises about 20% forests of its total area, which have an influence on local as well as global climate change. Efforts are underway to initiate and establish long-term and continuous carbon water and energy flux observation in the forests representing different biogeographical regions of the country.

The Government of India has chalked out an ambitious plan for installing flux towers in different ecosystems of the country, which in conjunction with remote sensing data are to be used for qualifying carbon and water flux exchanges over large geographic area of the country.

The eco-physiological measurements of these parameters in different forest types would facilitate spatio-temporal characterisation of mass and energy flow in such forest ecosystems and this inter-alia would provide scientific input for adopting suitable management imperatives assisting in development of appropriate policy framework.

ThaiFlux

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ThaiFlux is a network of flux observation sites in Thailand. There are currently 11 active observation sites in ThaiFlux network. These sites are located in natural forests, tree plantations and cultivated field crop plantations. The initial objectives of this network are (1) to promote collaboration among researchers (2) to promote information exchange, (3) to organize scientific meeting and workshop on flux studies, (4) to organize training courses on important scientific techniques, and (5) to attempt to find research fund.

Thailand has approximately 12.5 million hectare of forest. This represents approximately 25% of total land area in Thailand. Four observation sites have been set up to study fluxes in major types of forest. Kog-Ma watershed observation site was set up to study hydro-meteorology on hill evergreen forests which are wide spread throughout Southeast Asia in mountainous area at elevation higher than 1,000 m. Sakaerat observation site aimed to study CO_2, water vapor and heat exchange in dry evergreen forest. Maeklong observation site was established to study the meteorological and biological influence on CO_2 concentration and flux in the mixed deciduous forest. In 2008, an flux site began operation at the 3rd generation dry dipterocarp forest at Ratchaburi Province.

There are two existing observation sites in economically important tree plantations. One is located in a teak (*Tectona grandis*) plantation in Lampang province. The initial objectives of this site were to observe and to model the hydrologic cycle and energy fluxes. The other is located in a rubber (*Hevea brasilensis*) plantation in Chachoengsao province. The aims are to study carbon, water, and energy budget in the plantation ecosystem. Rubber plantation in Thailand now covers more than 2.5 million hectares.

There are four observation sites at three economically important field crops. Rice is the most important field crop in Thailand and its growing area exceeds 10 million hectares annually. One observation site is in rain-fed paddy field in Sukhothai province and the other site is in irrigated paddy field in Pitsanulok province. In addition, there is an observation site in a cassava field in Nakorn Ratchasima province. Cassava planning area averages more than 1 million hectares. The above mentioned sites in field crop plantations were established in the Global Energy and Water Cycle Experiment Project. The other observation site is in sugarcane plantation in Burirum province. The main objective is to study water flux in order to estimate total water use.

Finally, there is one observation site that monitors long term changes in CO_2, water vapor and energy fluxes due to land use change in Tak province.

All of observation sites in Thailand were established through extensive international collaborations with many scientists from Institutes and Agencies, mainly from Japan, Korea, France, and USA.

The information and analysis result from all 11 observation sites provides extensive knowledge of CO_2, water vapor, and energy fluxes of important ecosystems in Thailand. This knowledge has served as a basis for decision making and policy setting by several both government agencies and private sectors.

Oral Session

O01 ***Keynote Speech***

LESSONS LEARNED FROM A DECADE OF FLUX MEASUREMENTS ACROSS A GLOBAL NETWORK OF REGIONAL FLUXNETWORKS

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FLUXNET project brings together scientists from across the world (Asia, Europe, the Americas and Africa), who are measuring carbon dioxide, water vapor and energy fluxes between vegetation and the atmosphere, to collaborate and produce a value-added and integrated database. In concept-FLUXNET-starts with measurements of carbon, water and energy fluxes and meteorological variables being measured by individual groups sponsored by a constellation of regional networks. Data are submitted to a central database, they are checked for quality and gaps are filled with a variety of statistical methods. FLUXNET is responsible for producing and distributing a value-added database that consists of daily and annual integrals and averages of carbon, water and energy fluxes. In addition, these fluxes are manipulated to produce ecologically relevant variables. For example, net carbon fluxes are partitioned into components, like gross primary productivity and ecosystem respiration. The database also contains a cohort of site metadata variables including associated meteorological variables and site (plant and soil) meta-data. Viewed together, as an integrated database, one is able to query the database across time and space. Obviously, this database is becoming a 'treasure-trove' of information for divining how the biosphere 'breathes' and is poised to support a new generation of science questions and projects.

The first FLUXNET database was produced for the 2000 Marconi workshop. The Marconi dataset represented a limited number of plant functional groups and climate spaces, many of the records from individual sites were 3 years or less, and the data were accessed and manipulated as a collection of EXCEL spreadsheets and ascii files. Nevertheless, it has lead to a number of widely cited synthesis papers. In the meantime, limitations with this first database are widely recognized and are being rectified as the network continues to grow and the duration of data records of the original cohort of sites expands. For example, a new initiative was launched in the Fall of 2006 to produce a new, expanded and standardized FLUXNET database with evaluation of errors and flagging of high and low quality data. This activity was culminated by the LaThuile II Workshop in February 2007, where a new database was released. The new LaThuile database contains flux and meteorological information from over 250 sites and represents over 950 site years of data. Moreover, many sites in the network contain records exceeding 10 years in duration, giving us the opportunity to investigate issues relating to trends and interannual variability. Our current goal is to use this database to better understand how terrestrial ecosystems 'breathe' and how this breathing respond to a wide range in climate variables, plant functional types and ecological disturbance.

Tight correlations are being found between gross primary productivity and respiration, causing them to move in tandem with favorable and unfavorable conditions. Clusters of sites studying stand age, via chronosequences, are finding that old forests continue to be carbon sinks and that large amounts of carbon are lost with disturbance. Data are also proving to be useful for validating remote sensing algorithms and ecosystem models and producing new understanding of phenology. We are entering a new era where the network is becoming able to understand interannual variability.

O02

THE SEASONAL AND DIURNAL PATTERNS OF NET ECOSYSTEM CO_2 EXCHANGE IN A SUBTROPICAL MONTANE CLOUD FOREST

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CO_2 fluxes were measured by an open/closed path eddy covariance system at a natural regenerated 50-years-old yellow cypress (Chamaecyparis obtusa var. formosana) forest at Chi-Lan Mountain site (CLM site, 24°35'N, 121°25'E, 1650 m elevation), north-eastern Taiwan. CLM site is located at a relative uniform south-eastern-facing valley slope (15°) characterized with year round fog occurrence and diurnal mountain-valley wind and can be classified as subtropical montane cloud forest. Based on measurement from July 2007 to June 2008, seasonal and diurnal patterns of CO_2 fluxes were described and patterns under different cloudiness and foggy conditions were presented.

Comparing with other cypress forests in temperate region, there is only a weak seasonal pattern of the CO_2 fluxes at CLM site. Throughout the year, average incident photosynthetically active radiation in summer was almost the double of that in winter, whereas the difference of mean daytime CO_2 fluxes among seasons was much less than the seasonal light difference. During summer when light intensity was higher, mean daytime CO_2 fluxes reached -7.5 μmol/m^2/s in July and -8.8μmol/m^2/s in August. As heavy fog accounted for 64% and 67% of the time in November and February, mean daytime CO_2 fluxes dropped to -6.9 and -6.1μmol/m^2/s respectively.

With comparable higher incident radiation intensity (>1100μmol/m^2/s), the CO_2 fluxes were higher in overcast days than in clear days. In July 2007, clear days accounted for 30% of the month, light intensity reached its peak at midday, and however, CO_2 fluxes didn't show the same pattern. Canopy conductance calculated by the big leaf model (i.e., the Penman-Monteith equation) and measured latent heat fluxes both showed a midday depression at clear days, which indicated the regulation of transpiration by plant physiological mechanism even under favorable soil water condition. With lower incident radiation intensity (<1100μmol/m^2/s), the CO_2 fluxes were higher in overcast days than in foggy days. The difference suggested that water droplets deposited on leaves might partially block the pathway of the gas exchange through stomata as canopy immersed in the very humid air. However, CO_2 fluxes did not cease during foggy periods, which also supported by sap flow and leaf chamber measurements. In conclusion, the morphological characteristics of leaf or/and canopy structure could contribute to the well adaptability of this subtropical montane cloud forest for the humid environment.

O03

CARBON BUDGETS RESPONSES OF *LEYMUS CHINENSIS* GRASSLAND TO PRECIPITATIONS IN INNER MONGOLIA

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The components of carbon cycle in *Leymus chinensis* grassland under different precipitations were assessed, in terms of the collected data from published literatures from 1980 to 2006 and the field data in Inner Mongolia, including net primary productivity (NPP), above-ground net primary production (ANPP), below-ground net primary production (BNPP), above-ground biomass (AGB), below-ground biomass (BGB), the fluxes transferred from shoots and roots to soil, and soil respiration (Rs) consisted of root respiration (Rr) and soil heterotrophic respiration (Rh). The results showed that 1) Interannual ANPP was positively related to annual precipitation. ANPP were 237.64±75.91, 194.61±54.40 and 138.50±32.31 g $C{\cdot}m^{-2}{\cdot}a^{-1}$ in wet, mean and dry years, respectively. However, interannual BNPP, BGB/AGB and BNPP/NPP were significantly negatively related to annual precipitation. BNPP were 178.54±71.91, 267.43±90.07 and 330.69±149.59 g $C{\cdot}m^{-2}{\cdot}a^{-1}$ in wet, mean and dry years, respectively. BGB/AGB were 5.20±0.92, 9.58±2.09 and 16.47±6.33, and BNPP/NPP were 0.43±0.04, 0.57±0.05 and 0.67±0.13 in wet, mean and dry years, respectively. Annual carbon released by soil respiration were 486.87, 387.15 and 263.94 g $C{\cdot}m^{-2}{\cdot}a^{-1}$ in wet, mean and dry years, respectively. It seems that *Leymus chinensis* grassland was carbon sources in wet years, but was carbon sinks in both mean and dry years. 2) Below-ground biomass and above-ground biomass were not consistent in responding to interannual precipitation. Above-ground biomass was positively related to annual precipitation; however, below-ground biomass was in reverse. They also presented different patterns in responding to precipitation in temporal and regional scales in different areas. At regional scale, above and below ground biomass presented the same pattern in responding to annual precipitation, but in verse at temporal scale. 3) Biomass allocation patterns at temporal and regional scales were dissimilar in fenced *Leymus chinensis* grassland. At temporal scales, BNPP/NPP decreased concurrently with the augmentation of annual precipitation, and plant would allocate more biomass to below ground in dry years; however, pattern was different at regional scales, BNPP/NPP did not decrease along precipitation gradient from the east wettest end to the west driest end, and it was the highest in the wettest meadow steppe, the lowest in the typical steppe other than the presumed driest desert steppe.

O04

CARBON FLUX OF TYPICAL STEPPE ECOSYSTEM IN INNER MONGOLIA AND ITS ENVIRONMENTAL CONTROL

Withdraw

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

Long-term measurement of the CO_2 fluxes between the vegetation and the atmosphere has facilitated the research on carbon cycle in terrestrial ecosystems and its controlling mechanism. In this report, the characteristics of net ecosystem CO_2 exchange (NEE), gross ecosystem productivity (GEP) and ecosystem respiration (Re) and their environmental controls at different temporal scales were discussed, in terms of long-term eddy covariance measured CO_2 flux over a *Stipa krylovii* ecosystem in northern China. The results include:

(1) The diurnal variation of NEE is characterized by daytime carbon uptake and carbon release at night, asymmetry phenomena is observed. Seasonal variation of daily NEE is indirectly determined through the seasonal change of SWC, which is controlled by the seasonal distribution of precipitation. At daily scale, NEE is mainly controlled by temperature and SWC. NEE is mainly controlled by SWC at monthly scale. Annual carbon budget of *Stipa krylovii* ecosystem is 49, 68 and 41 $gCm^{-2}yr^{-1}$ in 2004、2005 and 2006, respectively.

(2) GEP, Re and NEE over a *Stipa krylovii* ecosystem have distinct seasonal variations. Magnitude of carbon fluxes is lower in winter or drought spells, higher in summer and wetter season. Drought stress restrained both GEP and Re, but the depression is stronger to GEP than to Re. as SWC decreased, accumulative NEE turned into positive.

(3) Air temperature (T) and soil water content (SWC) are key environmental factors which regulate the photosynthesis active radiation (PAR) – NEE curves. 10-20ºC is the optimum temperature for half-hourly GEP, 15-20ºC is the optimum temperature for daily GEP。Daily GEP increase with SWC at low range and keep relatively stable when SWC exceed $0.2m^3m^{-3}$. Ecosystem respiration (Re) is controlled by soil temperature and SWC at same time. Rain pulses stimulate the high Re in short-term. Lloyd & Taylor functions is better than exponential functions to describe the relationship between Re and soasgil temperature.

O05

UNCERTAINTY ANALYSIS OF CO_2 FLUX COMPONENTS AT ALPINE GRASSLAND OF TIBETAN PLATEAU

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With the unique characteristics of climatic change and its specific alpine grassland ecosystem,Tibetan plateau plays an important role in ecosystem carbon cycle. An accurate estimation of CO_2 flux components is the premise and foundation of ecosystem carbon cycle research, and an uncertainty assessment of the estimated results is necessary and has great significance for carbon cycle studies. In this paper, We present an uncertainty analysis of ecological process parameters and CO_2 flux components (GEE) derived from continuous eddy covariance measurements of CO_2 fluxes at 4 ChinaFLUX flux sites of Tibetan plateau in 2004, which are an alpine meadow(HBBT), an alpine shrub meadow(HBGC), a swamp alpine meadow(HBSD) and a steppe alpine meadow at Dongxiong(DX). Daily-differencing approach was used to analyze the random error of CO_2 fluxes measurements and bootstrapping method was used to quantify the uncertainties of CO_2 flux components. In addition, we evaluated different optimization methods in influencing estimation of key parameters and CO_2 flux components. The results show that: (1) Random flux error more closely follows a double-exponential (Laplace), rather than a normal (Gaussian) distribution. Across sites, variation in the random error follows consistent and robust patterns in relation to environment variables. The non-normal distribution and non-constant variance violate the assumptions that the error is Gaussian and homoscedatic for ordinary least square (OLS) optimization. (2) Different optimization methods result in different estimates of model parameters. Uncertainties of parameters estimated by MLE are lower than that derived from OLS. The relative uncertainty(RU) of the max photosynthetic efficiency in HBGC, HBSD, HBBT,DX are 8.28%, 13.50%, 6.65% and 21.62%.(3) The relative uncertainty of CO_2 flux components derived from OLS is higher than that from MLE .Furthermore, the uncertainty is related to timescale, the larger the timescale, the smaller the uncertainty.

O06 *Invited Speech*

IMPACT OF CLIMATE CHANGE AND WATER TABLE MANIPULATION ON ARCTIC ECOSYSTEMS: LESSONS FOR TROPICAL PEATLANDS

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Arctic and tropical peatlands have more in common than may at first be apparent. Both represent very large reservoirs of carbon in peat more than 191.8 Pg C as soil organic matter in the Arctic and more than 70 Pg C as soil organic matter in tropical peatlands. This peat in both locations has developed due to perched water tables maintaining high water content and low oxygen saturation near the surface. And, both systems are highly susceptible to human disturbance. In the Arctic, this is primarily through impacts of climate change. In tropical regions human impacts include both land use change and climate change.

Increasingly, carbon in Arctic peat is, or is at risk of, being released to the atmosphere as carbon dioxide (CO_2) (Oechel *et al*., 1993, 1994) and/or methane (CH_4) (Vourlitis and Oechel, 1993). However, predictions of future rates of release CO_2 and CH_4 flux, following changes in temperature, moisture, and other variables associated with climate change, are uncertain. Tropical peatland carbon is being released to the atmosphere at an unprecedented rate. This is due in large measure to forest clearing and drainage for agriculture and increased fire. Oxidation of peatland organic matter to CO_2 is responsible, in large measure, for Indonesia's ranking as the 3rd largest CO_2 emitter in the world after China and the U.S.

In order to predict with confidence future CO_2 and CH_4 releases to the atmosphere, it is necessary to understand the controls on net CO_2 and CH_4 fluxes. The patterns and controls on net ecosystem CO_2 and CH_4 fluxes in the Arctic are complex and non-linear. Warming and drying of the tundra can result in increased net CO_2 emissions from the Arctic to the atmosphere. However, areas that become warmer and remain wet, or become wetter, may be larger net emitters of CH_4 to the atmosphere. We believe that understanding and approaches developed in the Arctic in many cases can be applied to tropical peatlands.

Here we describe diurnal and seasonal CO_2 and CH_4 fluxes and evaluate controls on current and future CO_2 and CH_4 fluxes. Here we report the effect of primary environmental variables on CO_2 and CH_4 fluxes in the Alaskan Arctic at the Barrow Experimental Observatory at Barrow, Alaska. Presented are continuous measurements of CH_4 and CO_2 flux as affected by environmental variability and the large-scale manipulation of soil water table. Measurements are made at multiple scales by eddy flux towers and from flux aircraft.

According to our study, water table does not have a consistent impact on methane flux, and in certain conditions, a drop in water table causes an increase in methane efflux. This unexpected result is likely due to a lower physical resistance to methane emission from plant stem bases as water table approaches the surface. A further decrease in the water table depth, below the soil surface, resulted in decreased methane emission, presumably due to an increasing aerobic environment conducive to the activity of methanotrophs. There is an unexpected lack of a relationship between NEE and net CH_4 emissions.

Our observations made continuously over several months and over footprints of several thousands of m^2, appear helpful in ascertaining relationships not obvious from chamber measurements that tend to be discrete in time and space. Additional large scale continuous measurements, coupled with realistic large scale manipulations, may prove very helpful in further understanding the environmental controls on methane flux and could improve our ability to predict future methane release from the Arctic tundra. Also discussed is the use of a small flux aircraft, the SDSU Sky Arrow 650 RA, for large scale determination of the patterns and controls on CO_2 and CH_4 fluxes. This flux aircraft has proven invaluable in determining trace gas fluxes over hundreds of kms and correlating fluxes with land surface feature and remotely sensed information. This flux technology is also suitable for deployment on ocean going vessels, and is proposed for use on the Kupuas River of Indonesia.

O07

THE EFFECT OF CHANGES IN SOLAR RADIATION ON GROUND SURFACE WITH CLOUDINESS ON NET ECOSYSTEM EXCHANGE OF CARBON DIOXIDE OF TWO FOREST ECOSYSTEMS IN CHINA

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As an important environmental factor, solar radiation drives the photosynthesis of forest ecosystem. When there is cloud in sky, solar radiation, diffuse radiation and direct radiation on ground surface can be changed, and other environmental factors that affect photosynthesis and respiration of forest ecosystem, such as temperature, vapour press deficit can be changed as well, these would affect the net ecosystem exchange (NEE) of carbon dioxide of forest ecosystem.

In this study, we analyzed the responses of NEE to changes in solar radiation on the ground with cloudiness in Changbaishan temperate mixed forest (CBS) and in Dinghushan subtropical evergreen broadleaf conifer mixed forest (DHS) in China, based on 30min flux data and routine meteorology data in June-August from 2003 to 2006. We chose Clearness Index (k_t) to quantify the effect of cloud cover, cloud shape and cloud thickness on solar radiation on the ground.

The results showed, (1) when the sky was moderately cloudy, that was moderate intensity of solar radiation on the ground, k_t was between 0.4 and 0.6, NEE of the two ecosystems reached its maximum, when k_t exceeded 0.6, the sky became more clear, the radiation was more intensive, the NEE decreased obviously in CBS, but did not decrease obviously in DHS. (2) Response of NEE of the two forest ecosystems to photosynthetically active radiation (PAR) was different on cloud days and on clear days. In CBS, the light-saturated maximum photosynthetic rate ($P_{ec,max}$) was enhanced 34%, 25%, 4% and 11% on cloud days compared with clear days from 2003 to 2006, respectively, but $P_{ec,max}$ did not improved obviously on cloud days compared with those on clear days in DHS. (3) In the two ecosystems, when the sky changed from clear to cloudy, the diffuse PAR could increase, and it reached its maximum with the values of k_t was about 0.5 at which the NEE reached the maximum, therefore the increase of diffuse PAR could be one of reasons that promoted the NEE. We also found the gross ecosystem photosynthesis (GEP) of the two ecosystems increased linearly with diffuse PAR, and the GEP increased more obviously with increased diffuse PAR in CBS than in DHS. Furthermore, the enhancement of canopy assimilation and the decrease of respiration above ground, which resulted from the decrease in air temperature and vapour pressure deficit with a certain increase of cloudiness, were more intensive in CBS than in DHS.

These results indicated that the moderate intensity in solar radiation and increase in diffuse radiation above ground because of the increase of cloudiness was more benefit to temperate forest ecosystem rather than subtropical forest ecosystem in China. The significance of this study is to help us to uncover the different responses of the NEE to the changes in cloudiness in different forests in China, which due to the climate change in the future.

O08

QUALITY CONTROL OF FIELD MEASUREMENTS AND CLIMATE DATA ANALYSES

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Awareness of climate change in science and policy-maker communities has increased interest in using regional and global observation networks including surface climate monitoring networks and ecosystem exchange networks. The climate science community should be aware of long-term implications as instrumentation and monitoring techniques advance. Changes in instrumentation technology, long-term drift of instruments, siting exposures, observation practices, and data processing algorithms should be taken into account to improve the long-term comparability of measurements. In this presentation, we will address our understanding of fundamental principles of quality control applied to recommendations concerning instrumentation changes and operation in flux monitoring networks. We will also discuss some lessons and experiences learned from U.S. long-term surface climate monitoring networks.

O09

CARBON STORAGE OF BAMBOO FOREST ECOSYSTEM IN CHINA

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In recent years, greenhouse effect which was caused by more and more CO_2 emissions did a lot of harm to our living environment. In that case, many scientists focused on studying distribution and trends and mechanism of global carbon sinks and sources. Forest ecosystem played an important role in the terrestrial ecosystem carbon cycling. Since forest area was decreasing sharply year after year all over the world, bamboo forest area was increasing by 3 percent each year; it means the bamboo forest carbon sink will be larger and larger. Bamboos species in China were the richest one in the world. And that bamboo area, volume and its wood in China were all rank as the first. Natural bamboo forests in China widely distributed in 19 provinces, and they were in central in subtropical mountain region. Therefore it is important, necessary and urgent to study bamboo forest carbon storage intensively. National forest inventory materials and data from China Forest Ecosystem Location Research Network (CFERN) were obtained for estimating four periods of carbon storage of Bamboo forest ecosystem from 1977 to 2003 in China. The spatial and temporal patterns, vertical distribution and potential carbon storage of the bamboo forest ecosystem were analyzed. The results showed that carbon storage of Chinese bamboo forest ecosystem was 537.6Mt C during 1977 and 1981, 598.61Mt C during 1984 and 1988, 710.14Mt C during 1994 and 1998, and 837.92Mt C during 1999 and 2003. The growth rate of 1984-1988, 1994-1998, and 1999-2003 were 11, 19 and 18 percent respectively. It kept increasing continuously. There were 61.01Mt carbons were fixed in bamboo forest ecosystem during 1984 and 1988, with a rate of 7.63Mt each year; 111.53Mt carbons from1994 to 1998, with a rate of 10.14Mt each year; 127.78Mt carbons from1999 to 2003, with a rate of 21.3Mt each year. The results indicated that the bamboo forests were carbon sinks in China during 1977 and 2003.Zhejiang, Jiangxi, Fujian, Hunan, Guangdong and Sichuan were the major carbon pools in China, with the percentages of carbon storage between 80.04 and 83.13 percent in all. Carbon storage of bamboo forest ecosystem in vegetation were between 131.63and 199.81Mt C from 1977 to 2003 in China, and the percentage of bamboo forest ecosystem carbon storage were between 23.85 and 24.48 percent; in litter were between 5.15 and 7.75 Mt C, and the percentage were from 0.92 to 0.96 percent; in soil were between 400.82 and 630.36Mt C, and the percentage were from 74.56 to 75.23 percent. Therefore, it was concluded that the carbon storage in different layers were similar vertically. Compared with vegetation, soil and litter carbon storage in Chinese forest ecosystem, vegetation, soil and litter carbon storage of bamboo forest ecosystem took up 2.77, 2.53 and 0.76 percent respectively. It was summarized that bamboo forest fixed more and more carbons in vegetation layer. Carbon storage of bamboo forest ecosystem was 837.92Mt C during 1999 and 2003 in China. It will be 947.54Mt C after one age period (two years). There were 207.56 Mt carbons in vegetation and litter and will be 312.3Mt C after one age period; 630.36Mt C in soil, and 635.25Mt C after one age period. The carbon storage in bamboo forest ecosystem will increase by 54.81Mt C each year. The growth rate of vegetation and soil were 56.25Mt C and 2.44Mt C every year respectively. The forest carbon storage in vegetation increased by a rate of 26.5Mt C every year during 1977 and 1993 in China; the growth rate of bamboo forest in vegetation from 1999 to 2003 was higher than that of other forest in China. Forest carbon storage in vegetation was 3.7 Gt C during 1989 and 1993 in China, and the potential carbon storage was 8.4Gt C. The potential carbon storage was as 2.26 times as the current carbon storage. Bamboo forest potential carbon storage in vegetation was as 1.56 times as the current carbon storage from 1999 to 2003.Bamboo grew fast before the first two years. Therefore, the carbon storage of bamboo forest in vegetation increased more slowly when they grew up.

O10

PLANTS IMPROVE METHANE UPTAKE BY A WINTER WHEAT FIELD

Withdraw

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It is well known that plants play an important role on methane (CH_4) emission from rice paddy and wetland ecosystems. But the effect of plants on CH_4 uptake in the upland was always neglected. To investigate the problem, CH_4 fluxes were measured using the close chamber method during main growing seasons (March-early June) in a winter wheat field. There were three treatments in the experiment: (A) plant and soil covered by the transparent chamber; (B) plant and soil covered by the opaque chamber; and (C) soil covered by the small opaque chamber. Each treatment had three replications. The base frames of chambers were inserted into the soil at a depth of 10cm. For treatment C, it means there were no living roots in the soil at top 10cm, which is the main layer for soil CH_4 oxidation. In 2003 and 2004, the observations were done just after base frames installed. Seasonal mean CH_4 fluxes were from -22.8 to -23.0, from -11.3 to -28.0 and from -12.9 to -19.5 for treatment A, B and C, respectively. No obvious difference could be found on CH_4 uptake between treatments. In 2005 and 2006, the observations were done six months after base frames installed. Seasonal mean CH_4 fluxes were from -22.3 to -23.2, from -13.9 to -16.9 and from -4.1 to -9.1 for treatment A, B and C, separately. The difference between treatment A and C was significant ($p<0.05$) while other differences were unremarkable.

No diurnal pattern of CH_4 flux could be found for treatments A and C. Affected by precipitation and irrigation, soil moisture changed obviously and led to large seasonal variations of CH_4 fluxes in the wheat field, especially for treatment A and B. Nevertheless, no prominent relationship could be found between monthly CH_4 uptake rate and soil moisture for all treatments. During four year observations, no obvious difference could be found between seasonal mean CH_4 flux for treatment A and B. The influence of light on CH_4 flux was unapparent at seasonal scale while it was significant at monthly scale. Monthly CH_4 uptake rates for both treatment A and B increased linearly with enhancing temperature. However, only that for treatment A augmented when LAI enlarged. For treatment C, the responses of monthly CH_4 uptake rate to all factors above were unremarkable.

The results indicated that CH_4 uptake in the wheat field might be greatly improved by plants, especially in the daytime. Both roots and plant canopy may affect field CH_4 absorption significantly. It is implied that CH_4 uptake in the upland covered with vegetations may be largely underestimated by traditional opaque chamber-based measurements for soils only.

O11

QUALITY CONTROL OF LARGE SETS OF SOIL CO_2 EFFLUX TIME SERIES DATA

Withdraw

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The diffusion of CO_2 from the soil, and respiration processes that drive it, can vary substantially in space and time. Multiplexed soil CO_2 efflux measuring systems can record data more or less continuously from multiple chambers on an on-going basis, generating very large data sets that can be difficult to manage and evaluate. We discuss the quality of soil CO_2 efflux (F_c) data at three different levels. First, we recognize that diffusion of CO_2 across the soil atmosphere boundary is driven by diffusion, and demonstrate that this has important implications for how we calculate the flux. Linear regression systematically under-estimates the flux, and we show this under-estimation can be negligible (5% or less) or large (20% or more) depending upon soil type, even among replications at a single site. Second, we illustrate a robust method for efficiently screening out artifacts from the large sets of time series data that are necessary to compute soil CO_2 fluxes from multiple chambers over seasonal time scales. This is based primarily upon systematic evaluation of raw sensor measurements, not on statistical evaluation of apparent "outliers" in the final flux calculations. Third, we use results from a multiplexed soil CO_2 efflux system deployed over the entire growing season in a soybean field near Mead, Nebraska in 2007 to demonstrate how apparent outliers can be due to important and unexpected responses to an environmental driver.

Soil CO_2 efflux was continuously monitored using an automated soil CO_2 efflux system with 16 chambers (LI-COR LI-8100 Soil CO_2 Flux System with LI-8150 Multiplexer). Chambers were deployed on a deep silty clay loam soil in the soybean phase of a corn-soybean rotation under no-till management. CO_2 efflux from the soil surface was monitored continuously from planting until harvest. A heavy rain occurred on June 13 after a period of warm temperatures and low rainfall. One hour prior to the rainfall event, F_c was 2.23 ± 0.49 (sd) µmol m^{-2} s^{-1} (n=16), while one to two hours later the mean nearly doubled and the standard deviation increased 5 fold to 4.08 ± 2.76 µmol m^{-2} s^{-1}. During and after the rain event, fluxes from five chambers dropped to near zero, while fluxes from several other chambers increased by a factor of 3 to 4. Responses of the remaining chambers were intermediate between these extremes. When we first observed this apparently bizarre behavior we thought it was due to some kind of system failure. Subsequent analysis showed that the large increase in variance was due to a very different impact of rain on actual CO_2 efflux from the soil compared to respiration processes in the surface litter. Chamber collars with little or no surface litter showed dramatically reduced F_c for about two days after the rain, followed by near 2-fold increases as the soil dried. By contrast, in greenhouse experiments, we found that adding water to dry surface litter that had been collected from the field site caused immediate and dramatic increases in F_c. These observations have important implications (1) for how we operate CO_2 efflux systems, (2) how we interpret unexpected outliers, and (3) how we define carbon pools and moisture responses of "soil respiration" in models.

O12 *Keynote Speech*

LAND SURFACE MODELS AND THE GLOBAL FLUXNET DATASET

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The global Fluxnet dataset offers an unprecedented opportunity to evaluate various land surface schemes (LSMs) currently used in Global Climate Models. Fig. 1 shows a typical LSM describing the exchanges of mass and energy between terrestrial ecosystems and the atmosphere and between various carbon, water and nutrient pools.

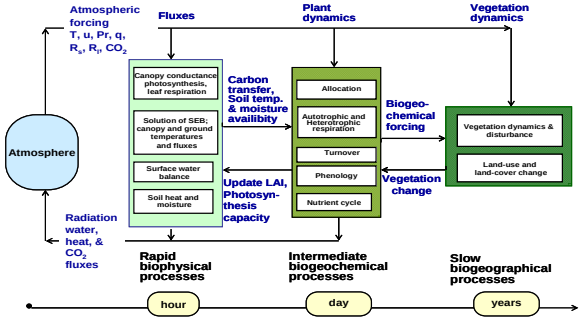

Fig. 1. Schematic diagram of a typical LSM showing processes modelled at hourly, daily and annual-decadal time scales. The LSM can be applied at local, catchment, regional and global spatial scales.

The LSM is used to map climatological and other inputs (e.g., leaf area index, soil types) into outputs, usually fluxes of heat, water and carbon, as well as state variables such as soil water storage and the stocks of carbon in soil and vegetation. Data from the global Fluxnet are vital to assess the performance of using local-scale observations. Inevitably, the LSM will be unable to match observations at all times and places, usually because of systematic bias in the model resulting from deficiencies in its mechanistic structure and/or because of incorrect choice of empirical parameters. Most land surface schemes used in GCMs use lookup tables to assign parameter values for various plant functional types (PFTs), with the implicit null hypothesis that there is little variation in parameter values within PFTs.

From a systems point of view, a model consists of the seven components shown in Fig. 2. At the local scale, the system boundary *B* equals the flux station footprint. Fluxnet data provide the forcing inputs and outputs. Inverse analysis is used to estimate model parameters and model states for a given model structure. Fluxnet data are most useful at the hourly to annual timescales.

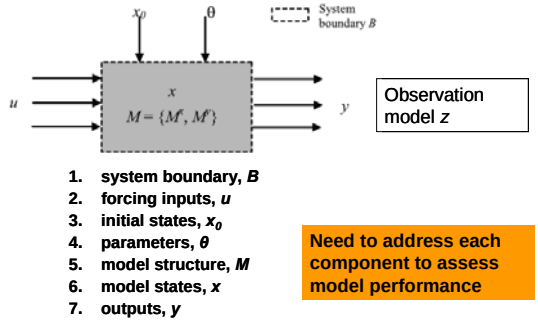

Fig. 2. Systems representation of a typical model, consisting of a boundary, forcing inputs, initial states, model parameters, model states and outputs. Observations *z* are compared to model outputs *y* to evaluate model performance.

The objective of the modeller is to reduce or remove the biases in the model and to select the optimal parameter sets for each process represented in the model. The paper will outline four stages in a systematic approach to achieving these goals:

1) Develop a statistical benchmark to test the extent the LSM utilizes the input information when predicting flux outputs.

