PROCEEDINGS

International Joint Conference of
11th AsiaFlux International Workshop,
3rd HESSS Hydrology delivers Earth System Science to Society, and
14th Annual Meeting of KSAFM Korean Society of Agricultural & Forest Meteorology

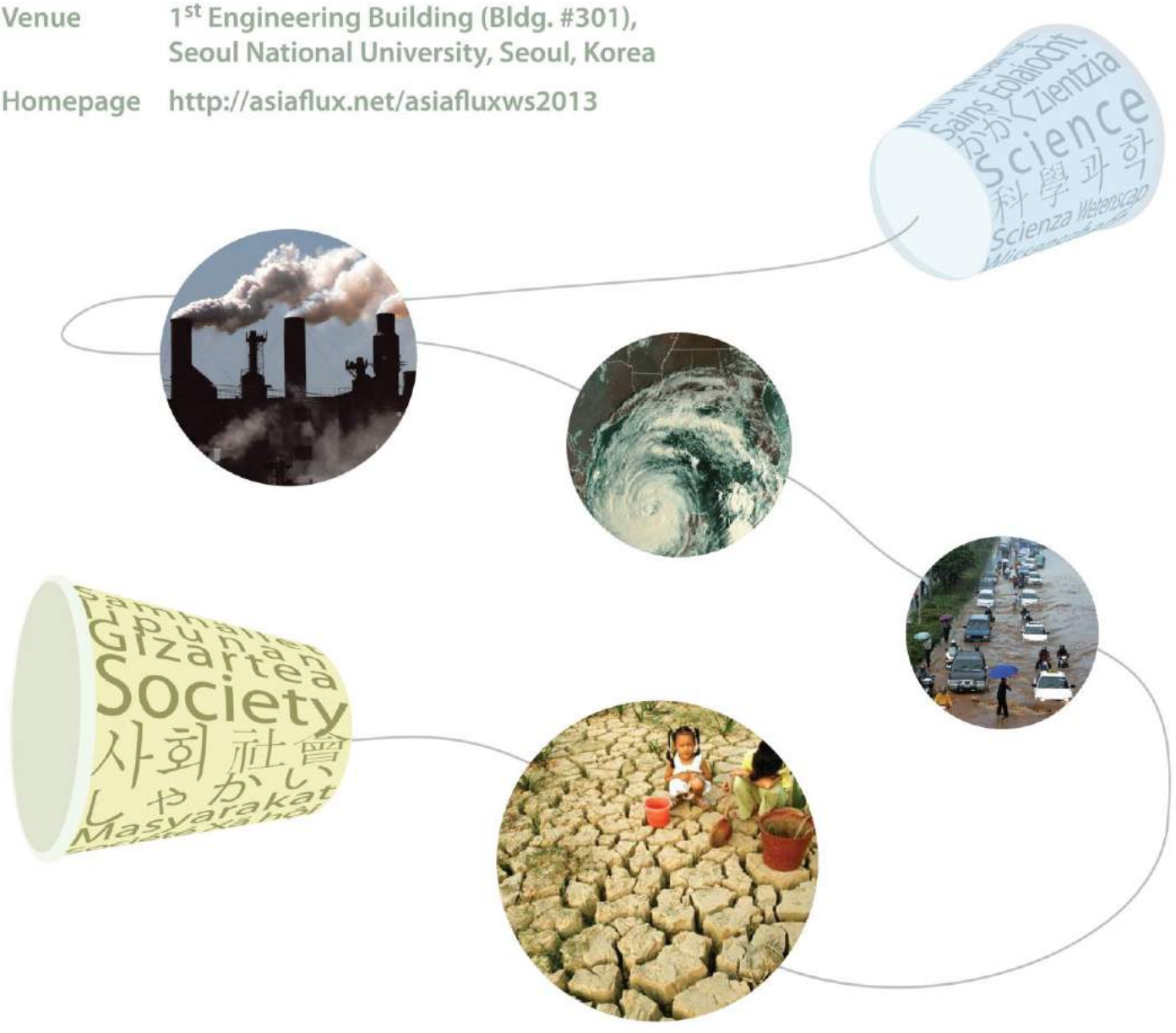
Communicating Science to Society:

Coping with Climate Extremes for Resilient Ecological-Societal Systems

Date 21-24 August 2013
(19-20 Pre-conference training on flux measurement)

Venue 1st Engineering Building (Bldg. #301),
Seoul National University, Seoul, Korea

Homepage http://asiaflux.net/asiafluxws2013



Welcome to the International Joint Conference of AsiaFlux, HESSS, and KSAFM

AsiaFlux pursues its mission to bring Asia's key ecosystems under observation to ensure quality and sustainability of life on earth. Our vision is a community where science and technology work more directly for sustainable ecological-societal systems in Asia by focusing on (1) developing forward-looking collaborative researches and data sets on energy, matter, and information flows in key ecosystems in Asia; (2) providing workshops and training on current and future challenges posed by global change; and (3) cultivating the next generation of scientists with skills and perspectives enabling them to engage in regional sustainability challenges in Asia as informed leaders and stewards via an ecosystem approach with resilience-based systems thinking and visioneering.

During 19-24 August 2013, we celebrate our community efforts by hosting a joint conference with HESSS (Hydrology delivers Earth System Science to Society), and KSAFM (Korean Society of Agricultural and Forest Meteorology). This joint conference is co-hosted by National Center for AgroMeteorology and Seoul National University. The themes of the AsiaFlux Workshop have been consistently evolving from carbon science toward regional stewardship since 1999. This year, our theme is "Communicating Science to Society: Coping with climate extremes for resilient ecological-societal systems." Humanity has emerged as a major force in the operation of the biosphere, challenging ecological-societal resilience. This urgent situation necessitates a fundamental shift in our perspectives, worldviews, and institutions. We eagerly hope and expect that the joint conference 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 options to reconnecting to the biosphere and becoming active stewards of the Earth Systems as a whole.