2) Separately assess model bias (due to its mechanistic structure) and model error (due to its empirical parameter set).

3) Test whether model bias and model error differ for various plant functional types.

4) Use knowledge gained from (3) to improve key processes in a major LSM's by a) doing detective work on the biophysical formulations or b) better estimate the model parameter space by use of the Fluxnet synthesis dataset.

O13 ***Invited Speech***

REGIONAL ESTIMATION OF CO_2 BUDGET USING MODIS-VISIBLE BANDS: APPLICATION TO AN ARCTIC TUNDRA

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NDVI (Normalized Difference of Vegetation Index) has been employed to estimate the carbon budget remotely (e.g. Kimball *et al*., 2006; Gamon *et al*., 1993; Stow *et al*., 2004). However, the application of MODIS-NDVI to agricultural crops (Turner *et al*., 2006) and the boreal forest (Xiao *et al*., 2004) provided insufficient results, and also provided a confusing unclear seasonality regarding a tundra ecosystem in the Arctic (Harazono *et al*., 2007). Instead of NDVI, visible bands have been applied as a ground-base remote-sensing and have succeeded in detecting vegetation phenology (Richardson *et al*., 2007). However, the visible bands of satellites have seldom been applied to estimation of the terrestrial carbon budget. We introduced a new index, the simple greenery ratio GR =G/(R+G+B) of visible bands, to estimate gross primary production (GPP) remotely, where R, G and B are spectrum-strengths of red, green and blue, respectively. We examined the applicability of GR to estimate GPP for wet tundra in the Arctic by using the empirical relationship between tundra GR and observed tower-based CO_2 fluxes.

The seasonal trend of GR derived from MYD9 for the flux observation site pixel followed the seasonal changes of measured LAI and NEE. The relationship between GR and measured GPP showed reliable linearity, in which the coefficients for both 2005 and 06 were similar. Thus, we state that GR is a better index to estimate GPP remotely for wet tundra in the Arctic. Ecosystem respiration (Re) was related to LST derived from MOD11 by applying observed soil temperature (Ts) at the site.

GR-GPP and LST-Ts relationships (the empirical MODIS model) were applied to MODIS data of the site pixel, and calculated GPP and Re were reproduced well for both 2005 and 2006. The NEE was defined as the balance of GPP and Re. The seasonal trends and accumulations during the observation periods of estimated GPP, Re and NEE agreed with observed CO_2 fluxes. The ratios of estimated to observed GPP, Re and NEE were 104, 90, and 104% for 2005, and 111, 117, and 106% for 2006, respectively. Although Re and GPP were over-estimations in 2006, estimated NEE were reasonably reproduced.

As the empirical MODIS model was verified for the tower site case, we extended the application to estimate the entire regional CO_2 budget over wet tundra on the North Slope of Alaska. Scaling up was conducted for wet tundra pixels of about a 220x180 km-square area around Barrow. High GPP parts shifted from southeast to northwest during the growing season, and the highly productive area was distributed almost entirely in the high elevation area above around 30 m above sea level, while the low GPP part was distributed over the northern lowland. The cumulative GPP was high at the upland area. Accumulated GPP, Re and NEE at the highlands during each growing season were 1190, 585, and -605 $gCO_2\ m^{-2}$ season-1 in 2005, and 1540, 574, and -966 gCO_2 m-2 season-1 in 2006, respectively. Temperatures at the highlands during the growing periods were 1.2 oC higher in 2006 than 2005, resulting in a longer growing season.

The analysis of the regional CO_2 budget estimation over two years and three different areas revealed that the distribution and the seasonality of the CO_2 budget of the arctic wet tundra were affected by yearly differences in temperature and precipitation. This suggests that drought conditions enhance CO_2 source strength and warm and wet conditions enhance a CO_2 sink. The arctic wet tundra is vulnerable to climate change.

Oral Session

O14

PHENOLOGICAL EYES NETWORK: LONG-TERM GROUND VALIDATION OF SATELLITE REMOTE SENSING OF ECOSYSTEMS

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Satellite remote sensing (RS) is a powerful tool for the study of terrestrial ecosystems. For example, scaling up of the ground measurements of carbon flux, water flux, biomass, etc. from a site scale to a regional or global scale is often carried out with RS. Furthermore, information provided by RS is utilized in setting the initial condition or making validation of numerical regional ecological models. For the sake of it, various new satellite sensors are now delivering a lot of high-level products regarding to the terrestrial ecosystems, such as new vegetation indices, LAI, FPAR, phenology, GPP, and NPP.

However, in the ecological standpoint, these RS methodology has not enough checked on the ground level. Because an essential characteristics of an ecosystem is its dynamics (especially the seasonal change, or "phenology"), the accuracy, quality, and interpretation of the RS data should be also studied dynamically. For the sake of it, a stable, continuous, long-term, and multi-ecosystem ground validation network is desired. We believe that the ecological interpretation of RS data is possible only if it is based on a careful theoretical and experimental study of the relationships between optical characteristics, using the quality-controlled RS data considering the relevant noise factors such as cloud contamination or atmospheric aerosols.

With this background stated above, the "Phenological Eyes Network (PEN)" started. It is a network of the ground observatory for long-term automatic observation of the vegetation dynamics (phenology), vegetation's optical properties (such as spectral reflectance), and the atmospheric optical properties (such as aerosol optical thickness). Most PEN ground sites have been set up at the AsiaFlux sites. The collaboration of PEN and AsiaFlux is critically impotrant in the interpretation of the optical signals captured by RS in terms of ecology (especially the terrestrial carbon/water cycles).

Because the goal of PEN is to take long-term quality-controlled multi-site observation, the main instruments should be stable, robust, and low-cost. Based on this principle, we selected and designed the following three instruments: the Automatic-capturing Digital Fisheye Camera (ADFC), the HemiSpherical Spectro-Radiometer (HSSR), and the sunphotometer (SP).

ADFC captures images of the sky, the canopy from above and below, the forest floor, and shoots of typical species with short intervals (2 minutes to 3 hours, depending on the target). These images provides information about cloud condition at the satellite's observation, vegetation phenology, snow pack, tree cover, and LAI.

HSSR is a hyper-spectral radiometer which observes the spectral feature of the vegetation canopy with fine-temporal and fine-spectral resolution. By using such data, we can check the spectral observation of RS. Moreover, we can simulate various types of spectral indices (such as NDVI, EVI, PRI) with arbitrary spectral response of every specific satellite sensors.

SP is a spectral radiometer with small field-of-view and pointing functionality for estimation of the optical properties of the atmosphere which are critical for atmospheric correction of the RS data. It can provide quantitative information about atmospheric pollution or aerosol dust (such as the Yellow Sands), both of which may have some direct and indirect impact on the ecosystems.

Most data taken by these sites have been stored in a database on the PEN's data server. The original data are open to the PEN community member (anybody can join if she/he wants) and the summary or edited data are open to the public. If you are interested in the PEN data or PEN's activity, please visit the following website and contact us: www.pheno-eye.org

O15

TIBETAN OBSERVATION AND RESEARCH PLATFORM (TORP): A NEW BASE FOR THE STUDY OF FLUXES EXCHANGE OVER THE TIBETAN PLATEAU

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The Tibetan Plateau, with the most prominent and complicated terrain on the globe and an elevation of more than 4000 *m* on average above sea leave (*msl*), is often called the "Third Pole" due to its significance parallel with Antarctica and the Arctic. As a unique geological and geographical unit, the Tibetan Plateau dramatically impacts the world's environment and especially controls climatic and environmental changes in China, Asia and even in the Northern Hemisphere. Tibetan Plateau, therefore, provides a field laboratory for studying global change. Supported by Ministry of Science and Technology of People's Republic of China, Chinese Academy of Sciences, China Meteorological Administration, Ministry of Education of People's Republic of China, Tibetan Autonomous Region of China, and State Forest Administration, People's Republic of China, a Tibetan Observation and Research Platform (TORP) is now implementing. Firstly the background of the establishment of the TORP, the establishing and monitoring plan of long-term scale (5-10 years) of the TORP and three comprehensive observation and study stations (Mt. Qomolangma-Mt.Everest Station, Nam Co Station and Linzhi Station) will be introduced. Then the preliminary observational analysis results, such as the characteristics of land surface heat fluxes and CO_2 flux partitioning ("imbalance", diurnal variation, inter-monthly variation, inter-yearly variation and vertical variation etc), air temperature, pressure, air humidity, wind speed and wind direction, the structure of the Atmospheric Boundary Layer (ABL) will also been shown.

O16

$CH_4MOD_{wetland}$ – A MODEL FOR SIMULATING METHANE EMISSION FROM NATURAL WETLAND

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Wetlands are one of the most important sources of atmospheric CH_4, but the strength of this source is still highly uncertain. To improve estimating CH_4 emission at the regional and global scales and predict future variation requires a process-based model. With an understanding of CH_4 production, oxidation and emission in natural wetland, a process-based model has been developed based on a CH_4 emission model in rice paddies named CH4MOD. In this paper, modification to the original model focused on the substrate for CH_4 production derived from plant litters and the soil organic matter, the vegetation growth and the redox potential change due to standing water depth. The modified model named $CH4MOD_{wetland}$ was then validated against observations from China's two main natural wetlands including four microsites with different vegetation types. One is in Sanjiang Plain (47º35'N, 133º31'E; 56m above sea level), Heilongjiang Province. The other is in Ruoergan Plateau (32º47'N, 102º32'E; 3470m above sea level), Sichuan Province. The observed seasonal amount of CH_4 emission ranged from 9.2 to 61.3 g m^{-2} with an average of 30.0±20.4 g m^{-2}. In consonance with the observations, model simulations resulted in an average value of 28.26 ±21.69 g m^{-2}, ranging from 10.67 to 59.67 g m^{-2}. Comparison between the computed and the observed total amount of seasonal CH_4 emission yielded a correlation coefficient r^2 of 0.97 with a slop of 1.05 and an intercept of -3.13($n=7$, $p<0.0001$). It was concluded that the $CH4MOD_{wetland}$ can reasonably simulate CH_4 emissions from natural wetland with a minimal number of inputs and parameters. Sensitivity analysis showed that the response of climatic and edaphic factors to CH_4 emission depends upon the combination of air temperature and water table position levels.

O17

TEMPORAL AND SPATIAL VARIABILITY OF SOIL RESPIRATION AMONG FOREST ECOSYSTEMS IN CHINA - CONTROLLING FACTORS AND QUANTITATIVE EVALUATION MODEL

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Soil respiration (R_s) from 50 different forest ecosystems in China were summarized and analyzed with the goal to develop a simple model describing the temporal and spatial variability of R_s. The results showed that mean annual air temperature and precipitation both were correlated weakly with annual R_s, but most strongly with the soil carbon turnover rate. Furthermore, R_s at the reference temperature of 0 ℃ was only significantly positively correlated with soil organic carbon density at the depth of 20 cm. The mean monthly soil respiration ($R_{s,monthly}$) among different forests all increased exponentially and hyperbolically with monthly air temperature and precipitation, respectively. At a monthly scale, we tested a monthly-scale R_s model (TP model) that globally predicts $R_{s,monthly}$ from monthly air temperature and precipitation. Regardless of whether the original or a new optimized model parameterization (TP2 model), these two models were only able to explain the month-to-month variability of $R_{s,monthly}$ no more than 35% and failed to capture the intersite variability. However, the residuals were strongly correlated with soil organic carbon density at the depth of 20 cm. Thus, we suggested a simple TPS model that includes soil organic carbon density as an additional predictor of R_s. The TPS model explained month-to-month and intersite variability for 56% and 25%, respectively. Moreover, the simulated annual R_s with TPS model was significantly related to measured value. That the three driver variables included in the TPS model were easy to obtain provides the potential for applying it to R_s evaluation at regional scale.

O18

THE TOPOGRAPHIC EFFECT ON THE DISTRIBUTION OF POTENTIAL SURFACE SOLAR RADIATION

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Solar radiation is the main energy source for the ecological system. It affects and controls the distribution of vegetation and is thus often viewed as one of the major variables in ecological studies. The drastic terrestrial changes in Taiwan's mountain regions have enormous influences on the shading effect of solar radiation, yet many researchers often hypothesize that their research areas are flat and non-defiladed, ignoring the possible shading caused by nearby landscapes on solar radiation. This study firstly utilized a NASA/CLIRAD-SW radiation transfer model to conduct an atmospherically light-reducing calculation by using the monthly cross-sectional atmospheric data gathered via the balloon sounding in five sounding stations in Taiwan. A digital terrain model was used to correct the shading effect and finally to estimate the potential solar radiation that reached the surface of Taiwan. The findings indicated that elevation, slope, aspect, shade, and the length correction of sloped surface were all valid terrestrial factors that influenced the amount of solar radiation, and their integrated effects were greater than the astronomical and the geographical latitude factor at some cases. The above-mentioned terrestrial factors should be especially taken into account when the research grid size was smaller than 5Km. Besides, during May to July, the northward potential solar radiation was greater than the southward counterpart, which was a phenomenon often neglected in the related research in Taiwan.

O19

ROUGHNESS LENGTH'S EFFECTS ON FLUXES SIMULATION AND ITS DETERMINATION METHODS

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Many parameters would result in fluxes simulation uncertainties, of which roughness length (z_0) is an important one. We have known that z_0 varies with wind speed, atmospheric stratification, terrain and other factors. But in fluxes simulation models, z_0 is still considered as a constant or only with slightly seasonal variations. To simulate fluxes accurately, effects of z_0 dynamic on fluxes simulation and how to determine z_0 accurately deserve more attentions.

Effects of z_0 on sensible and latent heat flux are analyzed with commonly used models in Qianyanzhou (QYZ) and Changbai Mountain (CBS) Experimental Station. The results indicated that in the two ecosystem, mean annual of z_0 is much lower than $0.136h$, which is generally used in fluxes simulation models, and z_0 has the characteristic of daily variation except for seasonal variation. Annual error of sensible heat flux caused by z_0 in QYZ and CBS is 16.0% and 24.3%, and that of latent heat flux is 46.0% and 66.8%, respectively. There are also uncertainties in calculating daily variation of sensible and latent heat fluxes due to z_0 daily variations. With FSAM model, influence of z_0 spatial representative of fluxes is analyzed, and the result indicated that z_0 plays an important role in determining the spatial scope of fluxes.

z_0 is the comprehensive results of rough elements' geometric roughness within the fetch, and it plays an important role in fluxes simulation. How can it be determined accurately? As for a site scale, z_0 can be calculated with traditional least-square method using wind speed and temperature in several levels over the canopy, and it can also be calculated by eddy covariance data with statistic methods. The result testified that z_0 calculated with wind speed and temperature profiles is more accurate. As for a regional scale, z_0 can be calculated by leaf area index and vegetation height or vegetation types.

In conclusion, fluxes simulation uncertainties caused by z_0 should not be neglected, and with meteorological or eddy covariance data, it can be determined accurately at a local scale.

O20

ESTIMATION OF NET ECOSYSTEM EXCHANGE (NEE) IN SOUTH KOREA

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A method has been developed to estimate net ecosystem exchange (NEE) over South Korea at 8-km resolution. In this method, gross primary production (GPP) is estimated from model simulation and ecosystem respirations are estimated using empirical formulations developed in South Korea. The mSPA (modified Soil Plant

Atmosphere) model has been used for simulation of GPP. The model is a process based model with two-canopy layer and use a 30min integration scheme to implement a leaf-level photosynthesis. Two key driving variables, leaf area index and land cover type are derived from satellite measurements of Moderate Resolution Imaging Spectroradiometer (MODIS). Hourly observed meteorological data at 70 stations have been used as input data. The model outputs are compared with ground plot data measured at two KoFlux sites (Haenam and Kwangrung) to ensure that no significant systematic biases are created. Also spatial distribution of model GPP are compared with that of MODIS GPP and comparison results are discussed.

The spatial distribution of estimated GPP follows the pattern of maximum LAI except for elevated areas where air temperature is relatively low. Agricultural areas show relatively low GPP due to short growing season and low LAI in spite of large maximum carboxylation rate of crop. The spatial distribution of ecosystem respiration is dependent on the elevation showing low respiration in elevated areas. The spatial distributions of estimated GPP, ecosystem respiration and NEE are presented and uncertainties of estimates are discussed.

O21

EVALUATION OF ECO-PHYSIOLOGICAL MODEL FOR DETERMINATION OF NET PRIMARY PRODUCTION IN TROPICAL AREA USING ASTER DATA

Withdraw

M. Faidi, A. Ibrahim, and W. Rasib

Abreast with the development of industrial activity, composition of greenhouse gases also increase. Carbon dioxide (CO_2) is the main contributor of greenhouse gases revenue from human activity. Uncontrolled CO_2 composition in the atmosphere would contribute to the global warming problem. Earth natural ecosystems adapt this problem with act as a medium that absorb CO_2 from the atmosphere indirectly maintain the stability of carbon cycle. Carbon uptake by plant can be projected and measures either in the form of biomass or CO_2 exchange based on estimation of Net Primary Production (NPP). Eco-Physiological Model is one of the methods for estimating NPP uses remote sensing data, based on the modelling of plant physical environment sensitivity parameters. ASTER data is the remote sensing data that have the capabilities to supply the information of NPP changes with 15 metre spatial resolution. An assessment of Eco-Physiological model must be carried out with detail because this model was developed based on his adaptation for factor of radiation solar, temperature, and water availability in their area. In this study, four published Eco-Physiological models has been assess to suit with tropical environment in Hutan Simpan Pasoh. These models include CASA, GLO-PEM, VPM and C-Fix model. An accuracy assessment of the derived NPP for three land use types in the study area that is forest, oil palm and rubber was done based on the coefficient of variation value (CV) and also observed NPP data by Kosugi *et al*., (2008). After CV's comparison and the validation with observed NPP data, the results showed that GLO-PEM model was in good agreement to derived forest and rubber NPP which respectively record CV's value of 4.7 % and 3.0 %. While, CASA model was in good agreement to derived oil palm NPP in the study area with the CV value about 7.85%. The derived NPP for all three type of land use in the study area ranged from 451.58 gCm^{-2} yr^{-1} to 3042.20 gCm^{-2} yr^{-1}. From this range, NPP's average for forest is 2741.13 gCm^{-2} yr^{-1}, while NPP's average for oil-palm is 2859.42 gCm^{-2} yr^{-1} and NPP's average for rubber is 2172.17 gCm^{-2} yr^{-1}. Strong relationship among the derived NPP and environmental proved that Eco-Physiological model have the capabilities to estimate NPP nicely for tropical environment.

Special Session I - CarboEastAsia

C01

SEASONAL VARIATION OF PHOTOSYNTHETIC AND RESPIRATORY PARAMETERS OF LARCH FORESTS IN EAST ASIA

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Larch forests are widely distributing over northeast Eurasian continent and would have strong influence on the carbon cycles. This study aims to compare photosynthetic and respiratory parameters obtained in larch ecosystems in north-east Asia and these relations to environments. The 30-min NEE data obtained at 8 larch forests were used for the comparison (Table 1). Photosynthetic parameters (P_{max}, ϕ, R_d) in Eq. (1) were determined every day using daytime 30-min NEE data ($F_{NEE,\,day}$; μmol m^{-2} s^{-1}) within a 15-day moving window by the least-squares method. In the equation, Q, P_{max}, ϕ, θ (=0.9) and R_d are the photosynthetic photon flux density (μmol m^{-2} s^{-1}), maximum GPP at light saturation (μmol m^{-2} s^{-1}), the initial slope (mol mol^{-1}), the convexity of the light-response curve and daytime respiration (μmol m^{-2} s^{-1}).

$$F_{NEE,\,day} = \frac{-\phi Q - P_{max} + \sqrt{(\phi Q + P_{max})^2 - 4\phi Q\theta P_{max}}}{2\theta} + R_d \qquad (1)$$

Respiratory parameters (E_0, R_0) in Eq. (2) were determined every day using nighttime 30-min NEE data ($F_{NEE,\,night}$; μmol m^{-2} s^{-1}) within a 29-day moving window by the least-squares method. In the equation, T_a is the air temperature (°C), E_0 is activation energy (J mol^{-1}), R is ideal gas constant (J mol^{-1} K^{-1}). R_0 is $F_{NEE,\,night}$ at the reference temperature (T_{ref}: 10°C) and T_K and T_0 are 273.15 and 227.13 K, respectively.

$$F_{NEE,\,night} = R_0 \exp\{E_0/R\,(1/(T_K+T_{ref}-T_0) - 1/(T_K+T_a-T_0))\} \qquad (2)$$

Photosynthesis started at late May in Siberian sites and during late-march to early April for the other sites. However, the peak values for P_{max} and ϕ were observed in June for all the sites excepting TSE, where is a young plantation and other dominant undergrowth species contribute much to the GPP. Seasonal maximum values of P_{max} and ϕ were ranging 6(TUR)–56(TMK) and 0.023(SKT)–0.072(TMK), respectively and the seasonal maximum of both parameters for each site correlated linearly with the seasonal maximum LAI and exponentially with the annual average air temperature. Seasonal maximum of R_0 was obtained during July to August for all sites, ranging 1.5(TUR)–9.6(TMK), however no distinct seasonal variation was observed in E_0. These respiratory parameters increased linearly with the seasonal maximum LAI of the site.

Table 1. Site characteristics

Site	Abbrev.	Location	Elevation (m)	Tree Height (m)	Species
Tura, Russia	TUR	64°12'N, 100°27'E	250	3	*Larix gmelinii*
Nelegel, Russia	NLG	62°19'N, 129°31'E	200	8.6	*Larix gmelinii*
Yakutsuk, Russia	YLF	62°15'N, 129°14'E	220	18	*Larix gmelinii*
Southern Khentei Taiga, Mongolia	SKT	48°21'N, 105°39'E	1630	20	*L.. sibirica*
Laoshan, China	LSH	45°20'N, 127°34'E	370	18	*L.. gmelinii*
CC-LaG experiment site, Japan	TSE	45°03'N, 142°06'E	70	3	*L..gmelinii ×L.. kaempferi*
Tomakomai Flux Research site, Japan	TMK	42°44'N, 141°31'E	140	16	*L. kaempferi*
Fujihokuroku Flux Observation site, Japan	FHK	35°26'N, 138°45'E	1100	20-25	*L. kaempferi*

C02

COMPARISON OF CO_2 AND CH_4 EMISSION IN BOREAL, TEMPERATE, SUBTROPICAL, AND TROPICAL OLD-GROWTH FOREST SOILS IN EASTERN CHINA

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Old-growth forests play an important role in carbon loss and sequestration in forest ecosystems. To actually estimate carbon budget between atmosphere and forest soils and compare the difference of soil C efflux between forest types, four old-growth forests referred to Daxinganling boreal coniferous forest (DXAL), Changbaishang temperate needle-broadleaved mixed forest (CBS), Dinghushan subtropical evergreen broadleaved forest (DHS) and Xishuangbanna tropical rain forest were selected in eastern China. Soil-atmospheric CO_2 and CH_4 fluxes and controlling factors have been measured simultaneously for three years using the static chamber technique in four old-growth forests. Forest soils in eastern China behaved as CO_2 sources. Except for boreal forest soil in DXAL, other forest soil is CH_4 sinks. Annual mean CO_2 and CH_4 fluxes (mean±se) were 18.50±0.94 $MgCO_2$ ha^{-1} yr^{-1}, 20.08±1.20 $MgCO_2$ ha^{-1} yr^{-1}, 38.32±0.93 $MgCO_2$ ha^{-1} yr^{-1}, 34.52±0.50 $MgCO_2$ ha^{-1} yr^{-1} and 0.46±0.20 $kgCH_4$ ha^{-1} yr^{-1}, -2.28±0.70 $kgCH_4$ ha^{-1} yr^{-1}, -5.14±0.96 $kgCH_4$ ha^{-1} yr^{-1}, -2.47±1.08 $kgCH_4$ ha^{-1} yr^{-1} in DXAL, CBS, DHS and XSBN, respectively. Soil CO_2 effluxes were positively correlated to soil temperature and moisture at 5cm depth in all forests. The sensitivity of CO_2 efflux to soil temperature (Q_{10}) ranged from 2.05 in subtropical evergreen broadleaved forest to 3.08 in boreal forest. The Q_{10} tended to increase with the decline of soil temperature in growing season. The variation of soil CO_2 emission depended on the content of root biomass and soil organic carbon in topsoil. In contrast, soil CH_4 uptake was positively correlated to 5 cm soil moisture in tropical and subtropical climax forests. In boreal and temperate forests, soil CH_4 efflux decrease with soil moisture until reaching a threshold, and then increase. Moreover, soil ammonium N (NH_4^+-N) also restrained soil CH_4 uptake in all forests. This suggests that microbial CH_4 uptake and production mainly depended on the activities of methanotrophs in the mineral soil.

C03

WATER, TEMPERATURE, AND VEGETATION REGULATION ON CARBON DIOXIDE FLUXES OVER THREE GRASSLAND ECOSYSTEMS IN CHINA

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The temperate steppe and alpine meadow are two major natural grasslands growing on Inner Mongolia Plateau and Qinghai-Tibet Plateau, respectively, in China. In this paper we presented the results of CO_2 fluxes measured over three grassland ecosystems, including a semiarid steppe in Inner Mongolia (NMG), an alpine shrub-meadow at Haibei (HB) in Qinghai and an alpine steppe-meadow at Damxung (DX) in Tibet. The measurements were made in 2004 (a normal year) and 2005 (relatively a warmer and drier year) using the eddy covariance technique. To interpret the biotic and abiotic factors that modulate carbon exchanges over the course of a year at the three grasslands, we decomposed net ecosystem CO_2 exchange (NEE) into its constituent components, gross ecosystems production (GEP) and ecosystem respiration (R_{eco}).

Our results showed that the alpine shrub-meadow at HB has largest carbon exchange rate among the three sites and was acting as a net carbon sink, with a total of -137gC m^{-2} accumulation over the 2 study years. However, the semiarid steppe at NMG was a net carbon source, with more carbon loss in the drier year of 2005.The alpine steppe-meadow at DX showed very low carbon exchange rate due to poor soil nutrient and low vegetation cover.

With relatively sufficient precipitation during the growth season, the seasonality of NEE and GEP at HB was mainly determined by the variation in air temperature and leaf area index (LAI). However, the ecosystem carbon exchange at NMG was strongly constrained by the timing and amount of precipitation received, especially during the growth season. The seasonality of *GEP*, R_{eco} and *NEE* at DX indicated their responses to the variation in both air temperature and soil moisture. This steppe-meadow is easily inclined to suffer moisture stress due to its poor soil water retention, even with relatively proper precipitation in summer. For each site of this study, NEE was determined in a complex fashion by both GEP and R_{eco}, while variations in R_{eco} at NMG and HB were mainly controlled by canopy photosynthesis. The ecosystem respiration rate and its temperature sensitivity were markedly reduced by drought stress in 2005 at NMG and DX.

C04

SEASONAL VARIATIONS IN CARBON DIOXIDE EXCHANGE IN AN ALPINE WETLAND MEADOW ON THE QINGHAI-TIBETAN PLATEAU

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The unique climate of the alpine wetland meadow is characterized by long cold winters and short cool summers with relatively high precipitation. These factors shorten the growing season for vegetation to approximately 150 to 165 days and prolong the dormant period to almost 7 months. Understanding how environmental variables affect the processes that regulate carbon flux in alpine wetland meadow on the Qinghai-Tibetan plateau is critical important because alpine wetland meadow plays a key role in the carbon cycle of the entire plateau. To address this issue, Gross Primary Production (GPP), Ecosystem Respiration (Reco), and Net Ecosystem CO_2 Exchange (NEE) were examined for an alpine wetland meadow at the Haibei Research Station of the Chinese Academy of Sciences. The measurements covered three years and were made using the eddy covariance method. Seasonal trends of both GPP and Reco followed closely changes in Leaf Area Index (LAI). Reco exhibited the same exponential variation as soil temperature with seasonally-dependent R10 values. Yearly average GPP, Reco, and NEE (which were 575.7, 676.8 and 101.1 gCm^{-2} , respectively, for 2004 , and 682.9, 726.4 and 44.0 gCm^{-2} for 2005, and 630.97, 808.2 and 173.2 gCm^{-2} for 2006) values indicated that the alpine wetland meadow was a moderately important source of CO_2. The observed carbon dioxide fluxes in this alpine wetland meadow plateau are high in comparison with other alpine meadow environments such as *Kobresia humilis* meadow and shrubland meadow located in similar areas. CO_2 emissions are large on elevated microclimatology areas on the meadow floor regardless of temperature. Furthermore, relatively low Reco levels occurred during the non-growing season after a late rain event. This result is contradicted observations in alpine shrubland meadow. The timing of rain events had more impact on ecosystem GPP and NEE.

C05

APPLICATION OF ICROMETEOROLOGICAL METHODS FOR FLUX MEASUREMENTS DURING RAINFALL

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There is much evidence as to climate-induced changes in precipitation characteristics (e.g., frequency, amount, and intensity). Less is known, however, about the impact of such changing rainfall characteristics on terrestrial ecosystems (IPCC, 2007). Regional and Global networks of surface flux measurements based on eddy-covariance method (e.g., AsiaFlux, FluxNet) greatly contribute to improving our understanding of the ecosystem responses to environmental changes. Unfortunately, our current understanding of ecosystem response to rainfall is still poor, thereby hindering us from providing the information on their impacts on carbon uptake by plant canopy. Such lack of our understanding is mainly caused by the malfunction of sensors for eddy-covariance method (e.g., sonic anemometer and open-path gas analyzer) during rainfall. Consequently, our understanding of ecosystem response to changes in rainfall pattern greatly depends on the current gap filling procedures for missing data during rainfall. In particular, summer monsoon is unique phenomenon in Asia and lengthy summer rainy season in Asia can introduce significant bias in carbon uptake estimates when standard gap-filling strategy is routinely applied. In this study, we revisit various micrometeorological methods for CO_2 flux measurements during rainfall and attempt to quantify CO_2 flux over forest canopy using those methods during rainfall.

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C06

CARBON BUDGET PATTERNS OF FOREST ECOSYSTEM IN POYANG LAKE BASIN FROM 1901 TO 2001

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Poyang Lake receives water from 5 major rivers (Gan, Fu, Xin, Rao, Xiu) and exports water into Yangzi River, which becomes an independent water system. The catchments of the whole Poyang Lake Basin has an area with $16.22 \times 10^4 km^2$, which occupies about 97.2% of Jiangxi province. Since 1980s, the Integrated Management of Poyang Lake Watershed caused great changes in landscape and ecosystem. These ecological restoration projects have large effect on C cycle and C transport in Poyang Lake Basin.

This study reports the annual carbon (C) budget of forest ecosystem in Poyang lake Basin during 1901–2001 estimated using the Integrated Terrestrial Ecosystem C-budget model (InTEC). Annual carbon source and sink distributions are simulated for the same period using various spatial datasets including land cover and leaf area index (LAI) obtained from remote sensing, soil texture, climate, forest age, and nitrogen deposition. During 1901–1955, Poyang Lake Basin's forests were a small sink of 53.1 TgC without large disturbances (human activities). However, it turned to a source of 902 TgC during 1956–1988 due to intensified human activities in the late 1950s, early 1960s, 1970s and early 1980s. The forests became a sink of 282.4 TgC during 1989–2001, owing to large-scale plantation and forest regrowth in previously disturbed areas as well as growth stimulation by nondisturbance factors such as climatic warming, atmospheric CO_2 fertilization, and N deposition. From 1901 to 2001, forests in Poyang Lake Basin were a small carbon source of 566.6 Tg C, about 56.6 $TgCyr^{-1}$. The overall C balance in biomass from InTEC generally agrees with previous results derived from forest inventories of forests in Poyang Lake Basin. InTEC results also include C stock variation in soils and are therefore more comprehensive than previous results. The uncertainty in InTEC results is still large, but it can be reduced if a detailed forest age map becomes available.

C07

ISOPRENE EMISSION CHARACTERISTICS OF JAPANESE OAK IN A DECIDUOUS BROAD-LEAVED FOREST

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Biogenic Volatile Organic Compounds (BVOCs) including isoprene and monoterpene are released from many plant species. The emissions of BVOCs are estimated to be from 0.5 to 1.2 PgC y^{-1} in global scale (Guenther *et al*., 1995) that is greater than those of anthropogenic volatile organic compounds. The isoprene emission from vegetation accounts for about 50% of total BVOC emissions. BVOCs are an important component of atmospheric chemistry through their influences on the carbon budget, aerosol formation and ozone concentration. The majority of BVOCs are decomposed into CO_2 by oxidation, these CO_2 precursors may affect the global CO_2 concentration. Therefore, it is really important to estimate the accurate emissions of isoprene from the forests in worldwide. In order to estimate isoprene emissions, various studies have been conducted in western countries, however, field measurements of isoprene emissions from Asian vegetations have been hardly carried out. The aim of this study is to investigate the isoprene emission characteristics of *Q. serrata*, which is one of the major tree species in Japan.

Q. serrata is a major tree species of Yamashiro Experimental Forest (YEF) at 34°47'N, 135°51'E in Kyoto Prefecture, Japan. Thus, we conducted field measurements of isoprene emissions from sunlit and shaded leaves of *Q. serrata* in this site. In 2006, the isoprene emission rate (*I*), together with the net assimilation rate (*A*) and photosynthetic photon flux density (PPFD), was measured using a leaf cuvette(Li-6400). The ratio of carbon emitted as isoprene to carbon fixed by photosynthesis was discussed from the perspective of a carbon budget. The experimental results demonstrated that *I* peaked at around noon for both the sunlit and shaded leaves, while *A* of the sunlit leaves peaked in the morning with a subsequent gradual decline. Consequently, the ratio of carbon emitted as isoprene to carbon fixed by photosynthesis increased during the afternoon. *I* was highly correlated with PPFD and the leaf temperature. Our result indicates that *Q. serrata* should be categorized as a strong isoprene emitter (Okumura *et al*., 2008).

References:

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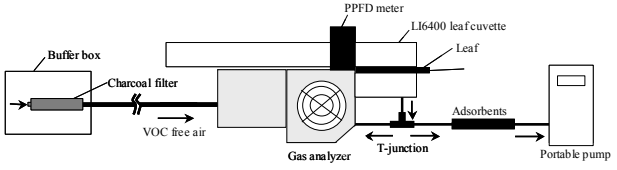

Figure 1. A schematic diagram of isoprene sampling using a portable photosynthesis system (LI6400).

C08

MULTI-MODEL ANALYSIS OF TERRESTRIAL WATER AND CARBON CYCLES IN JAPAN: FIRST RESULTS FROM JAPAN-MIP

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Terrestrial ecosystem models contain large uncertainties in simulating energy, water, carbon, and nutrient cycles. To evaluate these uncertainties, several model-intercomparison studies have been conducted in the past (e.g. NPP-MIP by W.Cramer *et al.*). However, most of them were based on the results of ecosystem models without sufficient model validation. We need to evaluate models using flux observations, and then conduct model intercomparison study. The study aims at (1) testing the inter-model uncertainties, (2) identifying uncertain processes, (3) discussing the role of ground observation data in terrestrial carbon/water cycle simulations, and (4) refining terrestrial carbon budget for Japan.

By running several ecosystem models (BEAMS, Biome-BGC, CASA, LPJ, Support Vector Machine, TOPS, and VISIT), we first evaluated how the models produce different simulation results at the flux sites (four flux sites in Japan) and at various spatial scales. Next, we improved each model using flux observations, then we evaluated how the model improvement process reduces uncertainties among different ecosystem model outputs.

At a point scale, model improvements based on flux tower observations significantly reduced uncertainties. For spatial analysis, although spatial differences among the model were also greatly reduced, still significant uncertainties remained between satellite-based and prognostic ecosystem models. Although this study significantly improved the understanding of current carbon and water budget estimations, further works is needed to find the remaining differences.

C09

MODEL ESTIMATE OF ANNUAL NEE AND UNCERTAINTY OVER MIXED FOREST IN COMPLEX TERRAIN

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A process based model has been used to examine seasonal variation of gross primary production (GPP) and net ecosystem exchange (NEE) and to estimate annual NEE over mixed forest in complex terrain under the influence of Asian monsoon. We have calibrated modified Soil-Plant-Atmosphere model (mSPA model) with eddy covariance data to calculate GPP and used empirical formula to estimate ecosystem respiration.

The simulation shows that the GPP shows broad maximum in summer, which is consistent with the seasonal pattern of plant area index (PAI).

Ecosystem respiration shows peak in August when soil temperature is maximum. Therefore, maximum carbon uptake shows in early June when GPP is high but respiration is not large yet. In winter, the forest is weak carbon source. The estimated annual NEE is about -296 gC m^{-2} yr^{-1} which is comparable to other studies over mixed forest in East Asia.

The uncertainties of estimated annual NEE have been discussed in terms of large energy imbalance and underestimation of nighttime flux due to decoupled flow between below and above the canopy in complex terrain.

C10

ESTIMATED CARBON RESIDENCE TIMES IN THREE FOREST ECOSYSTEMS OF EASTERN CHINA: APPLICATIONS OF PROBABILISTIC INVERSION

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Mean residence time (MRT) of carbon (C) is one of the most critical parameters for predicting C dynamics in terrestrial ecosystems. However, MRTs of many plant and soil pools have not been well quantified, especially for pools of metabolic litter, microbes, slow and passive SOM. Since net ecosystem exchange (NEE) data from eddy-flux measurements contain information of C input and release in an ecosystem, we expect NEE measurements may help constrain C residence times in such soil pools together with biometric data.

A probabilistic inverse analysis of multiple observations was applied to estimate MRT of C among three forest ecosystems in China. Carbon transfer coefficients (=1/MRTs) were the target parameters to be estimated in a modified terrestrial ecosystem (TECO) model. Three assimilation experiments with either NEE data or biometric data or both were conducted to evaluate their relative effectiveness on estimation of C transfer coefficients of different pools. Biometric data used in this study consisted of foliage biomass, fine root biomass, woody biomass, litterfall, soil organic carbon (SOC), and soil respiration.

The posterior PDFs for model parameters were generated from prior PDFs with observations by a Markov chain Monte Carlo (MCMC) sampling technique. Since not all posterior distributions of eight parameters followed Gaussian distributions, we chose maximum likelihood estimate (MLE, i.e., mode) as the best estimate for each parameter. Estimated MRTs at the three sites ranged from 2 to 8 months for metabolic litter and microbial biomass pools, from 1 to 5 years for foliage, fine root biomass, and structural litter pools, and from 11 to 897 years for woody biomass, slow and passive SOM pools. C in metabolic litter, structural litter, microbial biomass, slow and passive organic matter pools had shorter MRTs at the CBS site than at the other two forest sites.

Biometric data were found effective in constraining exit rate of C from three plant pools, because Measurements of foliage, fine root, woody biomass, and litterfall provided enough information on C transfer from plant to litter. Our inverse analysis also showed that daily NEE data did contain information on constraints of exit rates of C from metabolic litter, structural litter and microbes. It indicated that NEE data did reflect such processes of C transfer among metabolic and structural litter, and microbial biomass pools from which C exit with a relative quick rate. Either biometric or NEE data or both did not contain enough information to constrain the exit rate of C from passive SOM.

Enlarged parameter ranges and reduced error variance of observations did not have much potential in improving the estimates of poorly constrained parameters. Sensitivity analysis of parameter estimation to fix parameters indicated that GPP was an important model drive in inversing C transfer coefficients, especially for exit rate of C from metabolic litter and slow SOM pools.

NEE measurements have the potential to improve MRT estimation in metabolic litter, structural litter, and microbial biomass pools. However, the degree of improvement varied with volume of NEE data. If we decreased the sample size of NEE data, posterior estimation of exit rates of C from structural litter and microbial biomass pools showed larger uncertainties, which was similar to the result that only assimilating biometric data. The magnitude of negative log-likelihood value for NEE data was decreased from 257.04 to 19.69, which accordingly weakened its effect on parameter estimation in multiple constraints. We may have to explore more studies to determine how much information provided by each data set would be enough for parameter estimation in the future.

C11

AN INTEGRATED UPSCALING APPROACH BASED ON SPATIAL PATTERN IDENTIFICATION AND SCALE EFFECT ANALYSIS FOR ANNUAL NET PRIMARY PRODUCTIVITY

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The study tried to investigate an upscaling approach based on spatial pattern identification and scale effect analysis, and took annual total net primary productivity (AT_NPP) in Xilin river basin in Inner Mongolia, China for example. Different spatial pattern analysis methods were used for identifying spatial autocorrelation, hierarchical structure and characteristic scale(s). These methods included variogram and scale effect analysis of semi-variance, Moran's I correlogram and scale effect analysis of Moran's I coefficient, scale variance analysis and wavelet variance analysis. The results showed that three hierarchical levels were identified for AT_NPP over the entire basin, corresponding to 40×40~50×50 km^2, 9×9~13×13 km^2 and 6×6 km^2 scale levels, respectively. The occurrence of the highest hierarchy implied the break of the nature of spatial autocorrelation and the occurrence of a new dominant biophysical process, mainly caused by a gradient of precipitation. The occurrence of the intermediate and lowest hierarchies implied the break of the intensity of spatial autocorrelation, mainly caused by the boundary of different vegetation, soil, and landform (combined elevation and aspect) patches. The upscaling of AT_NPP based on spatial pattern identification and scale effect analysis could be performed within the identified three scale domains: (1) from 1×1 km^2 to 19×19 km^2, (2) from 20×20 km^2 to 45×45 km^2, and (3) from 46×46 km^2 to the entire basin, respectively. Thus, to upscale AT_NPP from 1×1 km^2 through progressively increasing scales to the entire basin, AT_NPP values of at least three scale levels had to be derived. The certainty of upscaling AT_NPP depended on the certainty of spatial pattern of AT_NPP.

C12

INVERSELY MODELING THE IMPACT OF DROUGHT ON REGIONAL CARBON FLUXES

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Soil and atmospheric water deficits have significant influences on CO_2 and H_2O fluxes between the atmosphere and terrestrial ecosystems. The reliability of regional terrestrial carbon balance estimation depends on the description of the processes affecting water and carbon cycles. The increasing availability of continuous CO_2 and H_20 measurements using the eddy-covariance technique makes model calibration and validation possible to control the uncertainties in regional carbon balance estimation.

The modified BEPS (Boreal Ecosystem Productivity Simulator) model was employed to simulate the impact of drought on carbon fluxes in subtropical forest ecosystems in Jiangxi Province, China. The model was first parameterized using measurements of CO_2 and H_20 fluxes taken over a subtropical planted coniferous ecosystem in Qianyanzhou during years 2003 and 2004. Key model parameters affecting CO_2 and H_20 fluxes (including *Vmax*, Ball-Berry coefficient *m*, and the coefficient determining the sensitivity of stomatal conductance to atmospheric water vapor deficit D_0) were optimized using the Kalman filter assimilation algorithm. After optimization, the model is able to simulate CO_2 and H_20 fluxes at half-hourly to seasonal scales with reliable accuracy. It captures above 80% of variances in half-hourly latent and sensible fluxes. The variations of half-hourly gross primary productivity (GPP) and net primary productivity (NEP) explained by the model are in the range from 71% to 82% during 2003 and 2004.The significant depression of CO_2 and H_20 fluxes caused by serious summer drought in 2003 was well captured by the model. The model performed better in summer than in winter. Optimized *Vmax* and *m* show distinguishable seasonal pattern in 2003 associated with soil water dynamics.

The optimized model was run for the forest ecosystems in Jiangxi province for the period from 2001 to 2005. In the spatial simulation, the model was driven by MODIS LAI and albedo products and spatially interpolated meteorological data. The MODIS LAI products were processed to remove unreasonable fluctuation caused by cloudy contamination. Simulations show that forests of this province are now acting as a carbon sink, ranging from 3.2 to 20.5 Tg C yr^{-1}. Seasonal drought has significant influences on both carbon assimilation and respiration. Annual NEP decreased from 20.5 Tg C yr^{-1} in 2002 with plentiful precipitation to 4.5 Tg C yr^{-1} in 2003 with a drought summer. More efforts should be taken to improve the ability of models to simulate coupling between water and carbon cycles and to evaluate the impact of drought on carbon sequestration.

C13

TOWARD HIGH RESOLUTION REGIONAL LAND SURFACE CARBON BALANCE MAPPING OVER EAST ASIA USING TOP-DOWN MODELING AND FLUX TOWER OBSERVATION

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"Top-down" approaches (*i.e.* inversion), which utilize atmospheric gas measurement and atmospheric transport model to evaluate surface source/sink, has been appealing advantage in giving a quantitative interpretation to total net carbon balance explained by the total change of atmospheric CO_2 amount. Currently, "top-down" approach is established technique and many of "top-down" studies have been reported at global or large scale (-continental). On the other hand, "top-down" approach still has difficulties in applying regional studies. In fact, their outcome is rather coarse than that of "bottom-up" approaches which scale up the flux tower observations using process based models. For regional application, we need to overcome several difficulties (*e.g.* complex mesoscale circulation, imhomogenuity, number of CO_2 data, computational cost). In this study, we focus on the data availability of CO_2 data for inversion among the difficulties, and study the possibilities to use CO_2 data from flux tower measurements in addition to existing continuous CO_2 measurements for estimation of the higher spatial resolution regional surface CO_2 flux in East Asia.

Many of inversions make use of NOAA's global network distributed all over the world and inverted them using atmospheric model. For regional estimation, we need to perform high resolution simulation of CO_2 transport and use CO_2 data to solve inverse problem of surface source/sink. Considering the nature of inversion, experiments over East Asia would suffer from poor data availability. To construct observation network of CO_2 is the best way, however it is expensive and difficult to maintain. One possible solution is to make use of CO_2 data from the flux tower observations in addition to the existing atmosphere monitoring stations. There are several requirements of CO_2 observation/data for use in inversion, however it would be less expensive and easier to carry out. This presentation reports a preliminary result of regional inversion over East Asia. We used the CO_2 data registered in WDCGG (World Data Centre for Greenhouse Gases) and from a few flux towers registered in Asia Flux network to constrain surface flux over East Asia and show the usefulness of tower measurements by changing the choice of the observation sites used in inversion.

The study area is approximately 2000 km x 2000 km around Japan and we focused on a 10-day period of August 2005 when our own atmospheric measurements (Suita) was available. The study area was descritized in approximately 120 km in simulation and estimates of

surface flux was shown in the same resolution. We collected CO_2 data from 5 WDCGG (Mikawa-Ichinomiya, Minamitorishima, Ryori, Yonagunijima and Suita) and 2 Asia flux tower sites (Takayama and Teshio). Meteorology over study area was calculated using the mesoscale meteorology model MM5. Because the number of CO_2 sites was not enough yet to constrain the surface flux over 2000 km x 2000 km, we used the land use of model grids categorized according to USGS land use data (1 deg.), and assigned a CO_2 flux to each land use type assuming that the same land use has the same flux intensity in the study area. In the inverse model, surface flux was optimized by minimizing the misfit between observed and simulated CO_2 using Genetic Algorithm. Our inversion methodology has some uniqueness, however we focused only on the effect of utilizing CO_2 data from flux towers, and the results are to be shown and discussed in the session.

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C14

SIMULATING CARBON AND WATER CYCLE AT LARCH FORESTS IN EAST ASIA BY BIOME-BGC MODEL WITH ASIAFLUX DATA

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Larch, deciduous conifer, forests are widely distributed over many cold-temperate and boreal regions in Asia, and expected to play an important role in global carbon and water cycle. Model parameterizations for the larch forests still remain large uncertainties due to a lack of validation by flux measurement data. In this study, a process-based terrestrial biosphere model, BIOME-BGC (Thornton *et al*., 2002), was tested to larch forests at five AsiaFlux sites; Tomakomai in Japan (Hirata *et al*., 2007), Laoshan in China (Wang *et al*., 2005), Southern Khentei in Mongolia (Li *et al*., 2005), Tura in Russia (Nakai *et al*., 2008), and Yakutsk in Russia (Ohta *et al*., 2001), and used to identify important environmental factors on the carbon and water cycle in both temporal and spatial scale.

The model simulation with default deciduous conifer parameters produced large differences from observed net ecosystem exchange (NEE), gross primary productivity (GPP), ecosystem respiration (RE), and evapotranspiration (ET). Therefore, we adjusted several model parameters in order to reproduce observed carbon and water cycle. The model calibration using the AsiaFlux data significantly improved the model performance. Although simulated annual GPP and RE by the calibrated model were highly consistent with observed ones, the simulated carbon budgets (NEE) was significantly underestimated due to a slight overestimation of RE at all sites. These discrepancies were probably caused by the model assumption, steady state condition. In addition, we found that a key uncertainty in current BIOME-BGC model was response of heterotrophic respiration to water conditions; large discrepancies in RE were found in the water-limited sites.

Observed and simulated ET across the five sites was positively correlated with annual mean air temperature. In contrast, observed and simulated annual GPP and RE were sensitive to annual total precipitation rather than air temperature. One model parameter, allocation for new fine root C to new leaf C, is needed to be site-specific, and it was also weakly correlated with annual precipitation. These resultsmay lead a hypothesis that water could be the key controlling factor on the spatial distributions of the carbon fluxes. Although this study significantly improved the model performance, the remained uncertainties and the proposed hypothesis should be examined in ongoing and long-term observations.

C15

IMPACT OF METEOROLOGICAL ANOMALIES IN SUMMER, 2003 ON GROSS PRIMARY PRODUCTIVITY IN EAST ASIA

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We examined how forest ecosystems responded to the meteorological anomalies in the 2003 summer based on the dataset collected at flux monitoring sites in Asia. The East Asian rainy season ('Baiu' in Japanese, 'Meiyu' in Chinese, 'Jangma' in Korean) provides sufficient water supply to terrestrial ecosystems over Japan, Korea and eastern China in early summer. The intensity and duration of the rainy seasons, which are determined by the air-sea-land interactions over the Pacific Ocean and the Eurasian continent, has a large year-to-year variability. This variability is one of the major focuses of researches in agriculture, disaster prevention, and estimations of carbon and water cycles in East Asia.

From June to August in 2003, the rainy season was prolonged in an area within latitudinal range of 35-40 ^{o}N and longitude range of 80-150 ^{o}E, an area extending from China, the main island of Japan through South Korea. The rain front remained over the area for an unusually long period and brought a cool summer with extremely low insolation over the main island of Japan. On the other hand, weather was hot and dry at lower latitudes around 20-30 ^{o}N in the southern part of China since the rain front was pushed up to the north.

We compared the GPP data obtained from various flux sites with the meteorological pattern during the anomaly period. The flux data we used were obtained from various ecosystems over Asia; sub-arctic larch forest in Mongolia (SKT), cool-temperate larch forest in Japan (TMK), cool-temperate birch-oak forest in Japan (TKY), warm-temperate mixed forest in Japan (SMF), cool-temperate mixed forest in China (CBS), and sub-tropical planted pine forest in China (QYZ). The gross primary production (GPP) significantly decreased at TKY and SMF in July 2003 due to unusually low solar radiation under the rain front. The GPP in TMK (north of the front) slightly increased by higher solar radiation than normal years. The GPP in QYZ (south of the front) was, however, reduced by severe drought stress due to the hot and dry condition in the summer, 2003. Our study illustrated that integration of flux data from wide range of areas can help us gain understandings in ecosystem responses to large-scale meteorological phenomena. These datasets, which show temporal and spatial distribution of productivity, will also be essential to validate ecosystem models and estimations of vegetation indexes by satellite remote sensing.

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C16

THE INFLUENCE OF AN UNPRECEDENTED SNOW STORM IN 2008 TO CARBON STOCK OF FOREST ECOSYSTEM IN SOUTHERN CHINA

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At the beginning of 2008, just before the Spring festival, southern China was hit by an unprecedented snow storm, the transport and energy systems were haveyly destroyed and brought huge economic losses and social confusion. The forest ecosystem, just like some other systems, was also severely damaged in the snow storm. A rough statistic indicated that about 370 million m^3 of forest stock volume was lost and about 10% of the total forest land in China was affected, while in Jiangxi province, it is estimated that as much as 37.3% of forest was influnced. The snow storm caused many trees broken down and created many canopy gaps. How dose the effect of the snow storm to the ecological function of forest ecosystem, especially for carbon balance? What countermeasure should we take for this kind of natural disaster? To further understand the ecosystem carbon losses and the variation in carbon assimilation ability, a field survey was carried out soon after the snow storm in mid-west Jiangxi province. We found that the destruction was mainly caused by the severe environment, but the forest structure, forest type and the topography were also contribute to some extent. Based on field measurement, the biomass and carbon losses were evaluated.

Fig. 1. A forest after the snow storm in Jiangxi Province in 2008

C17

SEASONAL DROUGHT EFFECTS ON ECOSYSTEM CARBON EXCHANGE OF A SUBTROPICAL PLANTED FOREST OF SOUTHEASTERN CHINA

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Continuous measurement of carbon dioxide exchange using the eddy covariance (EC) technique is made at the Qianyanzhou mid-subtropical planted forest as part of the ChinaFLUX network. Qianyanzhou planted forest is affected by typical subtropical continental monsoon climate. It is plentiful for water and heat resource but inconsistency of its seasonal distribution in the mid-subtropical region, thus seasonal drought frequently occur in this planted forest. In this study, seasonal drought effect on ecosystem carbon sequestration was analyzed based on net ecosystem productivity (NEP), ecosystem respiration (RE) and gross ecosystem productivity (GEP) at the month scale during 2003-2007. In this drought-stressed planted forest, ecosystem carbon sequestration showed a clear seasonality, with low rates during seasonal drought and in winter. The declining degree of ecosystem carbon sequestration under the seasonal drought condition was determined by the accumulation of soil moisture deficits and a co-occurrence of high temperatures. Different drought effects are expected for ecosystem respiration (RE) and gross ecosystem productivity (GEP). The net effect of ecosystem carbon balance depends on how these two quantities are affected relatively to each other. Summer drought and heat wave are two aspects of weather that likely play an important part in the annual NEP of forest in this region.

C18

RESPONSES OF CARBON EXCHANGE OF FOREST ECOSYSTEMS TO ASIAN MONSOON CLIMATE DURING SUMMER PERIOD

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1. Background

Forest plays an important role in mitigating global climate change, and the carbon processes and exchanges of forest ecosystems have received great attention in global carbon cycling research. Under the influence of the Asian monsoon climate, different types of forests are formed, especially, the forest transect along the eastern Asia including the tropic rainforest, subtropical evergreen broad-leaved forest, temperate mixed forest, larch forest and Taiga forest from south to north. Such transect provides a scientific platform to study the response and adaptation of forest ecosystem to Asian Monsoon Climate.

During summer, high temperature and plentiful precipitation are two general characteristics of East Asian Monsoon climate. Meanwhile, ecosystem carbon exchange (GPP, NEE and Reco) is also very active in summer. The influences of summer Monsoon on ecosystem carbon exchange are of great potential to the annual ecosystem carbon balance. The main objective of this study is to compare the responses of ecosystem carbon exchange to summer Monsoon climate across different ecosystems along the forest transect, explore the influence of the variation of summer monsoon on ecosystem carbon exchange with multi-year flux measurements.

2. Methods

In this study, the 15 site-year data of ecosystem carbon exchange (NEE) and routine meteorological environment from Tomakomai Japanese larch forest, Mongolia larch forest, Changbaishan temperate mixed forest, Takayama cool temperate deciduous forest, Fujiyoshida Japanese red pine, Qianyanzhou sub-tropical evergreen coniferous forest, Dinghushan subtropical evergreen broadleaf forest nd Palangkaraya tropical peat swamp forest are included.

To avoid the uncertainty resulted from different methods, the consistent gap filling and partitioning method are applied to datasets from different flux sites.

3. Main results

Under the influence of Monsoon Climate, both temperate and precipitation will attain the highest during the summer except the precipitation of Palangkaraya is the lowest than other ecosystems which probably relates the influence of Southern Asian Monsoon Climate in this site. During the summer period, the accumulative precipitation probably determined both GPP and Reco across different ecosystems, while NEE of temperate and subtropical ecosystems is influenced by temperature.

Due to the complexity of the interaction between terrestrial ecosystem and climate, and the difference in Eastern Asian Monsoon Climate and Southern Monsoon Climate, more sites and long term measurement are necessary, especially in temperate and tropical regions.

C19

EFFECT OF MANURE APPLICATION ON CARBON BALANCE IN FOUR GRASSLANDS IN JAPAN

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Japanese stock farming depends on imported stock feed, but compost application is not so popular in grassland in Japan. Consequently, excrements of domestic animals produce environmental contamination such as water pollution. Composting grassland is expected to increase organic carbon stock in the soil although N_2O emission possibly increases. The purpose of this study is to clarify the effect of manure application on carbon balance of grassland in Japan.

Study sites were four grasslands: Nakashibetsu (NKS), Shizunai (SZN), Nasushiobara (NSS) and Kobayashi (KBY). The sites are distributed from northern to southern Japan, and cover cool temperate and warm temperate region. There were two plots in each site; one is chemical fertilizer plot and the other is manure plot. We measure CO_2 flux using eddy covariance method, and calculated net ecosystem production (NEP) by adding CO_2 storage. Moreover, we estimated net biome production (NBP) by subtracting harvested carbon (H) from NEP.

Annual NEP tended to increase with annual air temperature both at chemical fertilizer plots (Fig. 1) and at manure plots (Fig. 2). NEP at the manure plot was smaller than that at the chemical fertilizer plot at the same site because of manure decomposition. At chemical fertilizer plots, NBP was nearly zero or negative except for KBY site (Fig. 1). In contrast, NBP at manure plots was positive in all sites (Fig. 2).

In cool temperate region, manure plots accumulated most of carbon from manure application. In contrast, carbon stock at manure plots in warm temperate region was not only from manure but also from plant biomass. In summary, (1) grassland at chemical fertilizer plots functions almost carbon neutral ecosystem except for warm temperate region. (2)Composted grassland ecosystem in cool temperate region stocks carbon because manure is not easily decomposed. In warm temperate region, however, grassland ecosystem accumulates carbon because of high plant productivity although manure is relatively easy to be decomposed.

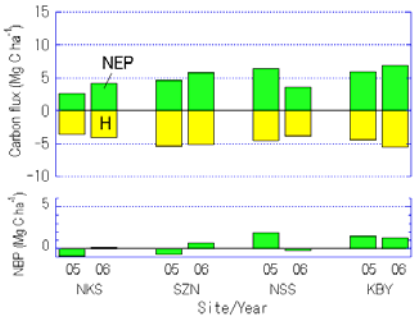

Fig. 1. Annual Net Ecosystem Production (NEP), H (Harvest) And Net Biome Production (NBP) At Chemical Fertilizer Plots

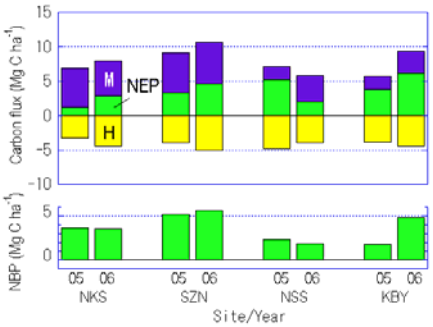

Fig. 2. Annual net ecosystem production (NEP), H (harvest), manure (M) and net biome production (NBP) at manure plots

C20

EVALUATION OF THE EFFECT OF GLOBAL WARMING ON SOIL CARBON EMISSION OF JAPANESE FOREST ECOSYSTEMS

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It has been predicted that global mean temperature will increase about 4°C (ranging 1.1~6.4°C) (IPCC2007). Most of the carbon cycle models apply the exponential functions to predict the future global heterotrophic respiration with a Q_{10} of 2.0. In their models, global heterotrophic respiration increases exponentially with climate warms at an average rate of 6.2% per ºC, and resulting that the current carbon sink of terrestrial ecosystem will convert to a carbon source after 2050. The temperature sensitivity of soil CO_2 efflux, however, did not consist with a few soil warming experiments that conducted at ecosystem level in forest soils and grasslands. The ultimate objective of this project is to estimate the carbon emission rate of whole Japanese forest soils under the climate change by using multi-approaches, including the field soil warming experiment, open-top chamber facility, cross-country soil incubation and model simulation.

In 2007, we installed three soil warming experiment sites at three typical Japanese forest ecosystems, including a 35-year-old Japanese red pine in Kantou region (Tsukuba), a 25-year-old cool-temperate mixed forest in northern Hokkaido (Teshio), and a 25-year-old ever-green Japanese oak forest in Chyugoku region (Higashi-Hiroshima). In 2008, we installed another three sites: a 300-year-old Japanese beech in Cyubu region (Mt. Naeba), a 40-year-old cool-temperate deciduous-broadleaf forest in north-east region (Mt. Iwaki), and a 50-year-old sub-tropical ever-green forest in Kyusyu region (Miyazaki). We installed fifteen automated chambers (0.9m×0.9m×0.5m, L×W×H) at each site for continuous measurement of soil CO_2 efflux. By using a root-cutting chainsaw, we made ten 1m×1m (40 cm in depth) root exclusion plots. To prevent in growth of new roots, we inserted a plastic sheet down to 25 cm around the edge of the plot. Half of the plots at each site were used for soil warming, and another half of the plots were used as control plots by keeping them in the ambient environment. For the soil warming plots, an 800W infrared heater was vertically hanged over the center of the plot at 1.6m above the soil surface. Compared to the control plots, the infrared heater could warm the soil for 3.0, 2.5, 2.0, 1.7, and 1.5°C at depth of 0, 5, 10, 20, and 30cm, respectively. In 2007, soil heterotrophic respiration increased at a rate of 19%, 3% and 4% per degree at 5 cm depth for the Teshio, Tsukuba and Hiroshima site, respectively.

To date, we have collected about 1,500 soil cores, 18 cores each site, from more than 80 forest ecosystems that covered from northern Hokkaido to southern Okinawa, for studying the mechanism of the incubated soil-microorganisms in response to the temperature and soil moisture changes under controlled climatic conditions. The soil samples were divided into three groups. Each group was automatically incubated at a phytotron with temperature increased at 3 degree every 2-week, and the three phytotrons cover the temperature range from 5 to 30°C.

We focus on the productivity and decomposition processes of a evergreen Japanese oak (*Quercus glauca*) stand in six open-top chambers, of which temperature and CO_2 concentration are regulated or elevated: an ambient (B1: 1×CO_2; 0±°C), a mid-elevated CO_2 (B2: 1.4×CO_2; 0±°C), a high-elevated CO_2 (B3: 1.8×CO_2; ±0°C), an elevated temperature (A1: 1×CO_2; +3°C), an elevated temperature and mid-elevated CO_2 (A2: 1.4×CO2; +3°C), and an elevated temperature and high-elevated CO_2 (A3: 1.8×CO_2; +3°C). Soil carbon balance was calculated, based on the difference between input (litterfall and root turnover) and out put (heterotrophic respiration) in each chamber. Our results showed that the balance was minus in all chambers, which means the soils are the sources of atmospheric CO_2. Based on the balance in B1 as the criterion, the balances of other chambers were modified as the difference between the balance in B1 and each others. The minus balance in B3 and A3 was much larger than B1, suggesting that warm-temperate forest will function as the source of atmospheric CO_2 with global warming.

C21

EFFECT ESTIMATION OF ENVIRONMENTAL FACTORS AND SOIL PROPERTY ON TOPOGRAPHICAL VARIATION OF SOIL RESPIRATION

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1. Introduction

Studies on the spatial variation of soil respiration on slopes have been performed in many forest types. The slope heights in these studies varied widely between 7 and 120 m, and most of the studies reported that soil respiration rates were lower on the lower parts of the slopes. Jia *et al*. (2003), Mitani *et al*. (2006), and Kosugi *et al*. (2007) noted that a higher soil moisture ratio is one of the reasons for decreased soil respiration on lower slopes.

Contrary to these previous studies, Tamai *et al.* (2005a) reported that soil respiration was lower in areas of higher topography due to drier soil in deciduous forests of the weathered granite region.

To address this issue, we examined the effect of soil temperature and moisture on the difference in soil respiration between ridge and valley bottom locations in a deciduous forest in the weathered granite region of Japan.

2. Site description

The observations took place in the Yamashiro Experimental Forest in southern Kyoto Prefecture, Japan(34°47'N, 135°50'E). In 1999, Goto *et al*. (2003) determined the total basal area and aboveground biomass of stems with a diameter at breast height (DBH) greater than 3 cm to be 20.7 $m^2 ha^{-1}$ and 105.05 t ha^{-1}, respectively. The average litter fall from 1999 to 2002 was 5.16 t ha^{-1} $year^{-1}$, with a mean air temperature of 15.5°C, warmth index of 125.6°C month, and annual precipitation of 1,449.1 mm.

Tamai *et al*. (2005a) recorded soil respiration for 360 colors of soil in the Yamashiro Experimental Forest and reported that the following equation could be adapted to whole of this experimental forest, regardless of topography:

$$F_c = 0.0566\mathrm{EXP}(0.0717T_s)\left(\frac{\theta}{0.1089+\theta}\right) \quad (1)$$

where F_c is soil respiration (mg $CO_2\,m^{-2}\,s^{-1}$), and T_s and θ are the soil temperature (°C) and soil moisture ratio ($m^3\,m^{-3}$), respectively, at 5-cm depth.

3. Methodology

The Yamashiro Experimental Forest is located in a hilly mountainous area and includes an approximately 10-m-wide valley with a 30-m-high ridge. Plot V was located at the bottom of the valley, while plot R was on a ridge above the valley. Table 1 provides information on plots V and R. The distances between the plots were around 70 m and 30 m, horizontally and vertically, respectively. Soil respiration (F_c), soil temperature (T_s), and soil moisture ratio (θ) were monitored in both plots using an automated chamber system, SS-201A (ROGU DENSHI) and HYDRA (Stevens Vitel), respectively.

4. Results and Discussion

The effects of T_s and θ on ΔF_c (=$F_{cv} - F_{cr}$)were estimated by Eq.(2) and (3), respectively.

$$\mathrm{EF}(T_s) = F(T_{sv}, \theta_v) - F(T_{sr}, \theta_r) \quad (2)$$

$$\mathrm{EF}(\theta) = F(T_{sr}, \theta_v) - F(T_{sr}, \theta_r) \quad (3)$$

where $F(T_{sp}, \theta_p)$ is the rate calculated by Eq. (1), using T_s and θ values in plots V and R. The subscript p denotes Plot V or Plot R.

The annual soil respiration rate in plots V and R were almost the same at approximately 6.2 tC ha^{-1} $year^{-1}$. However, this rate at Plot R includes the effects of acceleration by warm soil temperature (0.68 tC ha^{-1} $year^{-1}$) and deceleration by soil drying (0.62 tC ha^{-1} $year^{-1}$). The values of 0.68 tC ha^{-1} $year^{-1}$ and 0.62 tC ha^{-1} $year^{-1}$ represent about 10% of the annual soil respiration rate. The minimum value of EF(T_s) and the maximum value of EF(θ) reached as large as –0.77 and 0.98 gC m^{-2} day^{-1}, respectively, throughout the year. These differences were large compared to the daily soil respiration rate, indicating that daily differences in the soil respiration rate cannot be ignored.