Joon Kim, Akira Miyata, and Shenggong Li

Chair & Vice-Chairs of AsiaFlux

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Venue

1st Engineering Building (Bldg. #301), Seoul National University

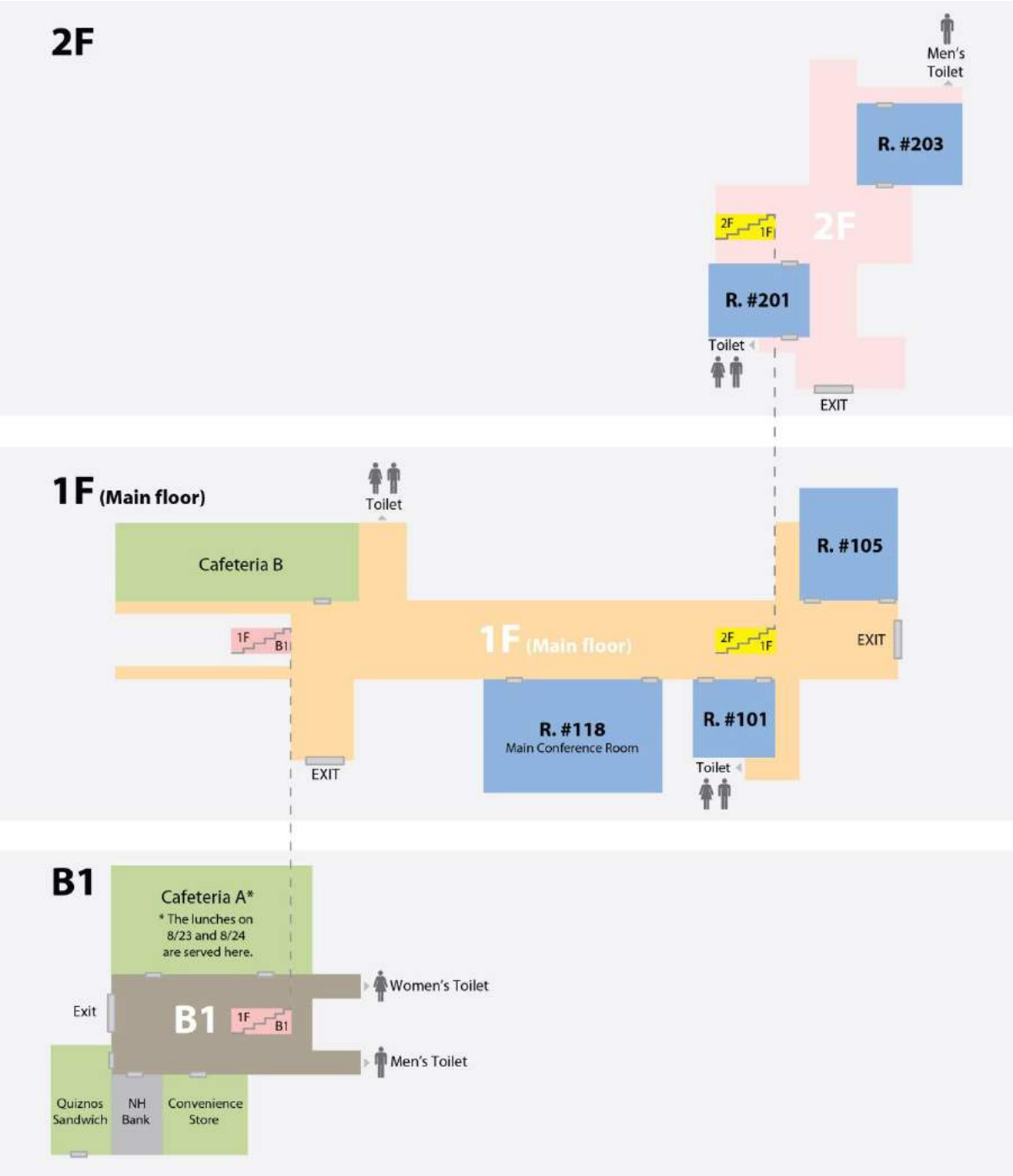
Pre-conference training on flux measurement: Building #10-1

Banquet: Building #310

Address

(151-742) Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul, Korea

Floor Plan


2F
Men's Toilet
R. #203
2F
1F
2F
R. #201
Toilet
EXIT
1F (Main floor)
Toilet
Cafeteria B
R. #105
1F
B1
1F (Main floor)
2F
1F
EXIT
R. #118
Main Conference Room
R. #101
Toilet
EXIT
B1
Cafeteria A*
* The lunches on 8/23 and 8/24 are served here.
Women's Toilet
Exit
B1
1F
B1
Men's Toilet
Quiznos Sandwich
NH Bank
Convenience Store

Program at a glance

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- 8/20</th><th>8/21</th><th colspan="4">8/22</th><th colspan="5">8/23</th></tr>
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<tr><td>9:00-10:30</td><td rowspan="8">LI-COR Training Course on Flux Monitoring</td><td>Opening
(09:15-10:00)</td><td>A1</td><td>A2</td><td>H1</td><td></td><td>A6</td><td>A7</td><td>J1</td><td>J2</td><td></td></tr>
<tr><td>10:30-11:00</td><td rowspan="2">Break
(10:00-10:15)</td><td colspan="4">Break</td><td colspan="5">Break</td></tr>
<tr><td>11:00-12:30</td><td>PL1
(10:15-12:30)</td><td>A1</td><td>A2</td><td>H2</td><td>K1</td><td>A8</td><td>A7</td><td>J3</td><td>J4</td><td>S1</td></tr>
<tr><td>12:30-13:30</td><td rowspan="2">Lunch
(movie)</td><td colspan="4">Lunch</td><td colspan="5">Lunch</td></tr>
<tr><td>13:30-14:30</td><td colspan="4">PO1: Poster presentation</td><td colspan="5">PO2: Poster presentation</td></tr>
<tr><td>14:30-16:00</td><td>PL2</td><td>A3</td><td>A4</td><td>H3</td><td>K2</td><td colspan="5">Summary and Synthesis
(Session Chairs & Rapporteurs)
Rm. #118</td></tr>
<tr><td>16:00-16:30</td><td colspan="5">Break</td><td colspan="5">Break</td></tr>
<tr><td>16:30-18:00</td><td>PL3</td><td>A3</td><td>A4</td><td>H4</td><td>A5</td><td colspan="5">The Way Ahead:
Opportunities & Challenges