Special Session II - HydroKorea

H01

OVERVIEW OF HYDROKOREA

J. Kim

Yonsei University, Seoul, Korea

'HydroKorea' is one of the core projects of Integrated Water Resources Management Technology Division in the Sustainable Water Resources Research Center. The main objectives of HydroKorea are to (1) construct daily evapotranspiration (ET) maps with 1 km resolution for the Korean Peninsula, (2) craft technologies that enable real-time forecasting of ET at various catchment scales, and (3) contribute to establishing global standard for water resource management to build global partnership by sharing information and technology. Current researches are focused on (1) production of quality ET data based on eddy-covariance flux measurements, (2) improvement of MODIS ET algorithms based on field measurements and ecohydrology modeling, (3) validation and enhancement of the next generation numerical prediction model with upgraded land surface parameters, and (4) synthesis of ET mapping based on MODIS, numerical prediction model, and off-line land surface model with digital climatology map. The success of HydroKorea depends on defining practical 'scaling logic' that incorporates a synergy of field measurements, numerical modeling and remote sensing.

H02

EVAPOTRANSPIRATION MAPPING OVER EAST ASIA USING KOREA LAND DATA ASSIMILATION SYSTEM

Y. Lim, K. Byun, and T. Lee

Yonsei University, Seoul, Korea

The objective of this research is to estimate evapotranspiration (ET) map over East Asia based on physical process-based land surface model. To accomplish this, we use Korea Land Data Assimilation System (KLDAS), which was originally developed by to initialize a regional weather forecast model, consisting of the Noah land surface model with the MODerate Resolution Imaging Spectroradiometer (MODIS) based land surface parameters, observation and analysis based input meteorological forcing data, and long-term integration procedure for model spin-up. Flux measurements from KoFlux network are used to evaluate KLDAS output over both mixed forest and paddy land surface, which are dominant land cover types over Korean Peninsula. KLDAS ET estimation in 2006 spun up during 18 months can predict ET with accuracies approaching 10%-20% of that of the in-site measurements, effectively capturing the temporal development of surface flux patterns for both forest and paddy land. KLDAS ET estimation can get the ET estimation even in precipitation case. Results also indicate that prediction accuracy was strongly related to crop type, with paddy predictions showing improved estimates compared to those of mixed forest. Overall, these data allow an assessment of modelled fluxes to expend to estimate ET map over East Asia.

Acknowledgments: This research was supported by grants (code: 1-8-3) from Sustainable Water Resources Research Center for 21st Century Frontier Research Program.

H03

MAPPING ACTUAL EVAPOTRANSPIRATION ACROSS GWANGNEUNG WATERSHED USING HIGH-DEFINITION GEOSPATIAL DATA AND SIB2

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[2]*Biometeorology Laboratory & Global Environment Laboratory, Department of Atmospheric Science, Yonsei University, Seoul, Korea*

While numerous studies are available for estimating actual evapotranspiration (ET) over homogeneous areas using point measurement of meteorological variables, monitoring of spatial ET has not been possible at landscape scales. We propose a site-specific application of SiB2 (Simple Biosphere Model 2), which is enabled by spatially interpolated input data at desired spatial resolution. Gwangneung experimental watershed was divided into a regular grid of a 30m spacing and hourly temperature, humidity, wind, precipitation and solar irradiance was estimated for each grid cell by spatial interpolation of synoptic weather data. Topoclimatology models were used to accommodate effects of topography in spatial interpolation procedure, such as cold air drainage on nocturnal temperature and solar irradiance on daytime temperature. Satellite remote sensing data were used to classify the vegetation type of each grid cell, and the corresponding spatial attributes including soil texture, canopy structure, and phenological features were identified. All data were fed into a standalone version of SiB2 to simulate latent heat flux at each grid cell. A computer program was written for data management in the cell - based SiB2 operation such as extracting input data for SiB2 from grid matrices and recombining the output data back to the grid format. ET estimates at selected grid cells were validated against the actual measurement of latent heat fluxes by eddy covariance measurement. We applied this system to obtain the spatial ET across the experimental watershed in 2006 on a continuous basis. According to the model calculation, the spatial average ET for each season was 0.5 for winter (December to February), 1.5 for spring (March to May), 2.1 for summer (June to August), and 1.6 mm d^{-1} for autumn (September to November), respectively. These values correspond to 76 (summer) to 80 % (winter) of potential ET estimated by FAO PM method.

Acknowledgements: This research was supported by grants (code: 1-8-3) from Sustainable Water Resources Research Center for 21st Century Frontier Research Program.

H04

MAPPING EVAPOTRANSPIRATION USING MODIS IMAGES

S. Kang[1], K. Jang[1], and J. Kim[2]

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A modified remote sensing-Penman Monteith (RS-PM) model (Mu *et al*., 2007) was applied to estimate land surface evapotranspiration (ET) by using MODIS products only. Our stand-alone algorithm was devised to utilize MODIS atmospheric products and land products to estimate input variables for the PM model including net radiation, vapor pressure, and canopy conductance. This presentation aims to demonstrate (1) some techniques increasing retrieval rate of, (2) uncertainty analysis on, (3) mapping MODIS ET and finally (4) its application to mapping vegetation water stress index. Ground insolation data from 22 Korea National Weather Stations (NWS) from 2004 to 2006 were utilized to test and improve MODIS insolation and the gap filling algorithm. Four AsiaFlux sites (two in Korea and the other two in Japan) were selected for testing accuracy of MODIS ET. MODIS ET for partial clear-sky condition showed almost similar errors to those for clear-sky condition, while retrieval rates increase nearly doubled. We devised a simple gap filling approach for MODIS aerosol data that is identified as a bottleneck to determine retrieval rates of insolation and ET. The retrieval rate of MODIS insolation doubled up to 42 and 44 % for Terra and Aqua, respectively, after aerosol gap filling with negligible compensation on accuracy. In spite of high accuracy of MODIS driven input variables (i.e. insolation and net radiation), MODIS ET showed meaningful errors at the two KoFlux sites but showed good agreements at the two Japan flux tower sites. Hence, uncertainty tests need to be extended across many geographic locations with different climate regime, biome type, and landscape complexity. As well, more process-level evaluation of the model performance is necessary especially for conductance terms in the P-M model. The algorithm was utilized for mapping daily MODIS ET in Korea from 2001 to 2006. The acquisition rate was averaged to one third of 365 days (i.e. ~120 days per each year) but each grid pixel has different acquisition rate, primarily depending on local cloudy condition of each year. The daily ET maps from MODIS were integrated to produce monthly and annual mean ET for only clear-sky conditions. The clear-sky ET maps showed both considerable inter-annual and spatial variations. The maps were applied to derive mapping vegetation water stress index by comparing with potential ET. Our demonstration on MODIS ET, however, remains for further improvements including process-level evaluation, parameterization on more divers land cover types, gap-filling for cloudy days to increase retrieval rate or development of MODIS ET algorithm for cloudy condition.

Acknowledgments: This study was supported by a grant (code# 1-8-3) from Sustainable Water Resources Research Center of 21st Century Frontier Research Program, A3 Foresight Program CarboEastAsia, and Innovative Forest Disasters R&D Center.

H05

ESTIMATING SPATIAL DISTRIBUTION OF EVAPOTRANSPIRATION IN ECO-HYDROLOGICAL SYSTEMS WITH DIFFERENT TYPES OF LAND COVER

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Evapotranspiration (ET) is critical to predicting the amount of available water resources in watersheds. Estimating long-term ET is in particular required, because the climate change will alter the water balance of the watershed. The estimation of ET is dependent largely on understanding spatial heterogeneity and dynamic relationship between plant physiology and water balance, where the distribution of land covers is complex.

In this study, daily ET was estimated using a modified eco-hydrological model (RHESSys), that integrates plant physiological processes, water processes, characteristics of the Korean specific land covers (e.g., paddy field) and spatial heterogeneity within a pixel. Modifications are as follows: (1) development of an ET algorithm considering forest cover fractions (CF) within a forest pixel; (2) improvement of a phenology algorithm including working schedule of paddy fields; (3) addition of freewater ET occurring on detention water of paddy fields using new irrigation algorithm, and (4) addition of freewater ET occurring on a surface of streams and reservoirs.

In the modified model, the effect which different types of land cover have on ET was discernable. At the small watershed of Gwangneung flux site, for example, the measured ET was 622 mm from Mar. 2006 to Oct. 2006. On the other hand, ET of CF1.0 was 643 mm (RMSE: 2.54 mm/day) and ET of CF0.9 was 599 mm (RMSE: 2.38 mm/day). Here, CF1.0 means that a forest pixel doesn't include bare soil cover within the pixel, and CF0.9 indicates that a forest pixel is comprised of 10% bare soil cover and 90% forest cover. Bare soil evaporation within forest pixels was also described by the modified model.

ET on rice paddy fields was 424 mm/year at non-irrigated system in 2006. When the irrigation module was applied to simulate ET, however, ET was 502 mm/year. It includes the evaporation from detention water on paddy fields.

The modified model is helpful in producing a map for spatial distribution of daily ET in a national standard watershed that comprises various types of land covers. The model will contribute to estimating long-term variations of available water resources.

Acknowledgments: This research was supported by grants (code: 1-8-3) from Sustainable Water Resources Research Center for 21st Century Frontier Research Program.

H06

CONTINUOUS ESTIMATES OF EVAPOTRANSPIRATION OVER FOREST AND FARMLAND IN KOREA

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HydroKorea II aims to produce evapotranspiration (ET) mapping over Korea Peninsula and to utilize the development for reliable water management and water budget prediction. In order to fulfil the goals, the integration of flux measurements, remote sensing observation, and ecohydrological modeling has been performed. ET estimates from the flux measurements has been used as a validation point of ET prediction from the remote sensing and modeling. In this study, we present the continuous estimates of ET at the two major ecosystems (deciduous forest, DK and farmland, FK) in Korea, and diagnose the effect of surface and environmental factors controlling ET. An eddy covariance technique was used to measure ET at both sites. The data analysis was focused on October 2005 – September 2007 for the DK site and January 2004 – December 2006 for the FK site. At the DK site, the averaged annual precipitation was 1543 mm and the averaged annual ET was 367 mm, which was about 24% of the annual precipitation during the measurement period. The averaged annual precipitation and ET at the FK site were 1397 mm and 624 mm, respectively. Although the annual precipitation at the DK site was larger than that at the FK site, the annual ET at the DK site was smaller than that at the FK site. Omega factor was 0.4 for the DK site and 0.5 for the FK site during the summer, indicating that 1) equilibrium ET and imposed ET were adequately harmonized and 2) various environmental factors controlled ET at both sites.

Acknowledgments: This research was supported by grants (code: 1-8-3) from Sustainable Water Resources Research Center for 21st Century Frontier Research Program.

H07

A SOIL MOISTURE UPSCALING TECHNIQUE USING MEASURED DATA FROM A HILLSLOPE

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In this paper, an upscaling technique is proposed using a log-term measurement of soil moisture at a hillslope scale. Considering the characteristics of the terrain feature, a monitoring scheme for soil moisture was designed and operated over a year, with the analysis period divided into 4 periods in consideration of the seasonal characteristics of soil moisture variations. Based on rigorous regression analysis, significant relationships were established between mean soil moistures and topographic attributes. The CDF matching technique is employed to upscale the soil moisture from the measured dataset. The prediction scheme for soil depth distribution is proposed from the adaptation of the multi-resolution valley bottom flatness algorithm. Scaling issues of different resolution in the terrain analysis could be partially resolved by the procedure of CDF matching, but parameters for the valley bottom evaluation still suffered from the uncertainty associated with the complex terrain in the Bongsunsa watershed. However, by combing the CDF matching technique with a depth prediction scheme, the spatial distribution of water depth could be predicted in the watershed scale.

Acknowledgments: This research was supported by grants (code: 1-8-3) from Sustainable Water Resources Research Center for 21st Century Frontier Research Program.

H08

VALIDATION OF MODEL AND SATELLITE-DERIVED EVAPOTRANSPIRATION USING LONG-TERM WATER BUDGET IN THE HAN RIVER BASIN, KOREA

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Secure and sustainable water resource management under changing climate conditions requires more quantitative understanding of water cycles and budget. In Korea, evapotranspiration (*ET*) has been one of the most uncertain water cycle components mainly due to the difficulty in measurement. Recently, inter-disciplinary studies such as HydroKorea program enabled a quantitative estimation of nationwide distribution of *ET*. Although the outcomes are promising, practical difficulties persist regarding the validation of model and satellite based *ET* estimates. In this study, we estimated catchment scale *ET* based on long-term hydrological data as an effort to provide data to be used for validation of model- and satellite-derived *ET*.

Measurements of precipitation (*PPT*) and discharge (*Q*) have been used as a convenient tool to assess the first order estimate of catchment scale *ET* based on simple relation: $ET = PPT - Q - S$, where S is the change of water storage in the catchment and is close to zero assuming a steady state. This simple approach has often been incorrectly used without confirming steady state conditions in terms of hydrological cycle (i.e., $S \approx 0$) and without quantitative estimation of mean residence time of water (*MRT*) in the catchment. In the Han River basin, the calculated *MRT* is less than or close to ~1 year regardless of catchment scale. This indicates that the steady state of hydrological conditions ($S \approx 0$) is satisfied at time scale of ~1 year. Therefore, the first order estimate of annual *ET* can be conveniently derived from the difference between *PPT* and *Q*.

Unlike *PPT* data, long-term continuous measurements of discharge are rare in Korea. Therefore, using available data, we derived *Q* based on the relationship between *PPT* and *Q* at annual time scale. For many catchments in the world, a linear correlation between measured annual *PPT* and *Q* is common and the slope (0.1 ~ 0.8, in case of the Mississippi River Basin) of the correlation is unique depending on the catchment types. For the Han River basin, the relationship is expressed as Q (mm/y) = $0.66 \cdot PPT$ (mm/y) – 254 (R^2 = 0.82). The obtained relationship was applied to Gwangneung catchment where comprehensive eco-hydrological measurements are underway and resulted in reasonable agreement with measured discharge data, indicating that the relationship may have broad applicability to various tributary catchments of the Han River basin. Using this relationship, the average annual *ET* in the Han River basin for the period from 1966 to 2001 was estimated as 56% (673mm) - ranging from 47% to 63% - of annual *PPT* (averaged as 1208 mm). The estimated *ET* represents the maximum quantity of water that can be used for evapotranspiration at catchment scale as constrained by hydrological processes and data.

Acknowledgment: This study is supported by a grant (Code: 1-8-3) from Sustainable Water Resources Research Center of 21st Century Frontier Research Program.

H09

SYNTHESIS OF ET MAPPING AND ITS APPLICATION

S. J. Kim[1], S. Kang[2], U. Chung[3], Y-J. Lim[1], H. Kwon[1], D. Lee[1], and J. Kim[1]

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To support long-term sustainable water resource management in Korea, HydroKorea research team is developing nationwide evapotranspiration maps and related technologies based on MODIS satellite images, ARC-SiB2, and numerical weather forecasting model. This synthesis discussion will present methodologies to produce an integrated ET map, characteristics of each mapping technology, and application of developed technologies for scientific and public demands.

Acknowledgement: This research was supported by grants (code: 1-8-3) from Sustainable Water Resources Research Center for 21st Century Frontier Research Program.

Special Session III - ACTSociety

A01 *Keynote Speech*

THE ROLE OF ECOSYSTEM FLUX MEASUREMENTS IN BRIDGING BETWEEN ENVIRONMENTAL SCIENCE, ENVIRONMENTAL POLICY AND NATURAL RESOURCE MANAGEMENT

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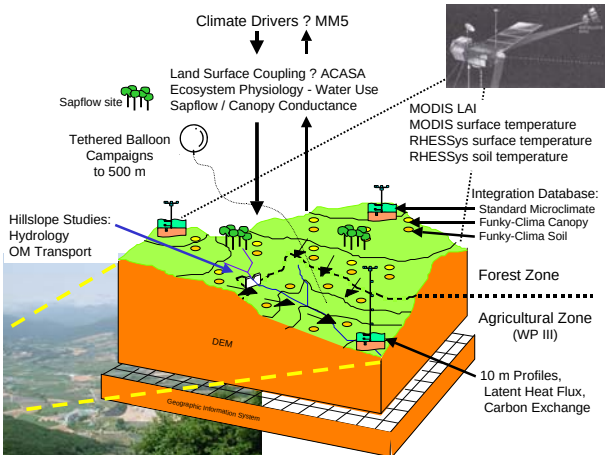
During recent decades, anthropogenic impacts on natural and managed ecosystems have increased to alarming levels. Climate change due to increasing atmospheric carbon dioxide concentration is altering the radiation input, temperature regime, and precipitation regime of ecosystems, and will, thus, shift both water balances and production. Atmospheric deposition and intensive land use with high levels of fertilization have modified plant growth, nutritional balances of ecosystems, nutrient losses to aquatic systems, susceptibility of organisms to disease, composition of communities, and ecosystem resistance to stress. These modifications in ecosystem function affect derived ecosystem services, i.e., agricultural and forest products, water discharge into rivers and streams, water quality, biodiversity, etc.

A complex interaction of at-mospheric, biological, geochemi-cal, and hydrological factors, together with decision-making and management, determines the dynamics of landscape water, car-bon, and nitrogen cycles impor-tant to mankind's well-being. Due to the complexity of landscape response to atmospheric deposi-tion, altered climate and land use change, sustainable use of natural resources requires a new understanding of how energy and water budgets, the carbon cycle, and nutrient cycles are coupled (Tenhunen and Kabat 1999). Experimental projects and models must be designed to achieve a synthetic understanding of ecosystem processes and their variation at the stand and landscape levels (Fig. 1). Flux measurements play a critical role in construction and validation of such models. But validated simulation models must also provide information on how to maintain appropriate levels of production, adequate water discharge from watersheds, and acceptable water quality, e.g., suitable integrated function of ecosystems at landscape scale. Subsequently and in coordination with natural science analyses, our regulatory choices and actions in policy-making and their consequences for management of social-ecological systems must be made clear. Thus, tools must be developed that help us to understand the consequences of human decision-making with respect to ecosystem performance. The preference for carrying this out at landscape scale relates to the desire to work with locally appropriate data, local integrative measures, to develop a focus on very specific environmental problems (rather than general problems), and to conduct analyses appropriate in a single cultural and social context.



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Tenhunen, J.D., Kabat, P. (eds.) (1999) Integrating hydrology, ecosystem dynamics, and biogeochem-istry in complex landscapes. John Wiley and Sons, Chichester, UK, pp. 367.

A02

CARBON DEBITS AND CREDITS: A VIEW FROM THE GROUND FLOOR IN AMERICA

P. Campbell

Campbell Scientific Inc. Utah, USA

A view from the ground floor is more about the traffic on the street than it is about the vista of distant horizons. As a small manufacturing business (250 employees) in the United States serving climate scientists around the world, there is a noticeable and growing difference between scientific observations about climate change and the urgency and public will to change how we live and do business. The influences and decisions that enlarge the company's carbon footprint will be contrasted against the influences and decisions that would shrink the company's carbon footprint. With a vested interest in the future of humanity, international trade, and continued business success, some suggestions will be made for public policy that will allow us to join hands and do together what a single small business would be reluctant to do alone.

A03

CARBON NEUTRAL PROGRAM IN KOREA: AN APPLICATION TO ASIAFLUX WORKSHOP

E. Yang[1], S. Im[1], J. Yoo[1], and H. Shin[2]

[1]*Yonsei University*
[2]*Korea Energy Management Corporation*

Being aware of the carbon track of our daily activities is the beginning of managing the carbon implications of daily decisions. 'Carbon neutral' pursues a world that maintains a safe living temperature and healthy environment for generations to come. It involves calculating the total carbon emissions, reducing them where possible, and then balancing the remaining emissions, often by purchasing a carbon offset (e.g., paying to plant new trees, investing in green technologies such as solar power). Offset expenses need to be factored into the cost of activities. Integrating budgets for offsets from the beginning makes the basic planning process more efficient and supports activities which encourage efficiencies first. The practical application of offsetting carbon emissions is a step towards slowing the increase of atmospheric CO_2. As has been pointed out by the Global Carbon Project, voluntary carbon offsets are expected to be a transient mechanism as a 'low carbon, green growth' strategy becomes business as usual in the future. In this presentation, we introduce the framework of practicing carbon neutral in Korea and its application to the present AsiaFlux workshop as an exemplary case.

A04

UK RESPONSE TO CLIMATE CHANGE

T. Clemson

Head Climate Change Section
UK Embassy, Seoul

Nobody is in any doubt that we currently face significant challenges that threaten the way of life and standard of living that we enjoy. The global economy is changing and changing rapidly. The recent credit and energy crunches have left their mark on all economies. Climate change affects all countries and requires a global response.

The global energy crisis, coupled with the recognition that we must act and act now to limit the effects of greenhouse gases - point in one direction: a transition, swift and complete, to a global low carbon economy. No country is exempt. There is no other option if we are to preserve current living standards l*et al*one build them still further. The only choice we have as nations is to decide whether we will be an early mover or hang back and let others go first.

The British Prime Minister, Gordon Brown, has spoken about the need for a fourth technological revolution. In the past the steam engine, internal combustion engine and the microprocessor transformed not just technology but the way society was organised and how people lived. Now we are about to embark on a comparable technological transformation: to low carbon energy and energy efficiency.

President Lee Myung-bak, in his key speech to mark Liberation Day on 15 August 2008 called for a "low carbon, green growth" future for Korea. President Lee understands well that the world is on course for a paradigm shift in state policies on food, environment, water, natural resources and energy.

I applaud the President's vision. Korea's future as a world leader and economic power depends on its ability to make this transition quicker and more completely than its competitors.

But it takes firm and ambitious policies to realise this vision. Not just Korea but ALL countries need to move outside of their comfort zones. The International Energy Agency predicts that if all the climate change policies currently under consideration were implemented we would still see a global temperature rise of 3 C. This is catastrophic climate change!

Political conditions for an ambitious binding global agreement in Copenhagen do not yet exist. Politicians, industries and citizens – as both consumers and voters – need to be mobilised.

The UK is playing its part. The Climate Change Bill – currently being debated in the British Parliament – will set statutory carbon emission reductions of at least 60% by 2050, based on 1990 levels. We are investing heavily in renewable energy such as off-shore wind, solar, tidal, wave and biomass. The UK is leading in the field of carbon capture and storage with one of the world's first commercial demonstration plants. And through the EU Emission Trading Scheme and a range of fiscal policies we are driving industry to shift to low carbon and reduce emissions *while at the same time* continuing to grow.

But we need to see comparative effort from all countries especially the most advanced wealthy countries such as Korea. Korea's GDP per capita is significantly higher than many EU countries such as Poland, Romania and Bulgaria. These nations have binding emission targets and their energy-intensive industries operate in a cap and trade scheme. Recently the FTSE Index declared that Korea is a developed market. I hope to see Korea, as an OECD member, take on binding commitments in line with its economic status.

A05

ECOSYSTEM CARBON STUDY FOR THE SOCIETY: SYSTEM APPROACH AND GLOBAL FOREST CARBON MONITORING SYSTEM

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National Institute for Environmental Studies, Tsukuba, Japan

Terrestrial ecosystem is one of the largest carbon pools in the global carbon cycle, and forest carbon sequestration is expected to ameliorate drastic climate change. However, vast areas of forest, especially in developing countries, are being lost rapidly, leading to huge amount of carbon emission to the atmosphere. There remain, also, large uncertainties in our quantification of carbon budget at landscape and larger scales. Accordingly, we needed to develop the System Approach, in which field data, flux observations, satellite monitoring, and models, are synthesized in an integrated manner. This was a mission of the GERF S-1 Project, and regional carbon budget in East Asia was fully investigated.

Now, we are developing a specific project (GERF B-81; Fig. 1) with the financial support of the Ministry of the Environment, Japan, for the global Forest Carbon Monitoring System (FCMS) driven as a GEO program. This project aims at evaluating carbon release from deforestation and forest degradation, and is deeply related with the Reducing Emission from Deforestation and Degradation in Developing countries (REDD) implementation, in terms of the Post-Kyoto carbon and climate management options. One of the key features of our project is the advanced usage of satellite monitoring of forest biomass by the ALOS/PALSAR images, in combination with inventory and modeling approaches. In this study, a process-based ecosystem model (VISIT) is employed to simulate long-term change in vegetation and soil carbon dynamics after disturbances.

Finally, we should emphasize that flux measurements as conducted in the AsiaFlux are expected to provide valuable data for development and validation of these activities. To provide quantitatively reliable knowledge to the society, long-term and wide-coverage flux observation effort is highly appreciated.

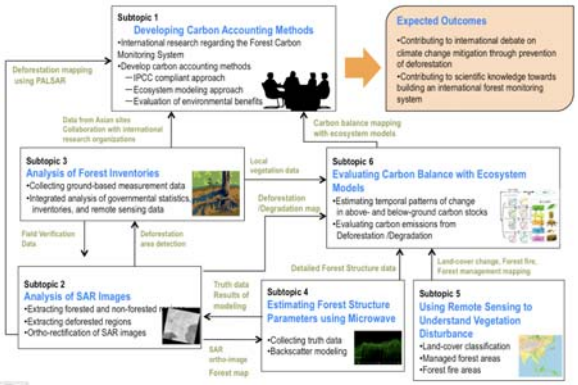

Fig. 1. Research project on global forest carbon monitoring system (2008-2010).

Poster Session

P01

ANALYZING A RELATIONSHIP BETWEEN TERRESTRIAL CARBON FLUX AND METEOROLOGICAL PARAMETER IN FAR EAST ASIA

T. Sasai[1], R. Hirata[2], N. Saigusa[3], K. Nasahara[4, 5], Y. Ohtani[6], K. Takagi[7], and Y. Yamaguchi[1]

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[7]*Hokkaido University, Horonobe, Japan*

Terrestrial carbon cycle is always affected by climate change via vegetation and soil activities. Especially, effects of incoming radiation, precipitation and air temperature on terrestrial carbon fluxes is fairly strong (Nemani *et al*., 2003; Sasai *et al*., 2005). In order to correctly understand seasonal and inter-annual changes in the carbon fluxes, we need to examine a relationship among three meteorological parameters and terrestrial carbon fluxes like Gross Primary Production (GPP), Net Primary Production (NPP), and Net Ecosystem Production (NEP).

We are aimed at clarifying a relationship between terrestrial carbon flux and meteorological parameter in far East Asia. Data used are carbon flux map estimated by biosphere model (Biosphere model integrating Eco-physiological And Mechanistic approaches using Satellite data; BEAMS), satellite observation dataset such as the TRMM/3B43 precipitation products and MODIS Photosynthetic Active Radiation (PAR) products provided by Japan Aerospace Exploration Agency (JAXA), and the NCEP/NCAR re-analysis air temperature data (processed with down-scaling using the WorldClim dataset). Either data have monthly mean time step and 1km spatial resolution. Study area is Far East Asia (N30°, E125° - N50°, 150°). In model validation, the BEAMS estimations were compared with ground measurements at tower flux sites (TSE, LSH, TKY, TMK, FJY), leading up to what BEAMS estimations could fall within reasonable range. In response to the validation result, we simulated carbon cycle using wide-area data, and compared among the model estimations such as GPP and NPP, and precipitation, PAR, air temperature. We could understand a difference of these relationships for each plant functional type in Far East Asia.

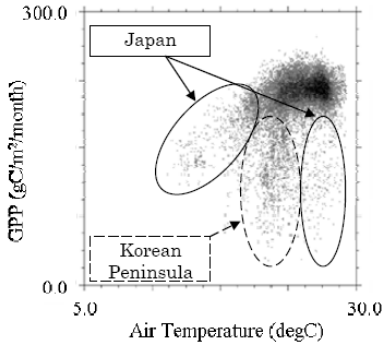

Fig. 1. Comparison between monthly GPP value and monthly-averaged air temperature on evergreen broadleaf forest on July, 2006.

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P02

THE IMPACT OF CARBON ON WETLAND ECOSYSTEM-MODEL CLIMATE CHANGE

Withdraw

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[2]*Laboratory of Quantitative Vegetation Ecology , Institute of Botany ,the Chinese Academy of Sciences , Beijing, China*

According to the statistics of 1950-2005 years of meteorological monitoring results, Liaoning Province climate warming rate was significantly higher than the national rate. Climate warming caused times of rainfall reduced and extreme weather events raised.

The combined effects of climate change have a huge impact on wetland NPP（net primary productivity）and carbon cycle.

Liaoning Province has many important wetlands, which of them Panjin wetland is the largest coastal wetlands, Paddy field accounted for 17% of the arable land of the province as artificial wetlands is China's major rice base.

This affected by climate change have significantly shorten period of rice, it also ahead of the budding trend schedule of the Liao He River Delta Reed.

Based on the statistics of the last 50 years climate data and the area dynamic changes of the wetlands, this paper analyzed the impact and feedback between the Liaoning Province climate change and wetland ecosystem.

P03

TIDAL EFFECT ON CARBON FLUX OVER AN ESTUARINE WETLAND

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Estuarine wetlands are influenced by tide, which not only change the groundwater level and the water residence time but also ecosystem processes and functions such as carbon accumulation and decomposition process. Two years of water level monitoring records and continuous data from three sets of tower-based eddy covariance towers established in Chongming Island along an elevation gradient were analyzed to evaluate the tidal effect on the estuarine ecosystem carbon exchange. Tides also play an important role in lateral matter exchange, such as the transport of plant litter (e.g. plant detritus), fish, and other organisms that come in from the sea to feed within the saltmarsh and then return to the sea. Vegetation dynamics can also influence *Fc* at multiple scales, however, during the peak growing season, especially in July and August, higher carbon uptake was observed during spring tides at each site, which contributes to study the regularities of tidal effect on *Fc*. Generally, *Fc* would change as a function of the tidal phase and height because tidal influences would decrease with increasing distance from the sea and the accompanying elevation change. During spring tides the amplitudes of diurnal *Fc* was lower than that during neap tides. Consequently, differences in *Fc* between the sites would be determined by differences in the suppression of respiration and alteration of photosynthesis due to tidal inundation. The dynamics of *Fc* at each site exhibit a tide-driven pattern with a temporal scale between 10 and 20 days, coinciding with the tidal period. Indeed at flood tides the floating plant litter is often blocked by the vegetation while at ebb tides the currents can be large enough to force the floating plant litter through the vegetation and export it to the tidal creek. Thus, further study on lateral carbon transport is required to investigate the tidal effect on the carbon sink/source role of the wetland.

P04

CARBON BUDGET AT BARLEY-RICE DOUBLE CROPPING FIELD IN JAPAN

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Introduction

Rice paddy is one of the typical cultivation patterns and is widely distributed in monsoon Asia. The cultivation practice of rice is different in each area across Asia. In Southeast and South Asia, which have sufficient water and high temperature, rice grow twice or thrice in a year. In East Asia, rice grow only once in a year, but other crop such as wheat or barley is planted during non-cultivated period of rice in some regions. We observed Net Ecosystem Exchange (NEE) by using eddy covariance method to evaluate carbon budget at barley-rice double cropping field in Japan. Barley and rice grow from early winter to late spring and from early summer to mid fall, respectively at the site. Water is only supplied by rainwater in barley cultivated period, but irrigation water is employed in rice cultivated period, so that the soil surface is covered about 4cm with water.

We present carbon budget of barley-rice double cropping field. Net Primary Production (NPP) in both crops is also evaluated by eddy covariance method and biometric sampling. In rice cultivated period, not only CO_2 but also CH_4 is also one of the most important components of carbon budget. In addition, CO_2 emission from soil is dissolved in irrigation water. These factors are also taken into account of carbon budget.

Method

The site is located in west Japan (34°32′N, 133°55′E, 2m a.s.l.). The barley was sowed on the soil on 28 November 2007 and harvested on 4 June 2008. Rice was transplanted on 24 June. NEE was measured with the eddy covariance system, which consisted of sonic anemometer (DA-600, Kaijo) and an open-path infrared gas analyzer (LI-7500, LI-COR). CH_4 flux was measured with the aerodynamic method in rice cultivated period. Air inlets for sample air were mounted at four height 0.25, 0.55, 1.00, 1.88m above the ground and CH_4 concentrations were measured using a flame ionization detection CH_4 analyzer (APHA-370, HORIBA). Irrigation water was sampled every irrigated and drained day. The total /inorganic carbon was measured with combustion catalytic oxidation/NDIR analyzer (TOC-V CSH, SHIMADZU). Other meteorological variables such as air temperature, photosynthetically active radiation, soil water content were also measured.

Results

Accumulated values of Gross Primary Production (GPP), Ecosystem Respiration (RE) and NEE in barley period was 562, 264 and -298 gC m^{-2}, respectively (Fig. 1). Accumulated RE in non-cultivated period, which between harvested of barley to transplanted rice, was 47 gC m^{-2}. Although the non-cultivated period in the field was only three weeks, the cumulated RE was comparatively large. Figure 2 shows accumulated NPP by eddy covariance method (NPP_M) and NPP by biometric sampling(NPP_B) in barley period. Although the carbon content of biometric sampling, 0.4 was used for the estimation of NPP_B, NPP_M agree with NPP_B. CH_4 flux and TC in irrigation water during rice period now under analysis, but we will show the carbon budget in the presentation.

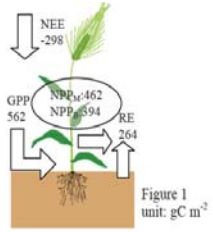

Figure 1
unit: gC m^{-2}

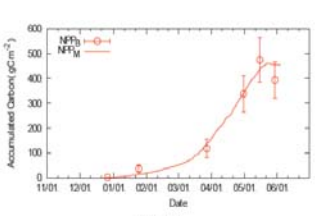

Figure 2

P05

CARBON BUDGET IN DOUBLE-RICE CROPPING PADDY FIELD IN NORTHERN BANGLADESH: DOES MULTIPLE CROPPING PROMOTE ECOSYSTEM CARBON ACCUMULATION?

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Paddy fields are one of the ecosystem types characterizing agricultural land use in monsoon Asia. Although paddy fields are distributed widely from Northeast Asia to Southeast and South Asia, cropping pattern in paddy fields is not uniform. In tropical and subtropical area 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 rice and barley) or single cropping of rice is generally practiced. Some of the authors have been continuing observation of carbon and water exchange at single-rice cropping paddy field (MSE site) in central Japan since 1999. By the observation, seasonality, annual budget and interannual variability of carbon and water exchange were well described. However, carbon and water exchange at paddy field would change with cropping patterns and related cultivation practices and field management. For example, MSE is a weak carbon source when harvested biomass carbon is taken into account, but multiple-cropping paddy field with larger input of biomass carbon may have different carbon budget. To characterize and quantify carbon and water exchange in multiple-rice cropping paddy field and to estimate influence of multiple-cropping on the annual budgets, we started observation at double-cropping paddy field in Mymensingh, northern Bangladesh in 2006 with support of AsiaFlux.

At the study site (MYM site), rice is cultivated twice a year under sub-tropical climate conditions. Boro rice is transplanted in late January and harvested in mid-May. Paddy field is irrigated during the Boro growing season because most of it is in dry season. Aman rice, on the other hand, is transplanted in mid-August and harvested in early December. The paddy field is basically rain-fed during the Aman growing season because it begins in the monsoon period. Flux densities of carbon dioxide (CO_2) and water vapor were measured by the open-path eddy covariance method. Seasonal and annual carbon budgets averaged for two years (2006 and 2007) were compared with those of MSE averaged for seven years from 2001 to 2007. Major findings are as follows:

1) Gross primary production and ecosystem respiration at MYM during the growing season were greater than those at MSE by 67% and 76%, respectively, in total of two cropping seasons.

2) Net CO_2 emission at MYM in the non-growing season was smaller than that at MSE by 180 g C m^{-2} principally because continuously inundated field in the monsoon season after harvest of Boro rice enhanced ratoon regrowth and also suppressed soil respiration.

3) The annual NEP at MYM (560 g C m^{-2} y^{-1}) was triple the amount of MSE. Consequently, MYM was carbon sink of 120 g C m^{-2} y^{-1} even after harvested biomass carbon was subtracted from the annual NEP.

4) Since increased carbon gain by double cropping (the increase in NEP in the growing season) was almost compensated by increased amount of harvest, reduced net CO_2 emission from inundated field in the post-Boro season was crucial to promote ecosystem carbon accumulation at MYM. However, the situation could be relaxed if rice straw is left in the field at harvest.

Acknowledgements: This study is supported by the following funds: Special Coordination Funds for the Promotion of Science and Technology (FY 2005-2007) by MEXT, JSPS-UGC Joint Research Program (FY 2005-2006), and Global Environment Research Coordination System (FY 2007) by ME.

Poster Session

P06

RUBBER FLUX, PROGRESS IN CO_2, AND WATER BUDGET EVALUATION OF RUBBER PLANTATIONS IN THAILAND

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Rubber Flux aims at providing a complete picture of CO_2, water and energy budget of a rubber plantation in Eastern Thailand.

Beyond the evaluation of the fluxes, our purpose is to partition them among the different components of the plantation ecosystem (canopy, trunks, roots, under storey, soil) and the different functions (photosynthesis, respiration, evapotranspiration) in order to understand the factors controlling the carbon, water and energy budgets of the ecosystem.

The experiment is situated at the Chachoengsao Rubber Research Station located in Phanom Sarakham district, about 140 km east of Bangkok. The observation site is located in a 6 ha plot at the center of the 350 ha station. The plot itself is planted with a monoclonal stand (clone RRIM 600). Trees were 13 years old in 2007. The average height was 20 m and average girth at 1.7 m was 60 cm. Initial planting density was 500 trees/ha and actual stand density was 430 trees/ha in June 2008. Trees are tapped for latex production for 6 years.

Carbon fluxes of rubber plantation ecosystem are continuously measured by the eddy covariance method (ED). Evapo-transpiration (ET) is measured by ED and water balance together. Meanwhile, amounts of carbon (C) stored in the trees will be evaluated by measuring biomass increment of the plantation, in combination with estimations of the carbon content at the different compartments. ED methodology was adapted from a similar experiment developed by our research group on another tropical tree crop plantation, coconut tree, in Vanuatu islands. The flux tower is 25 m high. Three-demensional (3-D) sonic anemometer Young 81000V 20 Hz is used together with an open path gas analyser (LI-7500; LI-COR, Inc., Lincoln, Nebraska, USA). Raw data are collected and pre-processed by the "Tourbillon" software (INRA-Bioclimatologie, Bordeaux, France) for a time-integration period of 300 s. Raw data are post-processed using EdiRe software (University of Edinburgh, UK) into half-hourly values. All data are despiked according to variance filters, planar fit is applied (parameters are calculated monthly), and vapour is corrected for buoyancy. Weather station measures semi-hourly net radiation (Rn), photosynthetically active radiation (PAR), diffuse PAR (PARdiff), reflected PAR (PARreflected), global radiation (Rg), Air temperature (Ta), Relative humidity (Rh), wind speed, wind direction, rainfall, vertical profile of air temperature (TCs). Energy balance is assessed by measurements of net radiation (Rn) and estimation of the energy partitioning among heat fluxes and heat storage. Results obtained at the ecosystem scale by these methods will be compared to gas exchanges measured at the level of the different compartments (canopy, trunk, root system, soil, etc). Thereby, the validated CO_2 and H_2O fluxes will be used to model gas exchanges of rubber plantation ecosystem according to climate and other environmental parameters as well as crop management. The presentation shows flux results for 2007.

P07

CHARACTERISTICS AND EFFECTS OF "CARBON LAKE" IN THE TROPICAL MOUNTAINOUS REGION OF XISHUANGBANNA, SW CHINA

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Knowledge of carbon flux in forests is a necessary step towards a better understanding of carbon cycle mechanism. This paper extended the knowledge by employing advances in our understanding of the "carbon lake" phenomena in complex terrain. Using continuous year-round observation data of CO_2 concentration profile at different heights from tower situated in tropical seasonal rainforest of Xishuangbanna, we wanted to know if the "carbon lake" phenomena existed or not in valley. Over 1 year measurement was performed in tropical seasonal rainforest of Xishuangbanna. Our research demonstrated that "Carbon lake" phenomena really existed in mountainous areas. Using cluster analysis based on diurnal CO_2 concentration change at surface layer (0.5m), we divided the phenomena into two groups. Group A (contains 5 types), standed for "carbon lake" phenomena emergence, the frequency is 51.8%. Group B (contains 3 types), without any "carbon lake" appearance. When "carbon lake" occured, always accompanied with the peaked CO_2 concentration. Likewise, the intensity of "carbon lake" in the daytime was more than in nighttime, and more in rainy season than in dry season. "Carbon lake" reached higher frequency from March to October, and the highest was recorded in June, while the lowest was in February. However, group B mainly distributed from October to March of following year, and the highest recorded in February, while lower from April to June. Variation of CO_2 concentration induced by different types of "carbon lake" mainly appeared below canopy, not in canopy and above canopy. Under different "carbon lake" types, the vertical and temporal changes showed the divergent distribution characteristics, which can obviously influenced carbon flux, carbon store and NEE estimation of tropical forest.

P08

ANNUAL AND SEASONAL VARIABILITY OF EVAPOTRANSPIRATION AND ITS CONTROLS OVER A REED MARSH (*PHRAGMITES AUSTRALIS*) IN NORTHEAST CHINA

Withdraw

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Water loss by evapotranspiration (ET) is a principle component of the hydrological cycle in wetlands. In this paper, we present the results from 3 years (2005-2007) of water and energy flux measurements, using eddy covariance method, over a reed marsh in the Liaohe Delta, northeast China. Seasonal and interannual variations of daily ET rates and their main environmental factors were analyzed. Annual ET for the reed marsh was 432, 480, and 445 mm in 2005, 2006 and 2007, respectively. Among three years, ET was comparatively higher in 2006, mainly due to larger wind speed and more precipitation. The non-growing season period (November to next April) contributed between 13% and 16% of the annual ET during the three years. On annual course, ET increased associating with increasing temperature and reed plant growing in late-April and early-May, and peaked in midseason with weekly mean rates of 3.7 mm day^{-1} (2005), 3.7 mm day^{-1} (2006), and 3.4 mm day^{-1} (2007). Decoupling factor (Ω) also varied seasonally, with its minimum values occurred in non-growing season and maximum values in the midseason, especially in July. During midseason, values of Ω were generally between 0.4 and 0.8, indicating that net radiation was the main factor affecting ET while the effect of vapor pressure deficit (VPD) on ET was relatively small. The relationship between ET and surface bulk resistance of the reed marsh could be described by an exponential function very well (R^2 = 0.87).The results would be helpful on developing regional hydrological and climate models.

Poster Session

P09

LONG-TERM WATER-LEVEL MONITORING AS A BASIS FOR TRACKING WATER FROM THE AIR TO THE SUBSURFACE

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Water budget analysis and most of surface- and ground-water models assume that the amount of total water is conserved in a given hydrologic boundary, so called a watershed or a basin. This assumption contains intrinsically that water completely cycles in the system, and subsequently, warrants the water-budget analysis as a tool for the quantitative estimation of hydrologic parameters including precipitation, surface runoff, groundwater recharge and evapo-transpiration (ET). For the long-term changes approaching to the steady-state condition, we may accept the assumption of water-budget closing as viable. However, with the global change in climate and aggressive utilization of water resources from both surface and subsurface, the hydrologic system could not respond in equilibrium to various stresses any longer.

Through the HydroKorea project, we have monitored groundwater levels from shallow and deep monitoring wells in the Gwangneung Supersite since early 2006. In this paper, we present some of our data showing typical summer and winter seasons in Korea. This study was objected to find some quantitative relations between water-level changes and ET. The water-level data were collected with automatic data-loggers and calibrated for barometric pressure changes. ET was directly measured at the flux-tower in the Supersite. ET data show clear cyclic fluctuations with 24.07 hours of periodicity. From the water-level data, the cyclic components with the same period of 24 hours were extracted through the spectral analysis. Water levels fluctuated with the maximum ranges of 4.8 cm and 2.0 cm in summer from June 1st to Aug. 31st, 2006 and in winter from Dec. 1st, 2006 to Feb. 28th, 2007, respectively. Considering the specific yield of the geologic media at the monitoring well location being 0.1 (MOAF, 2004), the water-level changes are equivalent to the water columns of 4.8 mm and 2.0 mm, respectively. In addition, the maximum daily fluctuations of water levels were 9.26 cm and 3.02 cm in summer and in winter, respectively. Therefore, the water-level movement with the diurnal cycle covers approximately 52% of the total variation in summer and 66% of that in winter.

Since diurnal variation of water levels could be attributed not only to ET but also to other tidal components such as the Principal solar diurnal tide, the water-level fluctuation data could not be matched directly to ET data. The plots of daily mean water-levels against measured daily ET values show the general trend of a negative relationship, though. In this case, the water level could be used as a cap for estimating the ET value for the day.

P10

A STUDY ON EVALUATION OF HEAT AND WATER VAPOR FLUX BETWEEN LAND SURFACE AND ATMOSPHERE OF UPO WETLAND

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Wetlands in Korea have been damaged indiscreetly to ensure farmlands and industrial lands from Japanese occupation period to the recent years. They used to be regarded as abandoned lands which have no economic values.

However, today, inland marshes are well-known to play a role as a paradise for wetland plants and season birds and a natural sewage treatment plant to purify environmental pollutants made in an inland. The role of inland marsh in terms of water quality environmentology is to stop river contamination by filtering the polluted water from daily living and agriculture. Moreover, coastal wetlands play a role to purify water one more time before the river flows into the sea. Wetlands of Inland and coastal have been continually damaged in order to a new land while a level of pollutants rises as human activities increase. As a result, the pollution of rivers and coasts is in an extremely sever condition.

In July, last year (2007), the water temperature and weather data (temperature, humidity, wind direction, wind speed, etc) are observed in the 10m Weather Tower installed at Upo wetland in this study.

By comparing and analyzing these two data, it is possible to understand the effect of climate change due to the land conversion from marshes to farmlands. At the same time, we gathered and analyzed data from Milyang weather station very close to Upo wetland. Analyzing the climate acclimatization effect (control of increase and decrease in temperature, control of humidity change, etc) of Upo wetland was by comparing the temperature and humidity of Milyang area with the data of Upo wetland.

In October, last year (2007), the water temperature and weather data (temperature, humidity, wind direction, wind speed, etc) are observed in the 10m Weather Tower installed at Upo wetland in this study.

By comparing and analyzing these two data, it is possible to understand the effect of climate change due to the land conversion from marshes to farmlands. At the same time, we gathered and analyzed data from Milyang weather station very close to Upo wetland. Analyzing the climate acclimatization effect (control of increase and decrease in temperature, control of humidity change, etc) of Upo wetland was by comparing the temperature and humidity of Milyang area with the data of Upo wetland.

The weather station (Milyang) is the closest to Upo wetland and is the area where convenient facilities for residence in a land use map are widely distributed in.

Upo wetland and Milyang are very close, so they have similar synoptic-scale weather pattern. Therefore, different climate in these two areas may be considered as the different environmental conditions in those areas.

The data for temperature of Upo wetland and Milyang weather station by time were as flow. The temperature data for the station located in an inland city showed lower than that of Upo wetland and farmlands after sunset and higher after sunrise. The maximum temperature observed in Upo wetland was 34.6℃ which is 1.5℃ lower than that of Milyang weather station, 36.1℃. In addition, the minimum temperature in Upo wetland was -9.4℃ and the minimum was -9.8℃, indicating Upo wetland was 0.4℃ higher. That's because the heat storage function of Upo wetland is stronger than that of Milyang, an inland area, so the strong sponge effect of heat was shown. That is the function of Upo wetland is to stop temperature decline by absorbing the heat of atmosphere in daytime and releasing it at night.

Milyang weather station's relative humidity was lower than that of Upo wetland. Especially, the difference was a day which is up to 2.7% difference.

Also, this study aims to survey the characteristics of heatbudget by performing heatbudget analysis of Upo wetland and Milyang.

Acknowledgement: This work was supported by the Korea Science and Engineering Foundation (KOSEF) grant funded by the Korea government (MEST) (No. R01-2006-000-10104-0).

P11

PRELIMINARY STUDY ON AIR TEMPERATURE AND RELATIVE HUMIDITY OBSERVATION AROUND FOREST WITH WIRELESS SENSOR NETWORK IN TAIWAN

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The standard open-area meteorological station setup requirements for synoptic weather observation could not be applied to the micro-meteorological observation inside the forest. To solve the above-mentioned problem, the purpose of this earlier-stage experiment was trying to create a new system based on a wireless sensor network

(WSN) which included 30 Tmote Sky nodes to monitor temperature-R.H. variances on different landscape patches at Sitou Ecosystem Education Area of National Taiwan University Experimental Forest. The results indicated the concept of WSN could be used for forestry and ecological temperature-R.H. observation both inside and outside forest. However, the results also showed the WSN hardware, Tmote Sky, could be overestimated if the sensor was not located inside a well-designed radiation shield to avoid direct solar radiation effect. The observed errors of air temperature and R.H. of this system were ±1.11℃ and ±1.87% respectively. Another disadvantage of this network was the more the data transfer hop counts, the more the power consumption and the less the data yield rate. The transfer yield rate of this system ranged from 90% to 10%. Due to both WSN technology and hardware are developing and improving speedily, the new designed product for field use could be expected soon in the future.

P12

ESTIMATING WATER USE BY MAIN TREE SPECIES IN THE NATURAL DECIDUOUS FORESTS OF S. KOREA

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Tree transpiration is one of the major sources of water loss from forest watersheds. In this study, tree water use (transpiration) of three overstory species was estimated by measuring sap flux density with heat dissipation probes installed at the stem bases. Diurnal patterns of xylem water flux were analyzed and the relationships that may exist between tree water use and the environmental variables were examined. Possible inter-specific relationships among species in utilization of water resources were also examined to assess the role of diversity in water use by mixed deciduous forests of S. Korea. The study sites were located at the Gwangneung Experiment Forest (GEF) (37°44'N and 127°9'E) and Mt. Gyebang (GB) (37°44'N and 128°26'E), respectively. The dominant tree species were *Quercus monglica* and *Carpinus laxiflora* at the GEF site and *Q. serrata, Tilia amurensis, Ulmus davidiana var.japonic* and *Acer Pseudo* at the GB site. *Q. monglica* accounted for 70.6 % of basal area at the GEF site, while *T. amurensis* and *Q. mongolica,* accounted for 29.7% and 14.3% of basal area of GB site respectively. Tree xylem sap flux density (F_d, g H_2O m^{-2} sapwood s^{-1}) was measured on 6 *Q. monglica* (GEF), 5 *Q.serrata* (GB) and 7 *T. amurensis* (GB) respectively from May to September, 2007. To scale F_d to tree sap flow (F, g H_2O s^{-1}), we assumed that F_d measured by each probe corresponded to that occurring in discrete sapwood annuli, and could be summed up for the entire tree stem. Meteorological dataset of GEF were obtained from a KoFlux tower erected on the study site, while for GB, weather observations at the Automatic Weather Station (AWS) was used. When total daily F was compared among tree species with similar DBH (20 cm), *Q. Mongolica* exhibited the highest (10.2 kg d^{-1}) sap flow compared to *Q. serrata* (3.9 kg d^{-1}) and *T. amurensis* (3.1 kg d^{-1}). Patterns of F were more dependant on vapor pressure deficit (VPD) and solar radiation, suggesting a strong regulation of tree water use by the meteorological condition. Estimation of water losses at local scale (entire watershed) is underway and the results of tree-level water use are the initial steps towards achieving this objective.

Acknowledgement: This study was supported by a grant (code# 1-8-3) from Sustainable Water Resources Research Center of 21st Century Frontier Research Program, by Innovative Forest Disasters R&D Center, and by Long-term Ecological Research under climate change in Korea Forest Research Institute.

P13

DROUGHT EFFECTS ON SAP FLOW AND STAND TRANSPIRATION IN A TEMPERATE DECIDUOUS FOREST

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In East Asia, precipitation is concentrated in the short monsoon season, which reduces plants water availability in the dry season. Furthermore, most forests are located in mountainous areas which results in increased lateral water flux and uneven distribution of plant available water. These climatic and topographic features of the forests make them more vulnerable to drought conditions. An improved understanding is quite necessary that how drought affects tree water use (i.e., sap flux density and stand transpiration) in a sloppy forest like Gwangneung. The principal aims of this study were 1) to examine daily and seasonal patterns of stand transpiration, 2) to relate the variability in total sap flow to environmental variables, and 3) to investigate how drought affects tree sap flow and hence, stand transpiration. We measured sap flux density at a temperate deciduous forest slope, the Gwangneung Experimental Forest, by the Thermal Dissipation Probes method and scaled up to stand transpiration. This site is dominated by *Quercus serrata* (51 percent of total basal area), and sub-dominated by *Carpinus laxiflora* (23 percent of total basal area). Based on tree location, size, and stem structure, 6 trees of *Quercus serrata*, the dominant species of Gwangneung Experimental Forest, were chosen for sap flow measurements. Estimates of transpiration were evaluated by examining differences in trees and relationship between transpiration and climate factors and comparing to evapotranspiration from eddy covariance. Although operating at different time scales, RR (reflected radiation) and vapor pressure deficit are important interacting environmental controls. Sap flux density increased exponentially with increasing vapor pressure deficit (< 1 kPa) and RR while soil water content was above 35.3 % at Gwangneung. The above relationships were not clearly observed for soil water content below 35.3 %.In 2007, significant drought period was found in early June. Sap flow in the investigated tree species *Quercus serrata* gradually decreased during the drought period in spite of increased RR and vapor pressure deficit. Our study evidenced primary impact of soil water content on tree sap flow during the drought period. A further study is however necessary to ensure mechanisms on how drought affects tree sap flow and stand transpiration.

Acknowledgment: This study was supported by Innovative forest disasters R&D center.

P14

HEAT BUDGET OF REGENERATION PROCESS OF LANDSLIDE DISASTER PLACE AT SITOU REGION, CENTRAL TAIWAN

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The purpose of this study was to analyze the sensible and latent heat flux of Agro-Observatory, Micro-Observatory and Regeneration Observatory by means of Bulk method according to the data of meteorological observatories collected during January, 2005 to December, 2007 at Sitou region of the central Taiwan. The soil heat flux were analyzed by Gradient Method. The energy budget analysis results showed that the landslide disaster place was regenerated gradually by vegetation. And new landslide or didn't happen again. The incident solar radiation at the soil surface were decreased obviously due to the crown becoming close, solar radiation had intercepted, absorbed and reflected. And the heat budget of surface layer at regeneration place were varied between meadow and forest caused by canopy had getting close steadily.

P15

OBSERVATIONAL STUDY ON THE CHANGE OF MICRO-METEOROLOGICAL ENVIRONMENT DUE TO DEFORESTATION

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Although the problem of reducing greenhouse gas basically takes the characteristics of a global scale issue among the countermeasures for climate change, its effects appear as regional or national problems. Therefore, individual nations should prepare for the effects of climate change, and the most important countermeasure would be the planned adaptive strategy. The development and establishment of adequate adaptive strategies considering the characteristics of each region are thought as essential actions to complement the problems that cannot be settled by the measures of reducing greenhouse gas through international cooperation (Burton, 1996; Smit *et al*., 1999; Jo *et al*., 2004). Thereby, Clause 1 of Article 4 in the Convention on Climate Change also says, "We entrust individual nations (nations concerned) of organization, cooperation, and executive methods that facilitate appropriate adaptation to climate change. Moreover, Kyoto Protocol (Article 10) authorizes nations involved in the convention to promote and encourage the adaptation to climate change and develop adaptive technology.

With this background, this study intends to evaluate the temperature and soil environment differences according to the forest preservation state in mountainous areas through field observation. To perform this study, it installed automatic observation systems separately in the lumbered area to prevent Pine Wilt in the mountain adjacent to the campus of Keimyung University in Daegu and the neighboring area having well-preserved forest and observed weather conditions, soil temperature, and soil moisture to compare and analyze the results. To analyze the difference of the climate conditions gained, heat budget analysis was conducted. The results are as follows:

(1) The air temperatures of point1were higher as about 1.5℃ than those of point 2 during daytime. But the differences of air temperature between two points were small during nighttime. And the difference of relative humidity between 2 points was large during the daytime. It was higher as about 10% at point 2 than point 1.

(2) The surface and underground temperatures were very different between 2 points during daytime. The soil temperatures of point 1 were higher as 3~10℃ than those of point 2. But the temperature differences were reduced during nighttime. The averaged soil moistures for observation period were 7.1 %(point 1) and 19.5 %(point 2).

(3) The differences of wind direction were small between 2 points. But the wind speeds were larger at point 1(3m/s) than point 2(1.1m/s). The heat budget analysis was also performed based on the observation data.

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Poster Session

P16

THE STUDY ON THE SOIL RESPIRATION UNDER PRIMARY FOREST TYPES IN DAGANGSHAN MOUNTAIN IN JIANGXI PROVINCE

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Soil CO_2 efflux is affected by various factors. Soil respiration induced by 3 typical forest ecosystems in subtropical over its entire growing season and the factors influencing soil respiration were investigated to examine the impact of conversion of forest, different cultivation and temporal and spatial on the process of soil carbon output. The result show that: the evergreen broadleaf forest, Chinese fir plantation and Mao bamboo plantation have significant difference, Mao bamboo plantation have the biggest soil respiration, but all of them show a similar changing pattern in the seasons: The highest respiration values were measured in July and August and then began to decline , both soil temperature and soil respiration have a significant drop after September and have minimum values in January and February; different stand age class in Chinese fir plantation show that, MAP（middle-aged plantation）and PP（premature plantation）have a bigger respiration values, while YP(young plantation) and PAP（past-aged plantation）have a smaller values, the response of soil respiration to variations in temperature and moisture was most obvious for the youngest stand. Similarly, the amplitude in soil respiration was highest for the YP; different planting density of Chinese fir plantation show that, the density of 3000/ha and 4500/ha have the higher soil efflux rate, while the density of 9000/ha and 1500/ha have the lower rate; different altitudes of Mao bamboo show that, the soil CO_2 efflux, as well as the temperature of air and soil decreased along elevation gradients, and this result indicated that the temperature is the leading factor which regulated spatial variation of soil respiration in different elevation soil. Our results show that the determination of some key environmental variables may help to explain a large proportion of total variation of soil respiration over the entire rotation length of afforested ecosystems.

P17

WINTER SOIL CARBON EFFLUX IN THE BROADLEAVED KOREAN PINE FOREST IN CHANGBAI MOUNTAIN

Withdraw

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Soil respiration contributes 60-80% of total ecosystem respiration in forests. Most researches on this flux were carried out during the growing season, while comparatively little work has done in non-growing season.

This study aims to investigate soil CO_2 efflux through the non-growing season in the broadleaved Korean pine forest in Changbai Mountain using measurement and modeling. It shows that (1) After the first snowfalls, soil CO_2 flux declined rapidly, from about 1μmolm^2s^{-1} to 0.1μmolm^2s^{-1}. During this period, there existed significant (p<0.01) exponential relationship between soil respiration rate and soil temperature. Then soil CO_2 flux continued a slow decline until spring thaw. Soil CO_2 flux increased slowly with the increase of soil temperature during the snow melting period. There is no clear daily cycle in soil CO_2 flux. (2) The significant fluctuations in soil CO_2 flux during snow-covered season and snow melting period indicated that, besides soil temperature, there exists other non-biological processes may significantly affect winter soil CO_2 flux over short timescales. (3)The fluctuations of airflow through snowpacks induced by atmospheric pressure variations had a significant short impact on CO_2 fluxes. Sometimes, it even caused negative fluxes over snowpack surface. But when averaged over a period of hours, the influence can be nearly eliminated. (4) Differences between hourly averaged CO_2 fluxes over snowpack surface and snow-soil interface may exist for the influence of wind and pressure. These differences would decline when averaged over long timescales. (5) Soil released 46.7 g C m^{-2} in this broadleaved Korean pine forest from November to next March.

P18

SOIL CO_2 EFFLUX IN NY-ÅLESUND, SVALBARD USING CHAMBER METHOD

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The potential impact of global warming on tundra ecosystem has been assessed because of the large carbon stock in the Artic soil and the possible feedback effect on global atmospheric CO_2. The soil CO_2 efflux chamber measurements were made to investigate quantifying of CO_2 efflux from soil surface to atmosphere and its controlling factors in the Dasan station. The Dasan station is one of the KoFlux sites located at Ny-Ålesund (78° 55' N, 11° 56' E), on the high Arctic island of Spitsbergen which is a part of the Svalbard archipelago, Norway. Soil CO_2 efflux was measured at 16 sampling locations in the plot (30 m x 30 m) of tundra ecosystem using a closed-dynamic chamber system during July in 2007 and 2008. The study plot was selected to be within the major footprint area for the tower CO_2 flux measurements. Measurement locations consisted of peat soil covered with lichen and soil including small stones. The vegetation distribution of plot is dominated moss (e.g. *Sanionia georgico-uncinata*) and phanerogamous plants (e.g. *Silene acaulis* and *Salix polaris*).

The air temperature (3～10℃) and soil temperature (≈ 8℃) were near normal during July of both years. The amount of precipitation of July was above normal (23mm) in 2007(55mm), but below normal in 2008(12mm) in July. The mean soil water content in 2008 was higher than that of 2007 even lower precipitation. These results are assumed difference of thawing period in both years. Averaged soil CO_2 efflux ranged from 0.2 to 1.1 μmol m^{-2} s^{-1} during the study period. And soil temperature of both years ranged from 5 to 14℃ and 4 to 12℃, respectively. And soil water content ranged from 10 to 35% and 10 to 40%, respectively. Soil CO_2 efflux in both years was determined by soil temperature whereas soil water content was less important. These results indicate that the changes in global warming can significantly alter the carbon sink/source strength of tundra ecosystems in the Arctic.

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P19

LONG-TERM MEASUREMENT OF SOIL RESPIRATION IN TEMPERATE DECIDUOUS FOREST IN KOFLUX SITE USING AOCC

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Using on Automatic Opening / Closing Chamber system (AOCC) based on an open-flow dynamic method (open-flow AOCC) was used to measure soil CO_2 efflux throughout about 4 years from 2004 to 2007 in temperate deciduous forest in Gwangneung KoFlux site in Korea. The study area, which is the Gwangneung Experimental Forest of Korea Forest Research Institute (KFRI), is located at Gyeonggi-do, the west central portion of the Korean peninsula. Our objectives were to quantify annul and seasonal variations of soil CO_2 efflux, and to investigate the effects of daily and seasonal variations of soil temperature and soil water contents on soil CO_2 efflux. The SR increased from spring to summer and showed maximum values in August, and then gradually decreased. The seasonal change of SR strongly related with fluctuation of soil temperature, especially 5 cm depth(R^2=0.85 in 2004 and 2005, R^2=0.83 in 2006). Annual average soil temperatures at 5cm depth were 10.8℃ in 2004, 11.4℃ in 2005, 10.9℃ 2006 and 11.3℃ in 2007. Soil moisture affected the soil respiration rate less than soil temperature but above 15 ℃ at 5 cm depth soil temperature, soil CO_2 efflux was highly correlated with changing of soil water contents. Soil CO_2 effluxes showed an average of 324.2 mg CO_2 $m^{-2}h^{-1}$ in 2004, 336.1mg CO_2 m^{-2} h^{-1} in 2005, 325.5 mg CO_2 $m^{-2}h^{-1}$ in 2006 and 320.5 mg CO_2 $m^{-2}h^{-1}$ in 2007. Total annual losses of C from soil respiration were estimated 7.9 t C $ha^{-1}yr^{-1}$ from 7.7 t C ha^{-1} yr^{-1} in 2004, 8.0 t C ha^{-1} yr^{-1} in 2005, 7.8 t C ha^{-1} yr^{-1} in 2006 and 7.7 t C ha^{-1} yr^{-1} in 2007.

P20

FEEDBACK OF AMBIENT AIR CO_2 CONCENTRATION ON SOIL CO_2 FLUX

Withdraw

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

We conducted a series of experiments at two field sites with different soil and vegetation types, to investigate the impact of ambient CO_2 concentration on F_c. We used two kinds of closed chamber systems (LI-6400 and LI-8100) to measure F_c. The LI-6400 used a draw-down approach and F_c was estimated when the chamber CO_2 concentration (C_c) was near the ambient CO_2 concentration (*Norman, et al., 1992. Soil surface CO_2 fluxes and the carbon budget of a grassland. J. Geophys. Res., 97*). The LI-8100 was a fully automated multiplexed system, and F_c was estimated using the initial slope ($dC_c/dt|_{t=0}$) of a fitted exponential function of C_c vs time, which we call the exponential approach. Both the draw-down and the exponential approaches were done to minimize the impact of altered CO_2 diffusion gradient inside the chamber on the flux measurements. Comparison of F_c measurements between these two approaches yielded excellent agreement, suggesting the two approaches were equivalent.

Nearly continuous measurements of night-time F_c from the two field sites demonstrated that F_c was negatively correlated with changes in C_a, suggesting F_c was suppressed under high C_a due to the reduced CO_2 diffusion gradient. Also, at sunrise, increased turbulence caused a rapid drop in C_a and a concomitant increase in F_c that preceded any increase in soil temperature, and persisted for one to two hours, which was much longer than the time required to bring C_a to a well-mixed daytime value. We tested the hypothesis that the increased F_c was due to elevated C_s by capping the soil using the LI-6400, and allowing the headspace CO_2 concentration to rise to various levels above ambient, whereupon we scrubbed the chamber air quickly back to ambient and measured F_c. Measured F_c increased with increasing CO_2 concentration in the headspace prior to measurement, as predicted by a diffusion-based mechanism. Wind-induced pressure pumping was not involved.

This has important implications both for chamber measurements and for ecosystem respiration. Our results suggest that respired CO_2 can accumulate in the soil profile under calm conditions. The accumulated CO_2 in the soil can slowly flush out when C_a returns to the atmospheric background level as the atmosphere becomes unstable. It is likely that it takes much longer to flush out CO_2 accumulated in the soil profile than to exchange CO_2 accumulated in the plant canopy. This diffusion-based process might provide an explanation, in addition to U*-dependent night-time flux and pressure pumping, for the abnormally high ecosystem respiration rate at sunrise often observed by the carbon flux community. Flechard, *et al*., (*, 2006. Temporal changes in soil pore space CO_2 concentration and storage under permanent grassland. Agric. Forest Meterol. in press*) present a similar argument, although they suggest wind-induced pressure pumping as the primary mechanism moving CO_2 out of the soil and into the atmosphere.