Closing</td></tr>
<tr><td>18:30-20:30</td><td>Banquet
(Bld. #310 Engineer House)</td><td colspan="4">Young Scientist Meeting
(Rm. #203, Bld. #301)
AsiaFlux Science Steering Committee Meeting
(Hoam Faculty House)</td><td colspan="5"></td></tr>
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Plenary Sessions

PL1: Communicating Science to Society (Ray Leuning, Murugesu Sivapalan, Benjamin Ruddell)

PL2: Coping with Climate Extremes (Hugo Berbery, Markus Reichstein)

PL3: Water and Food Security (James Famiglietti, Taikan Oki)

Break-out Sessions

A: AsiaFlux

A1) Linking Regional Flux Networks

A2) Effects of Climate Extremes and Human Disturbances on Ecosystems

A3) Current Issues in Flux Monitoring

A4) Carbon Tracking in Asia

A5) Challenges in Quantifying Greenhouse Gas Emissions across Soil Surface

A6) Communicating Carbon and Water Science to Society

A7) Tropical and Sub-tropical Ecosystems: Vulnerability and Resilience

A8) Process Studies from Leaf to Canopy

H: HESSS

H1) Recent Progresses in Hydrologic Simulations

H2) Capacity Building with New Data and Methods

H3) Natural and Human-induced Changes of Hydrologic Cycles

H4) Understanding Water and Carbon Dynamics

K: KSAFM

K1) Networking Ecological Observation and Modeling in Korea

K2) Biometeorological Modeling and Assessment (in Korean)

Joint Sessions

J1: Human Society, History, and Water in Changing World

J2: iLEAPS/IGAC/WMO Joint Initiative: Interdisciplinary Biomass Burning Initiative (IBBI) – Asian Perspective

J3: Bridging the Gap between Local Measurement and Large Scale Modeling

J4: iLEAPS/GLP/AIMES Joint Initiative: Interactions among Managed Ecosystems, Climate, and Societies (IMECS) – Asian perspective

Special Session

S1: Using EddyPro™ (Li-Cor, Inc.)

Wednesday, 21 August

Welcoming and Opening Session (Presider: Kwangsoo Kim)

09:15-09:20	OPENING	
09:20-09:40	WELCOME ADDRESSES	
	Hak-Lae Lee	(Dean, College of Agriculture and Life Sciences, Seoul National University)
	Taikan Oki	(The University of Tokyo)
	Man Yong Shin	(President, Korean Society of Agricultural and Forest Meteorology)
	Eun Woo Park	(Director, National Center for AgroMeteorology)
	Joon Kim	(Chair, AsiaFlux and Interdisciplinary Program in Agricultural and Forest Meteorology, Seoul National University)
09:40-10:00	INTRO: TAKING STOCK & LOOKING AHEAD (Joon Kim)	
10:00-10:15	Group Photo and Break	

Plenary Session PL1: Communicating Science to Society
(Chair: Nobuko Saigusa, Rapporteur: Shengong Li)



10:15-11:00 **[PL1-001]** COMMUNICATING (CLIMATE) SCIENCE (Ray Leuning)

11:00-11:45 **[PL1-002]** SOCIO-HYDROLOGIC MODELING TO UNDERSTAND AND MEDIATE THE COMPETITION FOR WATER BETWEEN HUMANS AND ECOSYSTEMS: MURRUMBIDGEE RIVER BASIN, AUSTRALIA **(**Murugesu Sivapalan)