P21

RELATIONSHIP BETWEEN CHANGE OF DOMINANT SPECIES AND SOIL RESPIRATION ACCORDING TO CHANGE OF THE SECONDARY SUCCESSIONAL STAGES ON THE TEMPERATE GRASSLAND

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In general, most of plant species shows peculiar biomass allocation pattern. To understand the effect of the change of biomass allocation pattern to successional stage on soil respiration (SR), we measured the long-term SR and biomass allocation pattern in three communities under different successional stage. Miscanthus sinensis var. purpurascens community is considered as the final stage of secondary succession of herbaceous communities in temperate grassland in Japan, and Solidago altissima and Imperata cylindrica var. koenigii communities as the previous stages. The SR was measured using the open-flow method from June 2002 through May 2003. Aboveground productivity significantly increased in lateral stage. Aboveground standing biomass of S. altissima, I. cylindrica var. koenigii, and M. sinensis var. purpurascens communities were 0.72, 0.83 and 3.35 kg d.w. m^{-2} $year^{-1}$, respectively. The ratios of the above- to the belowground standing biomass (new-bud), it was observed that S. altissima community are partitioning 1.3 times, I. cylindrica var. koenigii community 2.3 times, and M. sinensis var. purpurascens community 4.0 times more biomass allocate to above- ground parts. The annual decomposition rates of aboveground litter for S. altissima, I. cylindrica var. koenigii and M. sinensis var. purpurascens were 44, 32 and 41%, respectively. The SR rate significantly increased in progressed successional stages. The annual means SR rates in S. altissima, I. cylindrica var. koenigii and M. sinensis var. purpurascens communities were 520, 430, and 2,020 g C m^{-2} $year^{-1}$, respectively. The contributions of aboveground litter decomposition to annual SR rates were estimated about 27% for S. altissima, 28% for I. cylindrica var. koenigii and 31% for M. sinensis var. purpurascens community.

P22

BIOGEOPHYSICAL FACTORS INFLUENCING SPATIAL AND TEMPORAL VARIABILITY OF SOIL RESPIRATION AT A TROPICAL RAIN FOREST IN PENINSULAR MALAYSIA

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INTRODUCTION

Soil respiration is one of the largest and most important carbon fluxes in terrestrial ecosystems. To quantify soil respiration rate, it is essential to evaluate the spatial and temporal variability and how biogeophysical factors influence it. The objective of this study is to evaluate the spatio-temporal variation of soil respiration and the influence of soil temperature, soil water content, soil physics, total N and C content, C/N ratio, root biomass on it at a tropical rain forest in Peninsular Malaysia.

SITE DESCRIPTION

The study area was located in the Pasoh Forest Reserve (2°59'N, 102°18'E) of the Forest Research Institute Malaysia (FRIM) in Peninsular Malaysia. An intensive research project by the International Biological Programme (IBP) was conducted in this forest reserve from 1970 to 1974. The core area (600 ha) of the reserve is primary low land mixed dipterocarp forest, consisting of various species of Shorea and Dipterocarpus (Soepadmo, 1978). IBP Plot 1, in primary forest, is 6 ha in area and consists of two soil types, the Xanthic Ferralsol, and Haplic Acrisol in the FAO classification. The plot is located on a gentle slope and Haplic Acrisol is distributed on the upper slopes around a 52m-tall tower and the Xanthic Ferralsol on the lower slopes in Plot 1. The A horizon is thin (0-5 cm) and Lateritic gravels are abundant below a depth of 30 cm (Soepadmo, 1978; Yamashita *et al*., 2003).

METHODS

Soil respiration, soil temperature and soil water content were measured in a 100 × 200 m plot (same place with IBP Plot 1). The entire area has rather flat topography. In this plot, measurements were conducted at 39 points in August 2006, March 2007, December 2007, March 2008, and June 2008. Soil respiration rate was measured with the closed dynamic chamber method using an infrared gas analyzer (LI-820, Lincoln, NE, USA) and PVC chamber (diameter:13cm). Soil temperature was measured at the same time as soil respiration rates with a thermistor (RT-10, Espec Mic Corp., Aichi, Japan) at a depth of 2 cm adjacent to each chamber. Soil water content was measured with a HydroSense Soil Water Content Measurement System (CS-620, Campbell Scientific, Inc., Logan, UT, USA) at a depth of 0-12 cm and at three points very close to each chamber, but not in the chamber, to prevent disturbance. In March 2007, undisturbed soil samples (100ml) were taken at the depths of 0-5 cm at 39 points to investigate soil physical properties. Soil mineral and root biomass samples were collected at the depths of 0-5 cm at 39 points of 100 × 200 m plot in March 2008 and June 2008. Soil samples were sieved through a 2 mm mesh sieve to remove coarse fragments and then homogenized. Total N and C concentrations in the soil samples were measured using the combustion method in an NC-analyser (NC-22A, Sumigraph Co. Japan). The root system divided into several classes by size and the root biomass was measured.

RESULTS AND DISCUSSION

Soil respiration rate was high in the rainy period and low in the dry period. The rainy and dry period cycle is considered to determine seasonal variation in soil respiration rates by regulating soil water condition in tropical regions where seasonal variation in soil temperature is small. On the other hand, spatially, soil respiration rate was low where soil water content was high. Both amplitude and trend of the results in this larger (100 × 200 m) plot was similar with the previous results in a smaller (50 ×50 m) plot at this site. Although the dispersion of soil respiration rate at the larger plot was bigger than that in a smaller plot because of the existence of hot spots. Total N content correlated negatively with soil water content and positively with soil respiration. Total root biomass had no significant correlation with soil respiration rate and soil water content, although root biomass of 0-1.0 mm diameter (small size root biomass) had a positive correlation with soil respiration rate. Moreover, total N content was positively related to small size root biomass. It was suggested that the availability of N influence small size root biomass and thus soil respiration rate. These results suggest that several physical, biological and chemical properties co-varying with soil water drive the bipolar spatial and temporal variation of soil respiration rate.

P23

EFFECT OF RESPIRATION CHARACTERISTICS OF FOREST COMPARTMENTS TO NEP FOR A WARM TEMPERATE MIXED FOREST IN JAPAN

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1. Introduction

In respiration of forest stand, both autotrophic and heterotrophic respiration consists of various components (e.g. leaf, stem, root for Ra; leaf litter, CWD, root litter for Rh). Respiration rate of each component has different reactivity characteristics to environmental factors. Especially, relationships between heterotrophic respiration and

environmental factors have complex causality. On the other hand, forest respiration usually estimated by very simple models using soil temperature. In this study we evaluate relationships between results of respiration rate measurement from various components in a warm temperate forest. And we evaluate effect of respiration characteristics to net ecosystem production of a forest.

2. Materials and methods

The study was conducted in the Yamashiro Experimental Forest (temperate secondary broad-leaved forest in central Japan, 34°47'N, 135°50'E). *Quercus serrata* is a dominant species in the site. Annual mean air temperature was 15.5 °C and annual precipitation was 1449 mm in 2002. Tower CO_2 flux has been measured from 2000. Respiration from forest, soil and various components in forest was measured eddy covariance method and chamber method (Table 1). Estimate function of each respiration rate was derived using temperature, water content, DOY (phenological aspect), time from last precipitation and medium characteristics.

3. Results and Discussion

CO_2 flux per unit weight from each medium (branch and stem; fine root and woody root; leaf litter and CWD) highly depends on medium size. CO_2 flux increased according as decreasing of medium size. And response of CO_2 flux to the change of environmental factors became higher according decreasing of medium size especially in heterotrophic respiration.

Table 1. Components held respiration measurement

Compartment	Spiecies	Method
Forest stand		Eddy covariance Storage change automated chambers
soil respiration		manually chambers
foliage	Quercus serrata Ilex pedunculosa Miq Quercus serrata	automated chambers
stem	Ilex pedunculosa Miq	automated chambers
root	Quercus serrata	automated chambers
fine root	Quercus serrata	Sampling and chambers
	Quercus serrata	Sampling and chambers
CWD	Pinus densiflora Sieb. et Zucc	Automated chambers
leaf litter	Quercus serrata	Sampling and chambers
root litter	Quercus serrata	Sampling and chambers

P24

ATMOSPHERE-SOIL EXCHANGE OF TRACE GASES IN A DECIDUOUS NEEDLE-LEAF FOREST

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Soil of terrestrial ecosystems plays important roles as sink/source of atmospheric trace gases including greenhouse gases and related components. CH_4 is an important greenhouse gas and forest soil is known as a sink of atmospheric methane (CH_4). nitrous oxide (N_2O) is also an important greenhouse gas and some of forest soil is a source of atmospheric N_2O. Carbon monoxide (CO) and molecular hydrogen (H_2) have indirect effect on global warming. Although soil has been thought to be the most important sink of atmospheric H_2, the estimation of the sink capacity has great uncertainty. We observed gas exchange rate of CO_2, CH_4, N_2O, H_2, CO at soil surface in a Tomakomai Flux Research Site, Japan. The site was located in a deciduous needle-leaf forest. This forest type is representative for wide-spread area of northeast Eurasia. Measurements were conducted monthly by flask sampling using automated chambers. CH_4, CO and H_2 were up taken by soil significantly throughout year. Deposition velocity of CH_4 was about 0.4 to 0.5 x 10^{-2} cm sec^{-1}. N_2O was emitted slightly from soil. Deposition velocities of CH_4 and H_2 showed clear seasonality. We compared the exchange ratios of those trace gases between a root-exclusion plot and a non-root-exclusion plot. The deposition velocity of CH_4 in the root-exclusion plot was obviously lower than that in the non-root-exclusion plot. This feature suggested that the living plants potentially affected the activity of microbial community responsible for the CH_4 oxidation. Attention should be directed toward stand scale exchange flux of those trace gases and its relation to the ecological function.

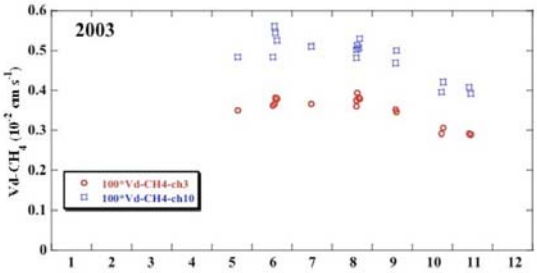

Fig. 1. Timeseries of deposition velocity of CH_4 observed at a root-exclusion plot (open squares) and a non-root-exclusion plot (open circles) in Tomakomai Flux Research Site.

P25

RESPONSES TO DROUGHT AND HEAVY RAINFALL OF SOIL CO_2 EFFLUX BETWEEN STANDS OF A NEEDLE FIR AND A MONGOLIAN OAK

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CO_2 efflux from soil surface (R_S) was measured periodically from December 2004 to April 2007 between neighboring stands of a coniferous evergreen (*Abies holophylla*, A stand) and a broad-leaved deciduous (dominated *Quercus mongolica*, Q stand) located in the Gwangneung forest, central Korea.

On the whole, the R_S was moderate in late spring (268–459 mg CO_2 m^{-2} hr^{-1} in May), increased sharply to a peak in summer (706–1170 mg CO_2 m^{-2} hr^{-1} in July), and decreased in autumn (123–155 mg CO_2 m^{-2} hr^{-1} in November) for the both stands. The R_S of the A stand were higher than those of the Q stand during the most of growing season.

On summer season, the study sites experienced somewhat different rainfall pattern (e.g., drought, heavy rainfall) in 2005 and 2006. First, the R_S for the both stands were suppressed by drought in June 2005 and September 2006. In the early summer (mild drought in June 2005), the response of drought stress on R_S for the Q stand was greater than that for the A stand. This period was stage of maximum leaf expansion for the Q stand. The more sensitively response on R_S of the Q stand possibly might be caused by root respiration suppressed. In the late summer (severe drought in September 2006), however, the response of drought stress on R_S for the Q stand was lower than that for the A stand, possibly due to period of leaf senescence in the Q stand. Second, after the concentrated heavy rainfall in July 2006 (maximum precipitation, 293 mm day^{-1}), the R_S was lower significantly than that in July 2005 at the both stands. The depressed response of heavy rainfall on R_S for the Q stand was much greater than that for the A stand. Third, in the mid-summer (dry hot in August 2006), under the higher soil temperature and lower soil moisture condition compared with August 2005, the R_S of the A stand was lower than that in August 2005, while that of the Q stand was not changed.

In spite of such responses at two forest types, the exponential relationship between soil temperature and R_S accounted for approximately 91–97% of the R_S variability at each stand and each year. The sensitivity of temperature on R_S (apparent Q_{10} value) for the A stand was higher than that for the Q stand; also the sensitivity in 2005 was higher than that in 2006. Moreover, we found a significant correlation between soil moisture and R_S using a second-order polynomial function when soil was warm (soil temperature >15 °C). Using by simple temperature exponential function, the annual R_S was estimated at 946 and 711 g C m^{-2} yr^{-1} for a year with mild drought (2005) at A and Q stand, respectively, and 735 and 587 g C m^{-2} yr^{-1} for a year with concentrated heavy rainfall and severe drought (2006). The result indicates that difference of rainfall pattern in the short monsoon season represent approximately 21–29% of annual R_S at two temperate ecosystems.

P26

EVALUATION OF CO_2 FLUX FROM LEAF LITTER USING MULTILAYER LITTER SAMPLE METHOD

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1. Introduction

The evaluation of carbon budget of forest floor is an important problem to estimate Net Ecosystem Production (NEP) of forest. However, the decomposition process is composed by various mediums and influenced by the various environmental factors in the forest soil, so the evaluation of carbon budget of litter input and decomposition rate is difficult. Classically, leaf litter decomposition has been measured using litterbag. But, environment in litterbag is not same with natural conditions, so the decomposition rate occasionally underestimated and is still controversial. To estimate leaf litter decomposition accurately, we set multilayer leaf litter samples on forest floor and measured profile of leaf litter respiration using newly developed chamber system. We evaluated relationship between leaf litter respiration and environmental factors (e.g. temperature and water content) and effect of microtopological condition to leaf litter respiration.

2. Site and Methods

The observation was performed in Yamashiro experiment basin located in the hilly mountains in western Japan (34° 47' N, 135° 51'). Forest soil originated from weathered granite is very mobile and classified to be immature soil. We used leaf litter of *Quercus serrata* for respiration measurement. Set of litter (10 pieces) was piled up and fixed using wire pin on forest floor and 109 sets of samples (1090 pieces of leaf) was used for measurement. CO_2 Flux from leaf litter was measured 12 times for May - September using a small closed chamber (IRGA, VAISALA GMP343). Each leaf of sample was measured separately (Fig.1). Water content was obtained from the difference between fresh weight and dry weight of the leaf litter sample. Temperature inside the chamber and soil temperature were concurrently measured using thermo-couples and the soil moisture content was measured using TDR.

3. Results

Mean decomposition respiration rate of the leaf litter from May to September 2008 was 365 $mgCO_2h^{-1}kg^{-1}$, and ranged from 0 to 1400$mgCO_2h^{-1}kg^{-1}$. Maximum rate of CO_2 flux from leaf litter sample (1400$mgCO_2h^{-1}kg^{-1}$) was about 40 times larger than that of coarse woody debris which diameter is 3cm (Jomura 2004). CO_2 flux of bottom leaf litter sample is about 6 times larger than the top leaf. Spatial position of leaf litter greatly affects leaf litter respiration.

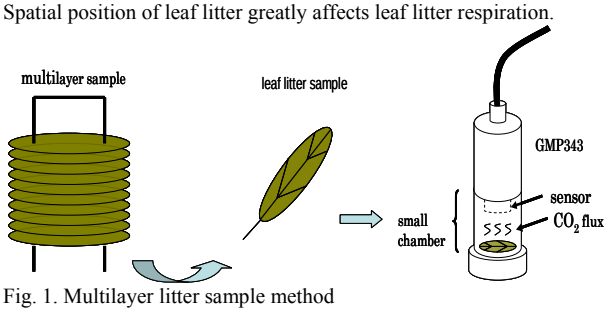

Fig. 1. Multilayer litter sample method

P27

SLOW DECOMPOSITION OF ORGANIC MATTER DUE TO EXCESS MOISTURE IN A FALLOW PADDY SOIL

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1. Introduction

Carbon sequestration to arable land has been recognized as a promising option to decrease the atmospheric concentration of carbon dioxide. It is conceivable and has actually been demonstrated in upland soils that leaving crop residues increases carbon input and reduced tillage suppresses decomposition of soil organic matter (SOM). Paddy soils receive a large amount of residues, if they are left therein, due to a high productivity of rice, and soak in water during the cultivation period, which leads to an assumption that paddy solids can accumulate more carbon than upland soils. This study evaluates the decomposition rate of SOM during the fallow season of a rice paddy and its dependence upon environmental factors.

2. Methods

Measurements were made at the Mase paddy site (36°03'N, 140°02E, 11 m asl.), where ecophysiological and environmental observations have continued since 1999. Fallow data obtained after senescence of rice regrowth in 2004–2005, 2005–2006 and 2006–2007 are presented to analyze, which seasons are denoted by 2004FS, 2005FS and 2006FS, respectively. The soil is a clay loam and was cultivated at the top 20 cm four times in a fallow season. Crop residues and stubbles of rice were incorporated into the soil several weeks before the analyzed period. To avoid the effect of CO_2 flush, three days after tillage were excluded from the analysis. The decomposition rate (HR) was directly deduced from measurements obtained over the bare soil using closed-path eddy covariance, which, unlike open-path eddy covariance, does not suffer from problems due to sensor heating. Volumetric soil water content (SWC) at 0–0.1 m was continuously monitored with a TDR sensor.

3. Results

Our HR measurements showed a close relation to each of soil temperatures at 0.01, 0.05, 0.1 and 0.2 m, surface skin temperature, SWC, and the amount of existing SOM as estimated from time after the input of crop residues. HR increased exponentially with surface and soil temperatures. Better fitting curves were obtained for surface temperature than soil temperatures, indicating that surface temperature is more appropriate to account for eddy covariance HR measurements probably because it reflects atmospheric conditions such as turbulent intensity as well as ground thermal environments. A small value of mean Q_{10} (1.38) with little inter-annual variation (1.5%) was obtained from the three-season data of surface temperature and HR. The effect of SWC on HR was evaluated using the basal value of respiration, R_0, in the Q_{10} equation. R_0 was sequentially calculated using a moving window over SWC data. R_0 remarkably decreased with SWC increasing in 2004FS and 2006FS, where R_0 at 0.5 m^3 m^{-3} decreased to almost half of that at 0.2 m^3 m^{-3}. In 2005FS, such a trend was not obvious because the soil was dried throughout the season by a small precipitation. R_0 also changed with days after incorporating residues into the soil in 2005FS, but not in other seasons.

These effects on HR were analyzed by a multiple regression model with independent variables of the surface temperature, SWC, and days after the residue incorporation. Q_{10} was determined to be 1.38 after averaged over the three seasons. The dependence of HR on SWC was expressed as a linear function in the model, and an averaged slope of –2.0 (μmol m^{-2} s^{-1})/(m^3 m^{-3}) was obtained. The effect of the amount of existing SOM was modeled by an exponential function, where an averaged dumping coefficient was found to be –0.003 d^{-1}.

In the three fallow seasons, inter-seasonal variations in precipitation and SWC were much larger than those in soil and surface temperatures. This suggests that SWC is the predominant factor to control the inter-annual variation in the decomposition rate in the fallow and the subsequent carbon balance in the paddy soil.

P28

REVIEW ON THE INFLUENCE OF DIFFERENT MANAGEMENT ON SOIL ORGANIC CARBON AND CARBON DENSITY OF *LEDUM-LARIX* GMELINI FOREST

Withdraw

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Soil is an important place to live for all the organism, it is also the biggest storage pool of terrestrial ecosystem. Larix Gmelini of the Greater Xingan Mountains is the only one coniferous forest of cold temperate and high Latitude zone in China, it plays an important role in Maintaining ecosystem stability in north of China. Carbon content and density of *Ledum - L arix Gemlini* Virgin forest, Successive Cutting forest and the Clear cutting forest were determined in our study.

The results showed that soil organic carbon content was the highest in humus layer of *Ledum - Larix Gemlini* forest Virgin forest, the value was 235.05g/kg,then it began to decline with the depth 0 ~ 10cm in illuvial layer, the distribution law of organic carbon content after twenty years cutting was roughly consistent with Virgin forest. The distribution law of carbon density in different layers was also consistent with organic carbon content, the value was 17.96kg·m^{-3}, carbon density of Successive Cutting forest and the Clear cutting forest after twenty years cutting were 81.61%, 56.85% of Virgin forest, respectively.

It also showed that the organic carbon content declined with soil depth in three forest types, the carbon density in Virgin forest and Successive Cutting forest was higher than in the Clear cutting forest, the influence of Successive Cutting working on carbon content and density was not significant, but the Clear cutting working can decline the carbon density of humus layer significantly, so it was not beneficial to improve the carbon storage function of humus layer.

P29

HYDROLOGIC EXPORT OF PARTICULATE AND DISSOLVED ORGANIC CARBON FROM A MOUNTAINOUS FORESTED WATERSHED: IMPORTANCE OF SUMMER MONSOON RAINFALLS

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Despite growing interest in the response of ecosystem C fluxes to climate change, little attention has been paid to climate change impacts on hydrologic C export from forested watersheds in mountainous terrains of East Asia, largely due to the general assumption of relatively small proportion of the hydrologic C export in forest C budgets. To obtain insights into watershed biogeochemical responses to changing patterns of summer monsoon rainfalls, a long-term biogeochemical monitoring has recently been launched in a mountainous watershed in northern South Korea in which large-scale agricultural expansion has dramatically changed the predominantly forested landscape over the last couple of decades. We combined intensive storm sampling and real-time water quality monitoring with biweekly routine water quality monitoring at 14 sampling locations encompassing major watershed characteristics to investigate seasonal and short-term variability in watershed material export in response to varying hydroclimatic conditions throughout the year. The concentrations of total suspended solid (TSS) in surface waters as a measure of suspended sediment were significantly higher following storm events and particularly in streams under a strong influence of agricultural runoff. Hourly storm sampling and real-time turbidity measurement during the summer monsoon showed rapid increases in suspended sediment loads even in forest streams. The rate of increase in sediment export appeared to correspond to the rainfall intensity of each storm event. UV absorbance at 254 nm in surface waters, as a measure of aromatic dissolved organic matter, also showed concurrent changes with stream discharge even in a series of storm events with total precipitation over 400 mm in 3 days. These results, together with preliminary measurements of dissolved and particulate organic carbon in storm water samples, highlight flashy responses of hydrologic C export from mountainous watersheds to monsoon rainfalls ranging from regular to extreme events. Without considering short-term variability of watershed biogeochemical responses to monsoon rainfalls, annual hydrologic C export might be underestimated, resulting in an inaccurate prediction of long-term responses of forest C storage to climate change.

Acknowledgements: This work was funded by Korean Research Foundation (project number: KRF-2007-313-F00033).

P30

ORGANIC CARBON SEQUESTRATION AND DISCHARGE FROM KOREAN NATURAL FOREST CATCHMENT

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Hydrological processes in forested catchments are critical to interpreting the sequestration and discharge of dissolved organic carbon (DOC) and particulate organic carbon (POC). However, it is no available data for evaluating the effect of hydrological processes on carbon dynamics in Korean forest ecosystems. To evaluate the effect of hydrological processes on organic carbon sequestration and discharge from forest catchment, we surveyed hydrological factors (precipitation, soil moisture, runoff discharge, groundwater level) and analyzed hydrochemical data (DOC, POC, end-member mixing analysis) in a natural deciduous forest catchment in Korea National Arboretum for the 2005. Total DOC infiltration to the soil was estimated at 0.45 t-C ha^{-1} (about 0.5% of soil carbon) during the summer monsoon period. The annual DOC and POC discharge from Gwangneung deciduous forest catchment was estimated at 0.04 and 0.05 t-C ha^{-1} yr^{-1}, respectively. During summer monsoon period, about 70% of the annual organic carbon efflux was transported out of study site through 30 to 80% of surface discharge, which was obtained result from end-member mixing analysis. The annual organic carbon was estimated 10% of net ecosystem exchange (0.87 t-C ha^{-1} yr^{-1}; 2006). These results suggest that DOC play an important role in carbon cycling between above- and belowground in monsoon climate forest ecosystems, and possibility of overestimation of carbon sink due to neglecting of organic carbon discharge.

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

P31

METHANE EMISSION FROM THE ROOTS OF BROAD-LEAVED SECONDARY FOREST

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In recent years, global warming has received significant attention. Methane is considered to be an important greenhouse gas following carbon dioxide. Main sources of methane are ruminant stomach, wet land and burning of fossil fuels. In addition, upland forest has attracted attention in recent years as a possible source of methane, because rich organic matter such as woody roots below the water table of the forest may be a source of methane under anaerobic conditions. However, the spatial variation of CH_4 emission in relation to the amount and characteristics of organic matter in the forest is poorly understood. Therefore, in this study we examined the methane emission from such roots.

We used the *Yamashiro* Experimental Forest (YEF) located in *Kizugawa* city in the southern part of *Kyoto* prefecture. The annual mean air temperature in YEF is 15.5°C, the warm index is 125.6°C· month, the average annual rainfall is 1449.1 mm and the altitude is 180–250 m. The geological features are weathering granite, sandy immature soil, and a generally thin soil structure. YEF is among the headwaters of the *Fudo* River and a branch of the *Kizu* River, and has a small catchment area (1.6 ha). In this research, an investigation plot was set in the riparian zone of YEF. This plot was the model area for woody roots under the water table. The plot area was dug down to the water table on the rock layer and refilled with granite soil without organic matter. Twenty soil columns (20 cm in diameter, 15 cm in height) made from polyvinyl chloride were inserted into the plot. In these soil columns, roots sampled from the forest were placed under the water table and non-organic soil was piled on top of it. The dry weights of roots were measured beforehand. To measure the rate of methane emission in the column, an acrylic cover was placed over the column and the headspace gas was collected using a syringe. The air was sampled at 0, 15, and 30 minutes after the starting time. The acrylic cover was equipped with a Tedlar bag for pressure compensation. The methane concentration was measured using a GC-FID 15-A (*Shimadzu*).

A high rate of methane emission was observed on the column that contained of organic matter. Especially, the emission rate of the column containing fine roots was relatively high per dry weight. These results suggest that woody roots are an important potential source of methane under the forest. The fine roots are rich in nitrogen and have specific characteristics. Further studies of roots as a source of methane may be needed.

P32

METHANE CONCENTRATION PROFILES IN WARM-TEMPERATE UPLAND FOREST OF CENTRAL JAPAN

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The overall climatic impact of methane (CH_4) on global warming is estimated to be nearly half that of carbon dioxide (NOAA, 2008). Over the past two decades, the annual rate of growth of CH_4 emissions has varied widely, yet the cause of this variation is unknown. In recent years, several reports have suggested that forests may be larger sources of CH_4 than previously believed. An analysis using a satellite-mounted instrument showed that atmospheric CH_4 concentrations are far greater than expected from ground-based emissions inventories of tropical rain forests (Frankenberg *et al*. 2005). In addition, methane concentration profiles in three upland forests of the Brazilian Amazon showed a CH_4 source within the lower 10 m of the forest canopy (Carmo *et al*. 2006). Nighttime pooling of CH_4 at 2 m above the soil surface was observed in a mixture of forest and savanna (Scharffe *et al*. 1990, Crutzen *et al*. 2006). Megonigal *et al*. (2008) assumed there was CH_4 emission from upland vegetation that was transported from the saturated zone below the water table through the transpiration stream. To understand the circulation of CH_4 in the upland forest ecosystem, detailed accurate measurements of CH_4 concentration are needed. In the present study, we conducted CH_4 concentration profile measurements in a warm-temperature forest, the Yamashiro Experimental Forest (YEF). In addition, we measured the CH_4 flux on the forest floor and leaves near the tower using the closed chamber technique.

The YEF is located in the valley of Yamashiro, Kizugawa city, Kyoto prefecture (34°47'N, 135°51'E), in a hilly, mountainous region of central Japan with an elevation of about 220 m asl. The forest consists of deciduous broadleaved species (mainly *Quercus serrata*) and evergreen broadleaved species (mainly *Ilex pedunculosa*). The diameter at breast height (DBH) of all trees has been measured in the YEF every 5 years (Goto *et al*., 2003). According to Goto's results, *Q. serrata* accounts for 27.5% of the total biomass in the YEF. The forest canopy height is about 12 m and the height of the micro-meteorological tower on the ridge is 26 m. In the present study, the profile of CH_4 concentration above the YEF was measured using the tower. Measurements were conducted around noon between 25 April and 3 September, 2008. The measurement interval was about once a week (n = 15). Air samples were collected at 2-m intervals between 0 and 26 m height from the base of the tower. Air samples were collected in Tedler bags (5 L) by pump (2 L min^{-1}) for 2 minutes. To carry the air samples to the laboratory, 40 ml of the air in the Tedler bags was injected into evacuated glass vials (30 ml) with a butyl rubber stopper. A gas chromatograph equipped with a flame ionization detector (GC-FID, Shimadzu, GC15A) was used to analyze the CH_4 in the air samples in the laboratory. The packed column of GC-FID was a Molecular Sieve 5A (Shinwa Chemical Industry, Ltd. 60/80, SUS 2 m × 3 mm I.D., col. temp.: 100ºC, carrier gas: N_2 50 mL min^{-1}, detector temp.: 130ºC, sample size: 2 mL). A soil chamber and a branch chamber were placed on the forest floor and in the uppermost canopy of *Q. serrata* near the tower. The chamber measurements were conducted about once a week.

For all chamber measurements, constant CH_4 uptake was observed on the forest floor but CH_4 flux on the leaf of *Q. serrata* was not detected. On the other hand, a small peak of CH_4 concentration around the canopy height was observed in more than 80% of the profile measurements. Moreover, a higher concentration of CH_4 at the level of 0 m than at 26 m was observed in 60% of cases. These results imply that there is horizontal advection of CH_4 from wet areas or an unexpected source in the forest, and that there is oxidation of CH_4 by OH radical in the upper atmosphere. To understand the circulation of CH_4 in the forest, further studies of the spatial variation, daily change and source of CH_4 are needed.

P33

MEASUREMENT OF METHANE FLUX OVER A LARCH FOREST BY A RELAXED EDDY ACCUMULATION METHOD AT FUJI-HOKUROKU, JAPAN

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Methane is a powerful greenhouse gas, whose greenhouse effect is about 20 % next to CO_2, and thought to be important in the global

carbon cycle. Although methane is produced under an anaerobic condition such as paddy field and wetland, recent studies proposed that plant leaves emitted methane under an aerobic condition (Keppler *et al.*, 2006); the emission from terrestrial plants was estimated to be 62 ~ 236 T g yr^{-1}, about 30 % of total global methane emission, by their experiment. In this study, we have conducted continuous observations of methane flux in a temperate forest by using a relaxed eddy accumulation (REA) method, and evaluated methane flux and the budget as ecosystem scale. The advantage of the REA method is that the system was not necessary to apply a fast response gas analyzer in case of eddy covariance systems. Thus, we developed the measurement system and validated it in the CO_2 flux measurement. The observed flux will compared with methane flux derived from a modified gradient method.

Measurements were conducted at the Fuji-Hokuroku site located at the North foot of Mt. Fuji in Japan. The dominant tree species is Japanese larch (*Larix kaempferi* Sarg.) covering about 150 ha, and the canopy height is 20 ~ 25 m. The annual mean air temperature and total precipitation are 9.4ºC and 1573 mm, respectively (CGER, 2006). A sonic anemometer and REA sample inlets set at 35 m, whereas profile sample inlets set at 35, 27, 16 and 0.3 m, respectively.

Since temperature and solar radiation were thought to affect methane emission from leaves (Keppler *et al.*, 2006), we expected upward methane flux with clear diurnal variation from the forest. However we could not find the diurnal variation clearly (Fig.1). Preliminary result showed that daily mean of methane flux was downward of - 0.3 g m^{-2} s^{-1}, with standard deviation of 0.8 g m^{-2} s^{-1}. Vertical profile of methane concentration showed that the lowest concentration was near the soil of 0.3 m. Consequently, we inferred that the forest soil might consume methane slightly, but not emit it from the leaf canopy.

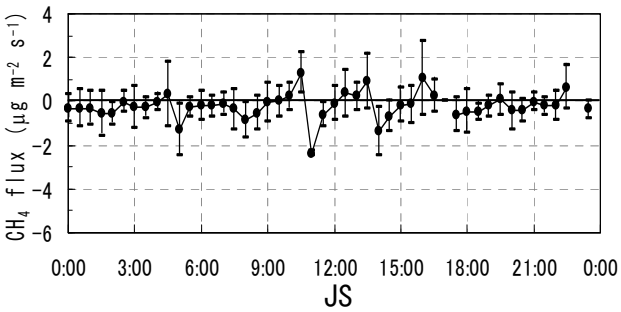

Fig.1. Diurnal pattern of mean half-hourly methane flux between August 21 and September 22, 2008

P34

ISOPRENE FLUX MEASUREMENT USING RELAXED EDDY ACCUMULATION TECHNIQUE IN JAPANESE OAK FOREST

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1. INTRODUCTION

Biogenic Volatile Organic Compounds (BVOCs) including isoprene and monoterpene are released from many plant species. Globally, the emissions of BVOCs are estimated to be from 0.5 to 1.2 PgC/year (Guenther *et al*., 1995), which is greater than those of anthropogenic VOCs. The emission of isoprene from vegetation accounts for about 50% of total BVOC emissions, so it is important to accurately estimate the emissions of isoprene from forests worldwide. Various studies to estimate isoprene flux have been conducted in western countries, but there have been very few such studies in Asia. Japanese oak (*Quercus serrata*) is a major emitter of isoprene in Japan, and is a major tree species in the Yamashiro Experimental Forest (YEF, Fig. 1), so we conducted isoprene flux measurements at this site.

2. MATERIAL AND METHODS

The YEF sampling site is located in the mountains in Yamashiro, Kizugawa, Kyoto prefecture, Japan (34°47'N, 135°51'E). There are two flux observation towers, and the ridge tower was used for the experiments.

The Relaxed Eddy Accumulation (REA) method was used to directly measure isoprene fluxes. Flux is given by $F=b\sigma_w(C^+-C^-)$ (Businger and Oncley *et al.,* 1990), where b is an empirically determined constant, σ_w is the standard deviation of the vertical wind, and C^+ and C^- are the average concentrations of the trace gas in the updraft and downdraft reservoirs for 30minutes sampling time, respectively.

Fig. 2 is a schematic diagram of the REA measuring system developed in this study. Air samples in updraft and downdraft directions were separated by the solenoid valves, and isoprene in each sample was trapped by adsorbents (200mg Tenax and 100 mg Carbotrap) in stainless-steel tubes. A two-stage thermal desorption system (ATD-400) and GC-MS system (Shimazu QP5050A) were used for analysis of isoprene samples.

3. RESULTS

The measurement was conducted on August 22nd, 2008. The weather was sunny, sometimes cloudy, and average temperature was 25 °C. The highest isoprene flux was observed around noon, and lower fluxes were observed in the morning and the evening. This clear patterns of diurnal variation matched the G93 model (Guenther *et al*., 1993), and confirmed that our REA system was effective for measuring isoprene flux

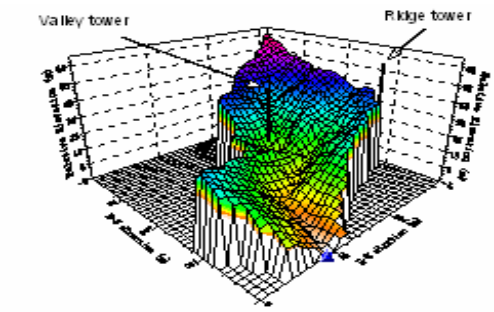

Fig.1. Overview of the measuring site

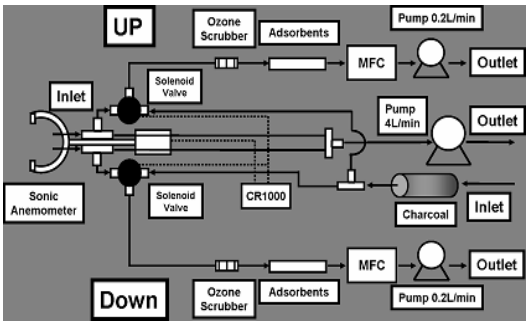

Fig.2. Developed REA measuring system

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Poster Session

P35

SURVEY ON GREENHOUSE GAS (METHANE GAS) EMISSION OF UPO WETLAND

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The attempt to presume the volume of methane generation from a rice field has conducted before the increase of methanedensity in the atmosphere was reported from a point of view to explain the geochemistry circulation of carbon. Even if the presumption was done based on the observed values of rice fields in 1980, but no study on methane gas emission of wetlands in Korea has been conducted. Therefore, we measured methane gas emission of Upo wetland in Kyeongsangnam-Do, one of the representative wetlands in Korea and greenhouse gas volume.

Here were various trials and errors over time in making a proper chamber for a wetland. We redesigned one of the existing containers placing on the market in order to meet the following conditions such as not large one, not heavy, easy to move, no change in long-term, numerous times of observation and minimization of chemical reaction.

We made a hole at the same location in two chambers and connected two tubes which can receive buoyancy at the same height in order to make no difference in both a sinking part and floating part on water. We blocked direct isolation with silver-paper tapes to stop temperature increase in a chamber and installed a fan inside of a chamber to keep uniform density in case of absorbing bubbles.

We measured the initial methane volume (T1) and another methane volume (T2) after 30 minutes. The net methane volume was T2-T1. If the volume was '-', then it was omitted because it was considered to be an invalid data value.

According to the study by KyungBo Kee and others(1999), flux volume of precocious species rice after using rice straw in a rice field was 18. 51 mg/㎡/hr on 3 Jul., 25.95 mg/㎡/hr on 1 Aug., 28.74 mg/㎡/hr on 27 on Aug maximally. Even if data are not stable yet, but we can see that methane volume in a rice field was greater than the volume in Upo wetland if comparing the maximum values such as 141.04 mg/㎡/hr on 4 May, 74.75 mg/㎡/hr on 27 July and 147.92 mg/㎡/hr on 21 Aug.

Acknowledgement: This work was supported by the Korea Science and Engineering Foundation (KOSEF) grant funded by the Korea government(MEST) (No. R01-2006-000-10104-0).

P36

METHANE EMISSION FROM LEAVES IN A TROPICAL RAIN FOREST AND A TEMPERATE CONIFER FOREST

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INTRODUCTION

Recently, it has been reported that leaves of many kind of plants including woody species can emit CH_4 in an aerobic condition (Keppler *et al*., 2006). They suggest that forest canopy may function as a net source of CH_4 and that tropical rain forest may be particularly an important natural source. If these calculations can be accepted, the emission of CH_4 by plant leaves may have an important influence on global warming. In this study, we focus on estimating the CH_4 emission from plant foliage in a tropical rain forest and a temperate conifer forest, and aim at evaluating the contribution of plants to the exchange of CH_4 between a forest and the atmosphere.

SITE DESCRIPTION

The study was conducted at the Pasoh Forest Reserve in Peninsular Malaysia (2°58′N, 102°18′E) and the Kiryu Experimental Watershed (KEW; 34°58′N, 136°00′E; 5.99ha) in Shiga Prefecture, Japan. The core area (650 ha) of the Pasoh reserve is a primary lowland mixed dipterocarp forest, consisting of various species of Shorea and Dipterocarpus. The continuous canopy height was approximately 35 m. In KEW, a meteorological observation tower is located in a 0.68-ha catchments within the experimental watershed, which is mainly covered by *Chamaecyparis obutusa* Sieb. et Zucc. (Japanese cypress, an evergreen conifer) that was planted in 1959 (19m canopy height).

METHODS

We measured CH_4 emission from leaves with closed static chamber method. Leaf samples were chosen from canopy and forest floor of Pasoh and KEW sites. At Pasoh, we sampled 4 species from canopy (*Xanthophyllum stipitatum, Dipterocarpus sublamellatus, Ptychopyxis caput-medusae, Neobalanocarpus heimii*), and 4 species from forest floor (*Alphonsea maingayi, Rinorea anguifera, Macaranga lowii, Neobalanocarpus heimii*). The leaves of *Elaeis guineensis* were also sampled at the oil palm plantation near the Forest Reserve area. At KEW, we sampled the leaves of Japanese cypress both from the top (18m) and middle (16m) of canopy, and also the leaves of *Eurya japonica* at the forest floor. Fresh leaves (detached from the plants) were sampled both at dawn (around 7:00-8:30) and in late afternoon (around 15:00-16:00) to examine the influence of sunlight on methane emission from leaves. Leaves were placed in glass vials (50ml, 100ml) sealed with a silicon septum, or PVC-chambers (330ml, 450ml, and 670ml). Before and after incubation in the dark for 16h at 30℃, CH_4 concentrations in the vial or chamber were measured with a gas chromatograph (GC; GC-14BPF; Shimadzu, Kyoto, Japan). After incubation, leaf area and dry weight were measured to determine the fluxes per each units. For comparison, methane fluxes from leaves of 5 temperate woody species (*Pinus densiflora, Quercus glauca, Quercus serrata, Quercus robur, Fraxinus griffithii*) were also measured in the same way.

The profile measurement for the CH_4 concentration along the flux observation tower was also conducted at both sites. Sample air was taken in vacuum 20ml glass vials every 1.5 to 2 hours during daytime at each of 10 heights (0.2m, 0.5m, 1m, 2m, 5m, 10m, 20m, 30m, 45m, 53m) in the Pasoh and 8 heights (0.3m, 1m, 5m, 10m, 15m, 20m, 25m, 30m) in KEW, and CH_4 concentration was measured with a GC.

RESULTS AND DISCUSSION

Incubation experiment revealed that methane was emitted from most of the tested species. The emission rate was particularly large for *Elaeis guineensis* at Pasoh, while small methane consumption was observed for *Eurya japonica* at KEW. The emission from canopy leaves at Pasoh was comparatively larger than that at KEW. The emission rate was generally larger from leaves at the upper canopy layer than those at the lower and forest floor both at Pasoh and KEW. Moreover, the leaves which were sampled in late afternoon tended to emit CH_4 greater than those sampled in early morning. These results suggested the importance of sunlight on methane emission from the leaf. As for profile measurements, CH_4 concentration was not much different in each height, but showing relatively large variation near the forest floor. CH_4 concentration was higher in the morning than in the afternoon both at the Pasoh and KEW. From these results, it was suggested that both sink and source exist in patches at the forest floor, consisting with the knowledge of the CH_4 dynamics at the forest soil.

It can be said from these results that forest canopy works as a small methane source relating with light conditions, but the contribution to the CH_4 exchange at the total forest ecosystem is far small comparing with the activities in the soil.

P37

FLUXES OF CH_4, N_2O AND CO_2 FROM PADDY SOIL WITH DIFFERENT NITROGEN APPLICATION IN XISHUANGBANNA, SOUTHWEST CHINA

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Although Xishuangbanna is within the tropics, it has large seasonal climatic variations. Paddy soil has substantial effects on carbon cycle. Exchange of CH_4, N_2O and CO_2 between paddy soil and atmosphere, and the factors influencing this exchange have become important issues for global carbon-cycle research. Using the static opaque chamber and gas chromatography technique, emission of CH_4, N_2O and CO_2 from paddy soil and their affecting factors were investigated in Xishuangbanna, Southwest China. In this study, soils with and without rice plants at three nitrogen fertilization levels (0, 150 and 300 kgN ha^{-1}) were examined. The results are as follows:

1) There was seasonal variation in CH_4 flux. In the fallow season, there was nearly no CH_4 emission, but paddy soil serves as a net source of CH_4 in the growing season of rice plant. Rice plant had a positive effect on CH_4 production, CH_4 emissions from treatment with rice plant significant higher than that from treatment without rice plant. Rice plant had an interaction effect with nitrogen fertilizer. Nitrogen fertilizer inhibited CH_4 emission when the amount of N fertilizer exceeded 150 kg N ha^{-1} in the treatment with rice plant. For treatment without rice plant, nitrogen fertilizer had no effect on CH_4 emission. Cumulative CH_4 emissions were 16.64 (N0), 18.40 (N150) and 14.91 g CH_4 m^{-2} a^{-1} (N300) in 2005, while in 2006, the values were 9.37 (N0), 10.51 (N150) and 8.04 g CH_4 m^{-2} a^{-1} (N300) for treatment with rice plant.

2) Cumulative N_2O emissions were 285.85 (N0), 561.51 (N150), 538.51 mg m^{-2} a^{-1} (N300) and 232.28 (N0), 376.90 (N150), 625.32 mg m^{-2} a^{-1} (N300) in 2005 and 2006, respectively, and remarkable difference between 2005 and 2006 was observed. In rice growing season, nitrogen fertilizer can enhance N_2O emission, but it was not the main factor influencing N_2O emission. Pulse N_2O emissions occurred when soil moisture was suitable. Rice plant also can influence N_2O emission by uptaking nitrogen element.

3) The average values of soil respiration rates differed among seasons at 1% level, maximum in the fallow season after rice harvest, minimum in growing season and intermediated in the fallow season before rice transplanting. Soil moisture and temperature were the dominant factors influencing soil respiration, when the soil moisture was below 34%, there was positive linear relationship between soil moisture and soil respiration rate, when the soil moisture exceeded 38%, there was an exponential relationship between soil respiration and temperature at 1% level. Through the total growth season, soil or ecosystem respiration rates from different nitrogen fertilizer level had no obvious difference, but N300 treatment inhibited plant respiration rates.

4) The estimated annual amount of soil respiration were 6.27 t C ha^{-1} a^{-1}, 6.31 t C ha^{-1} a^{-1} and 5.89 t C ha^{-1} a^{-1} for N0, N150 and N300 treatment, and the annual net fixation of CO_2-C from atmosphere were estimated as 1.41 t C ha^{-1} a^{-1}, 2.28 t C ha^{-1} a^{-1} and 1.11 t C ha^{-1} a^{-1}, this indicated that paddy soil in Xishuangbanna serves as a carbon sink.

P38

COMPARATIVE CO_2 FLUX MEASUREMENT WITH AN REA METHOD AND OPEN PATH, CLOSED-PATH METHOD IN FUJI HOKURPOKU, JAPAN

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An Relaxed Eddy Accumulation (REA) method for CO_2 flux measuring system was established and a measurement started from 2006 June at 35 m height over a larch forest. The result was compared with the eddy covariance of open and closed method.

Measurement was made at the Fuji-Hokuroku Research site of Center for Global Environmental Research (CGER), National Institute for Environmental Studies and the topography is fairly flat with the 3 to 4°up to the South-West. Top of the tower has moving mast and the mast installed instruments and sensors for flux measurements at 35 m height.

REA method has advantage to apples trace gas flux measurement, because of need not fast response such as open-path gas analyzer. The flux F is expressed as follows:

$$F = b\sigma_w(C_{up} - C_{down})R_C .$$

where C_{up}, C_{down} are mean CO_2 concentration of updraft and downdraft, b is an empirical coefficient, and $_w$ is standard of vertical winds speed. R_C is Pure CO_2 density respectively.

Sampling intakes are stetted to the top of the tower mast with a sonic anemometer. Intakes of flow rate were 0.7 min^{-1}. To measure C_{up} and C_{down}, the system has two sampling pumps (Iwaki, OP-026D1), and one is operated for updraft another for downdraft respectively. The system has four 40 sampling bags ($C_{up(0\text{-}30)}$, $C_{down(0\text{-}30)}$, $C_{up(0\text{-}60)}$ and $C_{down(30\text{-}60)}$). 0 to 30 min of every hour, sampled updraft and downdraft air were led to $C_{up(0\text{-}30)}$ and $C_{down(0\text{-}30)}$ bags. At the same time CO_2 concentration of bag $C_{up(0\text{-}60)}$ and $C_{down(30\text{-}60)}$ were measured with gas analyzer (Licor, LI-6262). Next every 30 to 60 min, these bags are alternatively exchanged sampling and measuring. The flow rate of the analyzing period by the gas analyzer and exhaust period were 0.5 min^{-1}.

Standard deviation of vertical wind speed σ_w was measured by instantaneous of vertical component of the sonic anemometer. The signal w was converted to digital signal and calculated to standard deviation σ_w by a data logger (Campbell, CR1000).

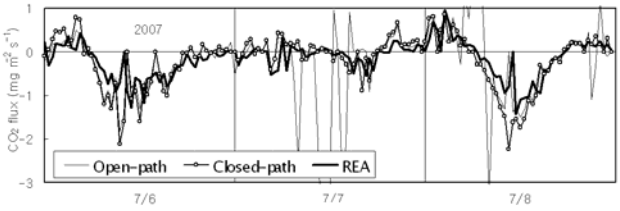

Fig. 1. Comparison of three method flux measurements.

P39

A CHAMBER SYSTEM WITH AUTOMATIC SLIDING CANOPY CHAMBER FOR CONTINUOUSLY MEASURING NET ECOSYSTEM PRODUCTIVITY

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To understand carbon cycle dynamics of an ecosystem, accurate determination of seasonal, daily and real-time CO_2 flux mechanism in field under natural meteorological condition is need. For these, it is very important to develop adequate facility for understanding CO_2 flow short and long term period. So far, there is no appropriate equipment for monitoring CO_2 flux in real-time and minimizing environment disturbance. In here, we describe the ASCC (Automatic Sliding Canopy Chamber) system that measures continuous crop CO_2 exchange with real-time NEP (Net Ecosystem Productivity) and cover whole cultivation season. The ASCC, enlarge type of greenhouse, move in turn along the fixed frame which consist of 5 sectors. The ASCC system, based on open-flow method, monitor the differences between air inlet and outlet which infer the CO_2 flux followed by plant growth or respiration. And the net CO_2 flux represents NEP. Meanwhile, the AOCC (Automatic Opening and Closing Chamber) system was installed inside the ASCC system to separate the HR from this CO_2 exchange (NEP). To minimize the surrounding environmental condition, the ASCC is opened for the most of time except measuring (30min.). A few concerns on measuring CO_2 flux using open-flow chamber method are leaking and any microclimatic changes due to ASCC system. As for leaking test, it shows 4.2% of leakage (1.8mg CO_2 m^{-2} h^{-1}) and it was negligible without introducing relative errors. The results of transmittance test of ASCC show minimum reduction of

Rs (solar radiation) about 7.4% and *Rp* (Photosynthetic Photon Flux Density) about 9.1%. With regard to temperature changes by greenhouse effect, they show less than 2 ºC difference in peak temperature among ambient temperature (96.4±1.5%) and soil temperature (97.1±1.2%: 5cm depth), respectively. Overall, we could possibly conclude that the effect of the ASCC is least, and compatible for field measurement. In field test with *Capsicum annuum* L. (red pepper) in 2006, we observed 4.8 ton CO_2 ha^{-1} of NEP and 4.0 ton CO_2 ha^{-1} of HR. As a result, we calculated 8.9 ton CO_2 ha^{-1} of absorption by *C. annuum* L. (Net Primary Productivity: NPP) and it was similar to reported value (9.0 ton CO_2 ha^{-1}). Unlike other small scale chamber system, installation on field makes it possible to pick any changes up which might be due to natural environmental condition. As a result, the ASCC system permitted continuous long-term measurement under a range of temperature conditions and did a good job of reflecting the seasonal, daily and real-time variation of CO_2 flux in field condition.

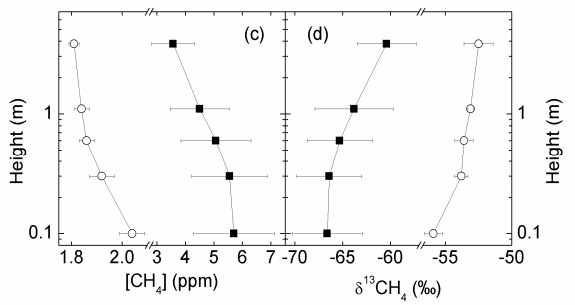

Fig. 1. Vertical distributions of concentration and carbon isotopic composition of CO_2 (top panels) and methane (bottom panels). The day time- and nighttime-averaged profiles were derived from the individual profiles obtained at 10:00, 12:00, and 14:00 and 21:00, 24:00, and 03:00 local hours, respectively. Error bars represent the standard error. For clarity, the sampling heights are plotted on a logarithmic scale.

P40

SIMULTANEOUS DETERMINATION OF CARBON ISOTOPIC SIGNATURES OF CO_2 AND METHANE EXCHANGED BETWEEN THE PADDY ECOSYSTEM AND THE ATMOSPHERE UNDER NATURAL CONDITIONS

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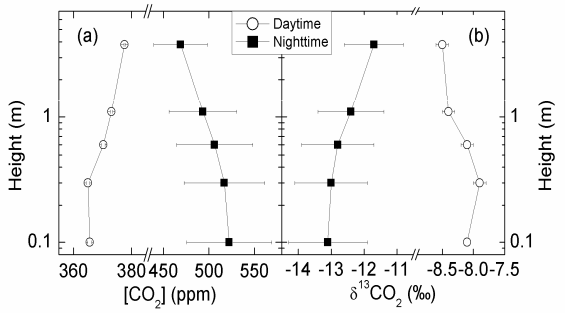
Recently, the carbon isotopic compositions of CO_2 and methane exchanged between the ecosystem and the atmosphere (δ_N and δ_M, respectively) are being utilized to partition net fluxes of CO_2 and methane into their component fluxes. In a Japanese rice paddy, we investigated the temporal variations of δ_N and δ_M at the same time by combining stable isotopes and concentration measurements within and above the canopy. There were close agreements between the measured concentrations and the $\delta^{13}C$ values of CO_2 and methane on both temporal and spatial scales. While atmospheric stability and environmental parameters influencing photosynthetic assimilation were the major controls on variability of [CO_2] and $\delta^{13}CO_2$, atmospheric stability was the predominant factor for driving changes in [CH_4] and $\delta^{13}CH_4$ profiles. We also found strong linear relationships between the measured isotopic compositions and the inverse of concentrations over the time spans of day, night, and whole day. The δ_N values determined on the two days contrasting in environmental conditions revealed that the relative contributions of photosynthetic assimilation and ecosystem respiration to the total CO_2 exchange did not change significantly. In contrast, the δ_M values showed a marked difference between the sampling dates, reflecting a transpiration-induced shift in methane transport.



P41

A PRELIMINARY STUDY OF TOPOGRAPHIC EFFECT ON CO_2 FLUX MEASUREMENT AT CHI-LAN MOUNTAIN SITE

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With ideal meteorological and fetch conditions, the eddy covariance method could provide reliable ecosystem-scale flux measurements. However, as most studies indicated, challenges remain as applying the eddy covariance at sloping terrain. The Chi-Lan Mountain site (CLM site) located in north-eastern Taiwan (24°35'N, 121°25'E, 1650 m elevation) is a subtropical cloud motane forest site, which is characteristic by frequent fog events and diurnal mountain-valley wind circulation. The site is located at a relatively homogeneous south-eastern-faced slope with an angle of 15°, mainly occupied by natural regenerated 50-years-old yellow cypress (*Chamaecyparis obtusa* var. *formosana*) with canopy heights ranged from 11 m to 14 m. In this study, the storage in the forest canopy and advection effect on eddy flux measurement are estimated and discussed.

With an open/close-path eddy covariance system installed above the forest canopy (at 24 m height), CO_2 eddy fluxes were calculated from July 2007 to March 2008. The advection effects were estimated with two additional open-path eddy covariance systems mounted at 22 m and 26 m heights on another tower 200 m downslope from the main instrument tower from July 28th to November 20th in 2007. The differences of eddy fluxes measured among these three systems were used to estimate the advection effects. Storage and vertical advection effects were also evaluated using an 8-layers CO_2/H_2O/temperature profile measurement on the main tower from December 2007 to March 2008.

The result indicated that the storage and advection effects added uncertainties of flux estimations at this sloping mountain forest stand. While the sum of storage effect diminished for daily and longer time interval fluxes, storage term could not be neglected for short interval fluxes during sunrise, foggy, sunset, and night time. As about half of the time during nighttime, short interval (30 minutes) storage terms could reached more than ±50% of the magnitude of eddy fluxes, inclusion of storage terms in the computation of short interval fluxes is a necessity. The profile measurement during foggy daytime also indicated that weak turbulence generated above the dense canopy could not effectively remove CO_2 released by soil respiration. Fog accounted for about one-third of time at the CLM site, neglecting storage effects would cause overestimation of the net ecosystem exchange during foggy daytime.

During daytime, either vertical or horizontal advection flux amounts to a magnitude less than an order of the eddy fluxes. Despite there was still uncertainty in quantifying the advection fluxes during nighttime, their magnitude were estimated in the same order as eddy fluxes and

thus could added significant error for the nighttime flux measurements. Our measurement indicated that at CLM site, there was weak daytime vertical advection fluxes resulted from CO_2 concentration difference between the two measurement heights above the canopy as well as weak vertical mean flow possibly modulated by the deep slope terrain. Concentration difference between measurements at the two towers might also indicate the existence of horizontal advection fluxes. Due to the uncertainties of footprint and turbulence development, there is uncertainty in quantifying the advection effects with our setup of multiple eddy covariance systems, but the CO_2 profile data indicated that CO_2 concentration increased during foggy afternoon (valley wind) and decreased when the wind regime turned around to downslope hilly wind. The eddy fluxes and friction velocity did not increase during these transition periods, below canopy drainage flows possibly would drain the accumulated CO_2 within and below the canopy out of the system, which also added difficulties in estimating nighttime CO_2 flux at the CLM site.

P42

PRELIMINARY STUDY OF DRAINAGE FLOW IN A SLOPING FOREST FLUX SITE – SIMULATION USING CFD METHOD

Withdraw

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Drainage flow occurs below the forest canopy is one of the unsolved problems at sloping flux measurement site. Chi-Lan Mountain (CLM) flux site is located at a relative uniform south-eastern-facing valley slope (15°), north-eastern Taiwan. The forest is a natural regenerated 50-years-old yellow cypress (Chamaecyparis obtusa var. formosana) stand and has a fairly uniform canopy. Analysis of flux measurement at CLM indicated that air flow could drain a considerable amount of the carbon dioxide gas accumulated beneath the flux measurement height and escaping from the eddy flux measurement above canopy. In order to evaluate the effect of drainage flow, vertical profiles and horizontal gradients of the horizontal wind velocity and carbon dioxide concentration caused by drainage flow were simulated by the Computer Fluid Dynamic (CFD) method. Simulation results will aid our future field instrumentation planning and to improve more detail modeling scheme at the steep mountain slope.

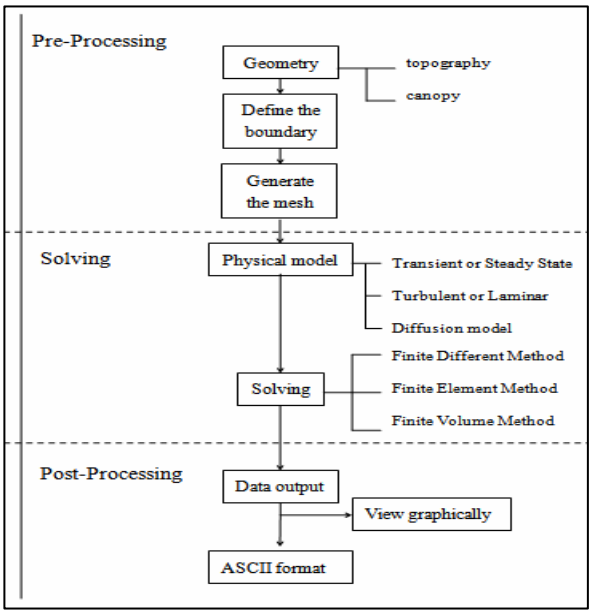

Fig. 1. Flow chart of the CFD method.

P43

FILLING DATA GAPS USING LOOK-UP TABLES (LUT) AT CHI-LAN MOUNTAIN SITE: THE EFFECT OF FOG

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Look-up-tables (LUT) method is a widely adopted method in gap filling of eddy flux measurement. Photosynthetically active radiation (PAR) and temperature were used as environmental variables to construct LUT at Chi-Lan-Mountain (CLM, 24°35 ' N, 121° 25 ' E) flux site in Taiwan. As the site is located in the mountain cloud forest zone characterized with year round heavy fog and frequent rain, PAR and temperature along could not fully explain variations of fluxes during those wet canopy situation (R^2=0.68, Fig. 1). Additional environmental factors such as visibility (reflect the fog occurrence) and ratio of diffuse to global solar radiation were used to construct the LUT. Our result showed a better estimation of fluxes during foggy period. The effect of wet canopy on the carbon dioxide flux from CLM cloud forest was also explored.

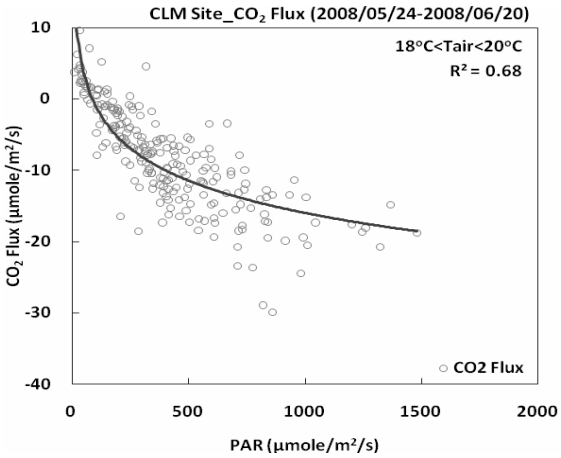

Fig. 1. The relationship between daytime carbon dioxide flux and photosynthetically active radiation.

P44

GUSTY WIND CHARACTERISTICS AT SKYSCRAPER AREA

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I. Introduction

Tall buildings in Seoul since 1990s induce the microclimatological and air hygienic impact to nearby area like reduced solar radiation, pollutant concentration, sunlight block and gusty winds. These unique micro-scale meteorological processes not only affect the local air quality but also the comfort of the city inhabitants (Bottema, 1993). Of the above-mentioned environmental impacts by tall buildings, gusty winds called building wind occur by descending turbulences due to the upper air blocking by tall buildings. When the wind descends, it makes three-dimensional turbulence around the buildings and makes eddy effects and prevents the air pollutants from being dispersed to surrounding area (Kim, 1998). However, there are few studies in measuring building wind. Generally it is known that wind data measured by 3-d ultrasonic wind monitor is more accurate than that by propeller type wind monitor. Thus, this study aims to observe the building wind and figure out the wind characteristics of skyscraper area using 3-d ultrasonic wind monitor.

II. Materials and Methods

2.1. Study Site

The study site is Dogok Subway Station Area at Gangnam-ku in Seoul, Korea. From the 1980s, the population of study site has grown rapidly mainly due to the urbanization and the development began for housing construction. Especially, there are nine skyscrapers at the study site such as Daelim Acrovill, Academy Sweet, and Tower Palace Ⅰ·Ⅱ·Ⅲ. Their heights are more than 164 meters within one block at the study site. In this block, the height of the tallest building, Tower-palace III, is 264 meters. The Tall building are used for business and commercial use in foreign countries such as Germany and Japan, but these skyscrapers are used for residential purpose in South Korea. The gusty wind characteristics at the study site has been done using propeller type wind monitor and 2-d ultrasonic wind monitor by authors. It shows the channeling effect of wind by sskyscrapers.

2.2. Data Measurement

The data observed includes wind speed and wind direction. For measuring wind speed and wind direction data, 3-d ultrasonic wind monitor (RM-Young 500) and Campbell CR1000 data logger were used. The wind monitor measured winds on rooftop of Woosung Apartment near Dogok Station. They recorded wind data for every 1/10 second. The wind speed and wind direction data were analyzed and interpreted. The Beaufort wind scale was used in the analysis.

P45

CHARACTERISTICS OF SOYBEAN IN LAND SURFACE MODELING

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Recently, due to rising oil prices and greenhouse gas emissions, interest in biomass fuels such as from soybean has been raised. Data sets of surface energy component measurements in Asia and American were used to derive the land characteristics of soybean for weather, climate or air quality models. The characteristics include albedo, Bowen ratio, aerodynamic roughness, canopy resistance and soil moisture availability at three soybean fields during both the growing period and the senescent stage. The albedo was observed at 0.17. The mean midday Bowen ratio was observed as 0.32. The values of aerodynamic roughness at the three sites were about 0.04 m. The mean daytime soil moisture availability was 0.32. It is found that canopy conductance can be described as a function of solar radiation, vapor pressure deficit, soil moisture content and leaf area index (LAI). Similarly, albedo and evaporative fraction can be estimated as a function of LAI.

P46

ASIAFLUX DB – A VITAL RESOURCE FOR LARGE SCALE STUDIES AND COLLABORATION

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AsiaFlux DB was developed in 2006 by Database and Data Policy Sub Work Group of AsiaFlux Network. As of September 2008, the database houses 49 sets of flux meteorology data, which were contributed from 14 sites in China, Russia, Indonesia, Japan, Kore, Russia, Thailand (Table 1).

AsiaFlux DB is designed to store eddy covariance CO2 measurement data (raw and/or gap-filled), soil respiration measurement data, and other ecological investigation data. The stored flux datasets each contains 1-year time-series of raw or gap-filled measurements recorded with intervals of either 15, 30, or 60 minutes. The data sets are accompanied with fairly detailed metadata to help the secondary users evaluate the dataset's credibility and usefulness. Metadata elements include descriptions on site information, measurement methods, calculation methods, QAQC protocols taken, references, and so on. AsiaFlux DB data are available to any users who agree with the fair-use policy. The database is still growing by accepting contribution of high-quality data from any researchers.

As the focuses of flux research shift from site-specific studies toward large-area estimation or comparative studies, AsiaFlux DB will become a vital resource to the researchers and provide opportunities for collaboration among them.

Table 1. The site and year of the collection of currently stored flux meteorology datasets on Asia on AsiaFlux DB

Site	2000	2001	2002	2003	2004	2005	2006	2007
Bukit Soeharto, Indonesia		*	*					
Fujiyoshida, Japan	*							
Gwangneung, Korea					*	*	*	*
Haenam, Korea					*	*	*	
Laoshan, China			*					
Mae Klong, Thailand				*	*			
Mase, Japan		*						
Palangkaraya, Indoenesia			*	*	*	*		
Qinghai, China			*	*	*			
Sakaerat, Thailand		*	*	*				
Takayama, Japan			*	*	*	*		
Tomakomai, Japan		*	*	*				
CC-LaG, Japan		*	*		*	*		
Tura, Russia					*			

P47

A NON-RECTANGULAR HYPERBOLA MODEL SIMULATING LONG-TERM DIURNAL CO_2 FLUX FOR DIVERSE VEGETATION TYPES

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Atmospheric CO_2 variability simulation by atmospheric transport modeling depends critically on the use of terrestrial ecosystem models to accurately simulate diurnal and seasonal variations in terrestrial biospheric processes. Comparisons of seasonal cycles and their amplitude between the observed atmospheric CO_2 variability and that simulated by several terrestrial ecosystem models based on simplified assumptions of biospheric processes have often shown poor agreement (e.g., Nemry *et al*., 1999). The biochemical model proposed by Farquhar *et al*. (1980) describes the dependence of photosynthesis rate on solar radiation, with CO_2 uptake rate limited by maximum photosynthetic capacity. This concept is used widely in land-surface schemes for meteorology and hydrology, such as SiB (Sellers *et al*., 1986) and LSM (Bonan, 1996, 1998), but is less successful in carbon cycle studies because of a lack of empirical data or models for describing the seasonal and spatial variability of the necessary parameters, such as maximum photosynthetic capacity. Alternative ways of evaluating biospheric processes are required for the estimation of diurnal cycles in CO_2 variability, empirical models can fit the data more usefully than mechanistic models (Thornley, 2002).

We present an empirical model for the estimation of diurnal variability in net ecosystem CO_2 exchange (NEE). The model is based on the use of a nonrectangular hyperbola for photosynthetic response of canopy and was constructed by using a dataset obtained from the AmeriFlux network and containing continuous eddy covariance CO_2 flux from 26 ecosystems over seven biomes. The model uses simplified empirical expression of seasonal variability in biome-specific physiological parameters with air temperature, vapor pressure

deficit, and precipitation. The physiological parameters of maximum CO_2 uptake rate by the canopy and ecosystem respiration had biome-specific responses to environmental variables. The estimated physiological parameters had reasonable magnitudes and seasonal variation and gave reasonable timing of the beginning and end of the growing season over various biomes, but they were less satisfactory for disturbed grassland and savanna than for forests. Comparison with observational data revealed that the diurnal cycle of NEE was generally well predicted all year round by the model. The model gave satisfactory results even for tundra, which had very small amplitudes of NEE variability. These results suggest that this model with biome-specific parameters will be applicable to numerous terrestrial biomes, particularly forest ones.

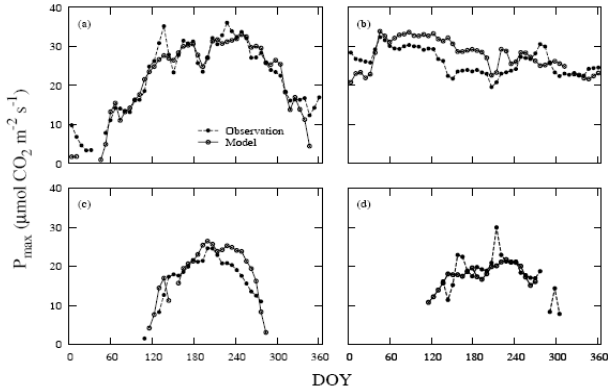

Fig. 1. Seasonal course of weekly averaged P_{max} at (a) Duke Forest evergreen needle-leaf forest site; (b) Santarem evergreen broad-leaf dorest site; (c) Bartlett deciduous broad-leaf forest site; and (d) Mature red pine mixed forest site in 2004. Dashed line with closed circles represents P_{max} estimated from the observed data, and solid line with open circles is P_{max} predicted by using the proposed model. DOY = day of year.

P48

A COMPARISON OF MEASURED ENERGY, WATER VAPOR AND CO_2 FLUXES USING EDDY COVARIANCE TECHNIQUE WITH MODEL PREDICTIONS FOR A SUBTROPICAL FOREST IN SOUTH CHINA

Withdraw

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Energy, water vapor and CO_2 fluxes were measured continuously for two years (2003-2004) using eddy covariance technique at canopy layer for a dominant subtropical forest in South China. Plotting the half-houry H+LE against Rn-G for both 2003 and 2004 years indicated an average underestimation of the available energy by 33% and 29%, respectively. Precipitation in 2003 was 1289 mm. Cumulative evapotranspiration above the forest canopy measured by eddy covariance and predicted by Pristly-Talor and Penman-M in this year were 662 mm, 697 mm and 831 mm, respectively. We found that daytime maximum CO_2 fluxes of the whole ecosystem varied from 15 to 20 mol m^{-2} s^{-1}. Contribution of CO_2 fluxes in the dry season was 53% of the annual total. Daytime CO_2 fluxes were very large in October, November and December, which was therefore an important stage for uptake of CO_2 by the forest ecosystem from the atmosphere.Using the estimates of biomass, soil carbon and parameters of leaf photosynthesis from other studies at the same forest, we ran a process-based model, CBM (stands for CSIRO Biosphere Model) for the site, and compared the predicted fluxes of CO_2 with measurements. We obtained reasonable agreement. Based on estimates of forest ecosystem respiration, NEE was calculated -242 and -276 $gCm^{-2}year^{-1}$ for measured and modeled, respectively. In previous study, NPP for this forest stand was 694 $gCm^{-2}year^{-1}$ during 2003/04 and litterfall was 424 $gCm^{-2}year^{-1}$. We therefore calculated NEE was -270 $gCm^{-2}year^{-1}$ and very similar to the values obtained by measured and modeled CO_2 fluxes in this study.

P49

SENSITIVITY OF MAXIMUM LAI TO MODEL PARAMETERS IN CLM-DGVM IN KOREAN CLIMATE CONDITIONS

H.-J. Lim and Y.-H. Lee

Kyungpook National University, Korea

This study examines the performance of CLM-DGVM (Community Land Model version 3.5 -Dynamic Global Vegetation Model, especially used LPJ model) to simulate maximum LAI and the distribution of plant functional type using observed climatology in Korea. The observed LAI at Gwangnung and land use distribution derived from MODIS are compared with the simulated model results and discussion have been made.

To get equilibrium state with current climate condition, we performed model for 200 years. The simulated results show that dominant plant functional types are deciduous forest and C3 non arctic grass and the maximum LAI of deciduous forest is about 8.5. Compared to observed LAI at this site, the model overestimates maximum LAI. And also needleleaf coniferous forest is not simulated in the model at this site due to bioclimatic limitation. To examine the cause of overestimated LAI, we designed sensitivity test of maximum LAI to model parameters such as the maximum carboxylation rate V_{cmax} and phenology. The results show that the use of lower value of V_{cmax} results in higher maximum LAI and the use of realistic phenology reduces maximum LAI a little bit, which is still high compared to the observed maximum LAI at this site.

To examine model performance to simulate distribution of plant functional type, we performed model using meteorological data at four stations in Korea. At most of stations, the simulated distributions of plant functional types show some difference from MODIS derived land use distribution. The simulated plant functional type distributions have been presented and the cause for the difference have been discussed.

P50

COMPARING DIFFERENT GLOBAL MODELS OF GROSS PRIMARY PRODUCTIVITY

Y. Wang and N. Zhang

Graduate University of Chinese Academy of Scinces, China

Based on the process model EPPML, Biome-BGC, PnET, Century. We extract the photosynthesis sub-model from these famous models, compare the sub-model construction, mathematical expression, input parameters and simulated scale. EPPML and Biome-BGC use the Farquhar's biochemical model to simulate the leaf photosynthesis. It's based on two processes: one is limited by the Rubisco activity, and the other is limited by the RuBP electron transport rate, then simulate the sun leaves and shade leaves photosynthesis respectively. PnET built on two principal relationship：1) maximum photosynthesis rate is a function of foliar nitrogen concentration and 2) stomatal conductance is a function of realized photosynthesis. It use the leaf N concentration to define the maximum photosynthesis rate, we also use the daily climate data, specific leaf weight and PAR which are declines with the canopy depth to calculate the whole canopy photosynthesis. The Century model use the more limited net photosynthesis and considering the aboveground vegetation's carbon, nitrogen process to simulate the GPP. Then we use these photosynthetic models to simulate GPP of the main vegetation type in Changbai mountain. Comparing and analyzing the different simulate method, model parameters and the result. Then give sensitivity analysis on the main parameters which changes may significant influence the GPP predictions.

P51

THE LAGRANGIAN STOCHASTIC MODEL FOR ESTIMATING FLUX FOOTPRINT OVER INHOMOGENEOUS SURFACES

C.-I. Hsieh[1] and G. Katul[2]

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This study investigated a two-dimensional Lagrangian stochastic dispersion model for estimating water vapor fluxes and footprint over homogeneous and inhomogeneous surfaces. Over the homogeneous surface, particle trajectories were computed from a 2-D Lagrangian model forced by Eulerian velocity statistics determined by Monin-Obukhov similarity theory (MOST). It was found that a Lagrangian model which includes the fluctuation of the streamwise velocity does not perform better than the one without this inclusion. For an inhomogeneous surface, the velocity and atmospheric stability profiles were computed using a second-order Eulerian closure model, and then these local profiles were used to drive the Lagrangian model. The model simulations were compared with water vapor flux measurements carried out above an irrigated bare soil site and an irrigated potato site. The inhomogeneity involved a step change in surface roughness, humidity, and temperature. Good agreement between eddy-correlation measured and Lagrangian model predicted water vapor fluxes was found for both sites. Hence, this analysis demonstrates the practical utility of second-order closure models in conjunction with Lagrangian analysis to estimate the scalar footprint in planar inhomogeneous flows.

P52

"SATELLITE ECOLOGY (SATECO)" AN INTERDISCIPLINARY STUDY FOR EVALUATING ECOSYSTEM FUNCTIONS IN A MOUNTAINOUS LANDSCAPE IN TAKAYAMA, CENTRAL JAPAN

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There is a growing requirement for ecosystem science to help our deeper understanding on the effects of global climate change and landuse change on terrestrial ecosystem structure and function from a small area ('plot') to landscape, regional and global scales. To meet these achievements, ecologists have been investigating the plant growth and carbon cycling processes at plot scale by using biometric method to measure plant carbon accumulation and gas exchange method to measure soil respiration. Also at the plot scale, micrometeorologists have attempted to measure the canopy- or ecosystem scale CO_2 flux by the eddy covariance technique, which shows us the diurnal, seasonal and annual cycles. Mathematical models have an important role in integrating the ecological and micrometeorological processes into ecosystem scales, which are further useful to interpret the time-accumulated information derived from the biometric method by comparing with the CO_2 flux measurements. For a spatial scaling of these plot-level understanding, satellite remote sensing is used to measure the landuse / vegetation type distribution and temporal change of ecosystem structure such as leaf area index. However, to better use of such data, still we need examinations along the concept of ecosystem ecology especially in mountainous area which is characterized by complex terrain and mosaic distribution of vegetations. For this purpose, we established a new interdisciplinary approach named "Satellite Ecology", which aims to link ecology, remote sensing and micrometeorology for studying plot to landscape and regional scale ecosystem functions. This new interdisciplinary community, which is being shifted from multidisciplinary approach in Takayama AsiaFlux site, will be requested to (1) seek the reasons why some of the remote sensing data are not appropriate for monitoring mountainous landscapes which involves mosaic of different vegetations and landuse, (2) seek how to bring out the full potential of the remote sensing data to measure the ecological processes responsible for carbon cycling and hydrology, and (3) construct a research system which can estimate the landscape scale ecological phenomena with high temporal and spatial resolutions coupled with climatic variables. These efforts would then be a new discipline which provides us with multi-scale and multi-aspect understanding on the ecosystem structure and functions, and their dynamics.

Acknowledgements: This project is supported by JSPS 21st Century COE Program and Gifu University. The ecosystem carbon cycle and hydrological research involved in this paper are conducted intensively by, J. Yoshino,T.M. Saitoh, S. Nagai, M. Ishihara, M-S. Lee, H. Noda, Y. Yashiro, Y. Shizu, M. Adachi, A. Nishiwaki, J. Nakata, T. Akiyama, I. Tamagawa, T. Kojima, K. N. Nasahara, H. Mikami, T. Motohka, T. Ohtsuka, T. Yasuda, A. Kishimoto, N. Saigusa ,S. Murayama, S. Yamamoto, H. Kondo, and encouraged by J.D. Tenhunen.

P53

ESTIMATING WETNESS INDEX USING EVAPOTRANSPIRATION DERIVED FROM MODIS PRODUCTS

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Evapotranspiration (ET), the sum of evaporation from soil and transpiration from vegetation, is essential component to understand hydrologic cycle, climate dynamics, air-sea-ice interaction, and terrestrial ecosystem productivity because it is closely related to carbon and energy transfer processes. Among many other environmental variables, net radiation, vapor pressure deficit, and sol water potential are known as primary factors controlling land surface ET. Compared to potential ET, actual ET is strongly controlled by surface moisture status that is the most limiting factor in vegetation growth during the growing season. Hence, ratio of actual to potential ET was suggested as a useful surrogate for soil water potential or soil wetness index. Many methods for estimating ET have been developed and nowadays satellite remotely sensed data, especially MODerate resolution Imaging Spectroradiometer (MODIS), offers a promising tool to monitor regional ET from land surface. In this study, we used atmospheric and land products of MODIS as inputs to predict ET, which was evaluated with flux tower ET measurement from a rugged deciduous forest (Gwangneung, GDK) and a heterogeneous farmland (Haenam, HFK) in Korea, and a complex cool temperate deciduous forest (Takayama, TKY) and a temperate planted larch forest (Tomakomai, TMK) in Japan. Incoming and outgoing radiation components including net radiation produced by MODIS data were also estimated and evaluated at each sites. MODIS ET algorithm based on revised Penman-Monteith equation (RS-PM algorithm; Mu *et al*., 2007) was applied to predict ET using MODIS input data. Our results showed good agreements with ground-based observations at the four flux measurement sites. Incident solar radiation was underestimated for Korea sites with RMSE of 50-87 W m^{-2} at GDK and 44-60 W m^{-2} at HFK, but overestimated for Japan sites with RMSE of 61-81 W m^{-2} at TKY and 85-86 W m^{-2} at TMK. Net radiation was overestimated only at HFK with RMSE of 39-47 W m^{-2} but underestimated for the other sites. Instantaneous ET generally showed underestimation at HFK, TKY, and TMK sites with RMSE of 73-89 W m^{-2}, 56-152 W m^{-2}, and 88-102 W m^{-2}, respectively, but overestimation at GDK site. Daily ET also showed a similar pattern that overestimated at GDK with RMSE of 0.19-0.82 mm day^{-1} but underestimated at another sites. This study indicates that MODIS can be applied to monitor land surface energy budget and ET with reasonable accuracy. More extensive parameterization and process-level evaluation on surface conductance is necessary across various biomes and climatic regimes. We also are conducting to produce wetness index by using ET for Korea.

This study was supported by the Top Brand project of Korea Institute of Geoscience and Mineral Resources, and by the Sustainable Water Resources Research Center of the 21st Century Frontier Program (Project No. 1-8-3), Republic of Korea.

Poster Session

P54

EVAPOTRANSPIRATION CLIMATOLOGY OF SOUTH KOREA BASED ON A MODIFIED HARGREAVES EQUATION AND HIGH DEFINITION DIGITAL CLIMATE MAPS

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Potential evapotranspiration (ET_p) is the evapotranspiration from an extended surface of a short green crop fully shading the ground and growing on a well watered soil. The ET_p concept has had major influence on geographic studies of world climate, on general hydrologic research, and on irrigation agriculture. Visualization of ET_p distribution across the nation at landscape scales may serve land management and planning. This study was carried out to prepare a prototype ET_p maps for South Korea at a 90m resolution by using a modified Hargreaves equation and high-definition digital temperature and solar radiation maps for the observed and the projected future climate. Gridded data sets of daily maximum and minimum temperature with a 90m cell spacing ("High Definition Digital Temperature Map", HD-DTM) were prepared for the current climatological normal year (1971-2000) based on observations at the 56 Korea Meteorological Administration (KMA) stations and a geospatial interpolation scheme for correcting land surface effects such as land use, topography, and elevation of the site. We obtained projected daily temperature over the Korean Peninsula at 25km horizontal resolution for 2011-2100 from the Meteorological Research Institute of KMA. The data were grouped into 3 climatological normals: 2011-2040, 2041-2070, and 2071-2100. Monthly averages of each period were calculated and the same procedure used for the current normals was applied to produce the monthly temperature data at 90m resolution corresponding to 2011-2040, 2041-2070, and 2071-2100 periods, respectively. We used a Fourier type expansion for temporal interpolation of monthly data, since the modified Hargreaves equation requires temperature data at a daily time step. As a result, daily maximum and minimum temperature data sets at 90m resolution were prepared for the 3 future periods (2011-2040, 2041-2070 and 2071-2100) as well as the current climatological normal year (1971-2000). A modified Hargreaves equation was run by the gridded daily temperature and solar radiation data to produce ET_p maps for each normal year. This method may be useful in detecting the climate change impact on hydrologic cycle at watershed scales across the nation.

Acknowledgments: This research was supported by grants (code: 1-8-3) from Sustainable Water Resources Research Center for 21st Century Frontier Research Program.

P55

ESTIMATION OF REGIONAL CO_2 FLUX IN RICE PADDY FIELD USING MODIS DATA

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Introduction

In East Asia, rice paddy field is major cultivation pattern and has a great effect on global CO_2 cycle. Therefore, it is important to estimate CO_2 flux above rice paddy field. In late years, Net Ecosystem Exchange of CO_2 (NEE) by the eddy-covariance method was observed various vegetations and those data have been accumulated. It is necessary to estimate regional scale of CO_2 flux. We observed CO_2 flux at Hachihama experimental farm of Okayama University in west Japan (34° 32 'N, 133°56' E). This site is rice single cropping field. The objective of this study is to estimate regional CO_2 flux in rice paddy field by the synthesis of observed and satellite data.

Model

We propose an empirical model which can estimate NEE in rice paddy field by use of variables, which is normalized difference vegetation index (NDVI), land surface temperature (LST) and surface reflectance of band1, from Terra/MODIS as input data. The model is developed and validated by integrating ground observed data, which is a long-term CO_2 flux observation by the eddy-covariance method and other meteorological data, and satellite data from MODIS. The model determines gross primary production (GPP) and ecosystem respiration (R_{eco}) separately. GPP is estimated by photosynthetic active radiation (PAR), hypothetical maximum of photosynthesis (P_{max}) and light use efficiency (α). R_{eco} is estimated by air temperature.NEE is estimated by the difference between GPP and R_{eco}.

Result

As shown in Fig. 1, the model could reproduce the seasonal variations of NEE. The peak values of estimated and observed NEE agreed well with similar values around -45gCO_2 m^{-2} day^{-1}. The accumulated NEE estimated by the model between June and October on 2006 was -2600 gCO_2 m^{-2}. This value was overestimated by 50% compared with observed NEE (-1800 gCO_2 m^{-2}) during the growing season.

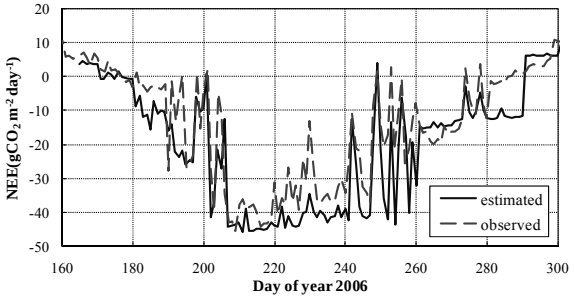

Fig. 1. Seasonal variation of estimated and observed NEE

P56

SPATIAL DISTRIBUTION OF FLUX INDICES RELATED TO NET ECOSYSTEM EXCHANGE USING SATELLITE IMAGES OF HIGH SPATIAL RESOLUTION

S.-K. Moon and J. Kim

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The net ecosystem exchange (NEE) measured at flux tower faces with the problem of spatial representativeness caused by the landscape heterogeneity of the site. Simple comparison between tower based and MODIS based NEE has scale mismatch. Therefore, the question that we want to explore in this report is: What is the spatial distribution of flux indices related to NEE within the footprint of tower flux? For this, the flux indices were calculated from satellite images of high resolution from Gwangneung KoFlux site with mixed forest in complex terrain. The seasonal change of them was investigated for 2006, the golden year of our research team. The scale appropriate comparison between tower based and satellite images of high resolution based NEE was discussed using footprint climatology. Relationships of spatial distribution between satellite based NEE and vegetation types or wetness index within the footprint climatology were also discussed for understanding ecohydrology process in flux sites.

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P57

SIMULATING THE RESPONSE OF SUBTROPICAL PLANTATION FOREST TO FUTURE CLIMATE CHANGE

Withdraw

N. Mi[1,2], G.-R. Yu[2], X.-F. Wen[2], X.-M. Sun[2], and S.-S. Wang[3]

[1]*Shenyang Institute of Atmospheric Environment, China Meteorological Administration, Shengyang,, China*
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The response of subtropical plantation forest to climate change scenarios was investigated in Qianyanzhou by the process-based physio-ecological model EALCO (Ecological Assimilation of Land and Climate Observation). Results suggested that CO_2 concentration, temperature and precipitation had different impacts on carbon and water fluxes of the plantation forest. The variation of CO_2 concentration had the greatest impact on carbon and water fluxes, followed by the variation of temperature and precipitation. CO_2 concentration was the driving factor for GPP. Both temperature and CO_2 concentration were the key environmental factors controlling ecosystem respiration. Increasing temperature accelerated the respiration from aboveground biomass dramatically, increasing CO_2 concentration had remarkable impact on the soil respiration. In terms of evapotranspiration (ET), it could be enhanced by increasing temperature but be reduced by increasing CO_2 concentration. Under the future climate changing scenario (the year 2100), the net ecosystem productivity (NEP) of Qianyanzhou would be increased by 22%, which indicated that this ecosystem is still capable of sequestrating carbon.

P58

FACTORING OUT OF INTERANNUAL TO DECADAL ECOSYSTEM CARBON BUDGET USING A PROCESS-BASED MODEL

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Long-term observation of atmosphere-ecosystem CO_2 exchange, i.e. flux measurements including AsiaFlux, has revealed remarkable variability in the ecosystem carbon budget in both space and time. The annual to decadal variability would be caused by: elevated CO_2 and resultant fertilization effect, climatic change, nitrogen deposition, and natural and human disturbances. They work together but in different manners, making it difficult to factor out causal relationship in the variability, for example, to detect a signal of global warming impact. This study proposes a convenient method for factoring out the interannual to decadal ecosystem carbon budget, as seen in long-term flux measurements, by means of a process-based model.

We have developed a model, VISIT (Vegetation Integrative SImulator for Trace gases; an improved Sim-CYCLE by Ito and Oikawa, 2002), for the purpose of simulation analyses in terms of atmosphere-ecosystem biogeochemical interactions through trace gas exchange including greenhouse gases, biogenic volatile organic compounds, and emissions from biomass burning and land-use change. The model consists of carbon and nitrogen cycles, which represent ecosystem growth and soil accumulation, and has been validated at several AsiaFlux sites (Ito, 2008: AFM). Then, it was applied to three sites in Japan: deciduous conifer forest at Tomakomai, evergreen conifer forest at Fujiyoshida, and cool-temperate deciduous broad-leaved forest at Takayama. VISIT simulated long-term ecosystem dynamics on the basis of climate condition (derived from NCEP/NCAR reanalysis with correction by *in situ* observation) and site-specific disturbance events.

Factoring-out was conducted through sensitivity analyses based on simulations (1) using stochastic meteorological scenarios derived from LARS Weather Generator, (2) assuming stationary atmospheric CO_2 concentration, and (3) removing disturbance impact. Fig. 1 exemplifies the result at Takayama site, showing that actual (i.e., considering all factors) interannual/decadal variability in net ecosystem production (NEP) is significantly different from those considering only meteorological factor. The analysis suggests that for each site, disturbances exerted substantial impacts on the present variability in carbon budget. Although long-term monitoring is prerequisite to detect subtle and time-lagged changes in ecosystem, such model-aided analysis will carry implications with respect to underlying mechanisms and enable prediction for the expected outcome of long-term monitoring, especially flux measurements.

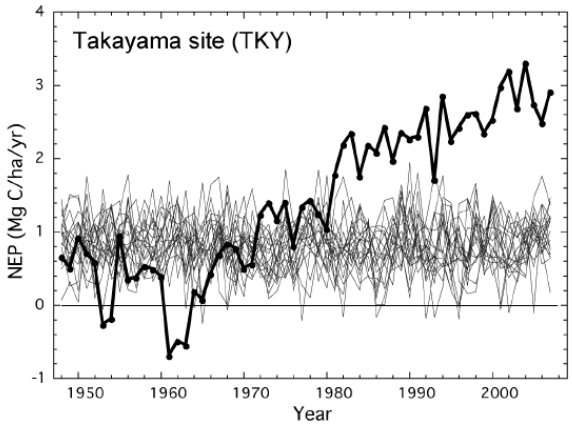
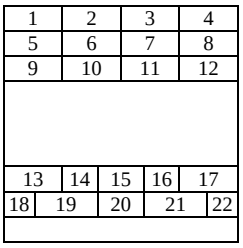


Fig. 1. Simulated annual net ecosystem production (NEP, net carbon budget) by VISIT at Takayama site. Thin lines show results (20 replications with different 'seed') including LATS-WG-derived stochastic meteorological factor but ignoring atmospheric CO_2 and disturbance factors. Thick line shows result considering meteorological, atmospheric CO_2, and disturbance (wood harvest in 1960) factors, and then represents the most realistic pattern; it was validated by flux data. Acute source just after the disturbance and evident sink lingering for decades were out of the range of stochastic variability, implying the impacts of disturbance and atmospheric CO_2 rise.

Poster Session

Front page



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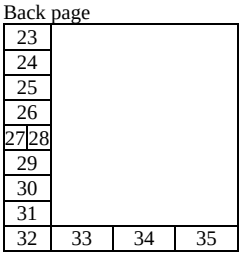

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2. Tibet, Yaoming Ma
3. FYJ, Yoshikazu Ohtani
4. Damxung, ChinaFlux
5. MSE, Masayoshi Mano
6. GDK, Hyojung Kwon
7. Xining, Yuling Fu
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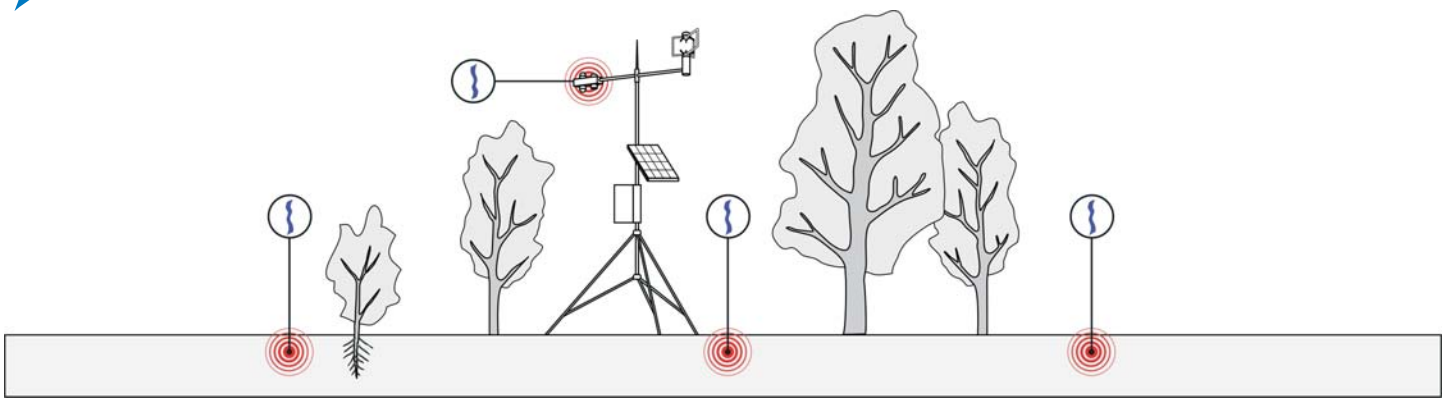
Thermal Sensors

meteorology and soil



NR01, 4-component net - radiation sensor
NR01 is a 4-component net-radiation sensor that is used for scientific-grade energy balance studies. The instrument has separate measurements of solar (Short Wave or SW) and Far Infra-Red (Long Wave or LW) radiation. Major improvements relative to comparable instruments include weight, solar offsets in the LW signal, ease of leveling.

SR11, first class solar radiation sensor
SR11 is a solar radiation sensor that can be applied in scientific grade solar radiation observations. It complies with the "first class" specifications within the latest ISO and WMO standards. The scientific name of this instrument is pyranometer.

DR01, first class pyrheliometer
The DR01 is a research grade normal incidence direct solar irradiance sensor (also known as a pyrheliometer). Suitable for tracker mounted operation, the DR01 is intended for short-wave direct solar irradiance measurement of the sun. The DR01 is a 'First Class' compliant pyrheliometer, as per the latest ISO and WMO standards

LP02, solar radiation sensor compliant with ISO and WMO standards
LP02 is a solar radiation sensor that can be applied for most common solar radiation observations. It complies with the latest ISO and WMO standards. The scientific name of this instrument is pyranometer.

IR02, Pyrgeometer with heating
IR02 is a sensor that can be applied for Far Infra Red (FIR) radiation observations. The main application is in meteorological outdoor experiments. The scientific name of this instrument is pyrgeometer. IR02 is heated, which improves measurement accuracy because it prevents dew deposition.

HFP01, Heat flux plate / heat flux sensor
HFP01 is the world's most popular sensor for heat flux measurement in the soil as well as through walls and building envelopes. By using a ceramics-plastic composite body the total thermal resistance is kept small.

HFP01SC, self calibrating heat flux sensor
The HFP01SC self-calibrating heat flux sensor is a sensor intended for high accuracy measurement of soil heat flux. Also it offers improved quality assurance of the measurement.

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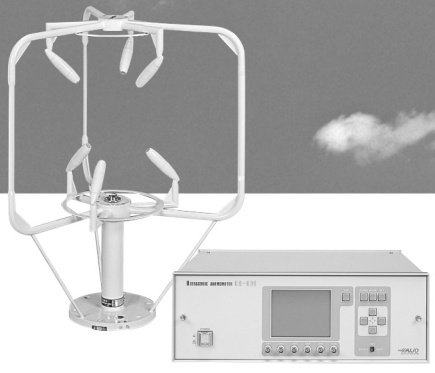

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GMP343 CO_2 Probe for Environmental Monitoring

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

Performance

Sensor	Vaisala CARBOCAP®
Measuring principle	Single-Beam Dual-Wavelength NDIR
Measurement range options	0…1000ppm, 0…2000ppm, 0…3000ppm 0…4000ppm, 0…5000ppm, 0…2%
Accuracy	at 25 ℃ and 1013 hPa after factory calibration with 0.5 % accurate gases with different range options 0…1000 ppm - ±(3ppm +1% of reading) 0…2000 ppm - 0…2 % ±(5ppm +2% of reading)
Body material and classifications	Anodized aluminum, IP66
Operating environment	Temperature : -40…+60℃ Relative humidity : 0…100%rh
Outputs	Analog outputs 4…20mA, 0…2.5V, 0…5V Digital outputs RS-232, RS-485
Operating voltage	10…36VDC
Dimensions	Length: 180 mm, Diameter: 55 mm Weight: 360g

WMT52 Ultrasonic Wind Sensor

WMT52 incorporates decades of Vaisala experience in wind measurement using ultrasound to determine horizontal wind speed and direction. With no moving parts makes it virtually maintenance free.

Technical Data

Wind Speed	Range : 0…60 m/s
	Response time : 250 ms
	Accuracy : ±0.3m/s or ±3% whichever is greater
	Output resolution : 0.1m/s
Wind Direction	Azimuth : 0…360°
	Response time : 250 ms
	Accuracy : ±3°
	Output resolution : 1°
Operating Voltage	5...32 VDC
Accessories	Bird spike kit, Surge protector for sensor
Dimensions	Height: 139 mm, Diameter: 114 mm Weight: 510 g

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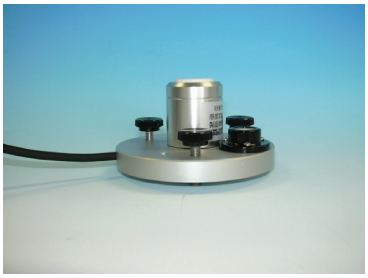
Portable Pyranometer PCM-01

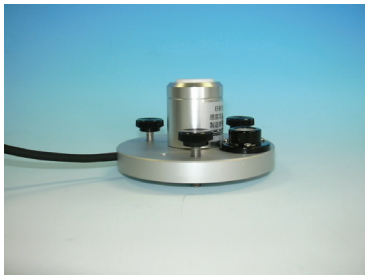


This Pyranometer observes solar irradiance. The sensor is thermopile.
It's used by micrometeorologic.
It's easy to use, light and no power.

Specification

Spectral range	315-2800nm
Sensitivity	7mV(kW·m⁻²)
Response time	1sec
Accuracy	±3%
Dimension	φ85×45mm
Weight	0.5kg
Cable	10m

Light Photon Senser PAR-01



It's instrument for measuring photon's quantum of solar spectrum (400-700nm).
The sensor is Siliconphotodiode.

Specification

Spectral range	400-700nm
Sensor	Silicon Photodiode
Sensitivity	0-3,000 μ Mol·m⁻² / 0-10mV
Dimension	φ85×45mm
Weight	0.5kg
Cable	10m
Calibration	1000W typically optical source

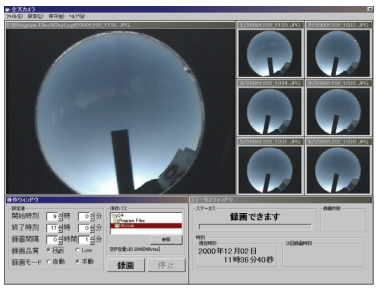
Portable Pyrgeometer PRI-01

This Pyrgeometer observes infrared radiometer.
It's simplified Pyrgeometer.

Specification

Spectral range	600-1400nm
Sensitivity	5-20mV(kW·m⁻²)
Thermopile putput range	-250-+250 W/m²
Response time	<100msec
Accuracy	±3%
Temperature sensor	Pt100Ω
Dimension	φ85×45mm
Weight	0.75kg
Cable	10m

Sky View PSV-100



This instrument monitores of the sky by CCD camera and automatically saves a photo to JPEG format in PC for a fixed interval.
It's outdoor-safe.

System
It needs PC of Windows XP with two serial ports of RS232C, memory over 64MB and Hard disk space over 10GB.

Rotating shadow blade PRB-100

This Shadow blade is used for global pyranometer. Shadow blade covers direct solar radiation and diffused solar radiation is measured.
The Blades set it in the latitude of the setting place and incline and fix it.
The blade can drive intermittence by a built-in CPU and pulse motor.
Therefore I can measure global solar radiation and diffuse solar radiation at the same time. In addition, continuance observation diffuse solar radiation is possible by changing setting.

Spec
Full view angle : about5 degree
Slope angle :about1 degree
Blade span :about582mm
Blade width : 50mm
Latitude range :20°～ 50°
（Other latitude supports it with a optional parts）

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