11:45-12:30 **[PL1-003]** BETTER UNDERSTANDING OF COMPLEX COUPLED HUMAN NATURAL SYSTEMS: NEW APPROACHES AND CONCEPTS (Benjamin Ruddell)

12:30-14:30 *Lunch Break*

LUNCHEON MOVIE: "LAST CALL AT THE OASIS"(Jessica Yu, 2011)

Plenary Session PL2: Coping with Climate Extremes
(Chair: Hyungjun Kim, Rapporteur: Nobuko Saigusa)


14:30-15:15 **[PL2-004]** DROUGHTS IN SOUTHERN SOUTH AMERICA: LARGE-SCALE DYNAMICS AND REGIONAL PROCESSES (Hugo Berbery)

15:15-16:00 **[PL2-005]** CLIMATE EXTREMES AND ITS IMPACTS ON THE CARBON CYCLE (Markus Reichstein)

16:00-16:30 Break

Plenary Session PL3: Water and Food Security
(Chair: Shenggong Li, Rapporteur: Hyungjun Kim)


16:30-17:15 **[PL3-006]** WATER CYCLE CHANGE AND THE HUMAN FINGERPRINT ON THE WATER LANDSCAPE (James Famiglietti)

17:15-18:00 **[PL3-007]** INTEGRATED MODELING FOR WATER CYCLES AND FOOD SECURITY UNDER ANTHROPOCENE (Taikan Oki)

18:30-20:30 **Banquet**

Thursday, 22 August

Break-out Session A1: Linking Regional Flux Network (1) (Chair: Akira Miyata, Rapporteur: Shenggong Li)

09:00-09:15 FLUXNET (Dennis Baldocchi) – invited (online participation)

09:15-09:30 AsiaFlux (Akira Miyata)

09:30-09:45 ChinaFlux (Shenggong Li)

09:45-10:00 IndoFlux (Chandra Shekhar Jha)

10:00-10:15 JapanFlux (Takashi Hirano)

10:15-10:30 KoFlux (Minseok Kang)

Break-out Session A2: Effects of Climate Extremes and Human Disturbances on Ecosystems (1) (Chair: Giorgio Alberti, Rapporteur: Ke-Sheng Cheng)

09:00-09:30 **[A2-008]** A BROAD VIEW ON FOREST RESPONSE TO GLOBAL CHANGE: EXPERIMENTS, MODELS, CONCEPTS (Sebastian Leuzinger) – invited

09:30-09:45 **[A2-009]** EFFECTS OF CLIMATIC VARIABILITY ON DISTRIBUTION OF PLANT FUNCTIONAL GROUPS IN MONGOLIA (Bolor-Erdene LKHAMSUREN and Sinkyu KANG)

09:45-10:00 **[A2-010]** EFFECTS OF DROUGHT AND ICE RAIN ON POTENTIAL PRODUCTIVITY OF A SUBTROPICAL CONIFEROUS PLANTATION FROM 2003 TO 2010 BASED ON EDDY COVARIANCE FLUX OBSERVATION (Kun Huang, Shaoqiang Wang, Lei Zhou, Huimin Wang, Yunfen Liu and Fengting Yang)

10:00-10:15 **[A2-011]** GRAZING AND FIRE EFFECTS ON CARAGANA MICROPHYLLA DENSITY IN MONGOLIAN STEPPES (Amartuvshin Narantsetseg, Sinkyu Kang, Bolor-Erdene Lkhamsuren, Dongwook W. Ko)

10:15-10:30 **[A2-012]** COMMUNICATING THE EFFECT OF CLIMATE CHANGE ON RAINFALL (Ke-Sheng Cheng)

Break-out Session H1: Recent Progresses in Hydrologic Simulations (Chair: Pat Yeh, Rapporteur: Hyungjun Kim)

09:00-09:15 **[H1-013]** A TEST BED OF LAND SURFACE WATER/ENERGY/ECOSYSTEM MODELS IN DRY CLIMATE - RESULTS FROM ASIAN DRYLAND MODEL INTERCOMPARISON PROJECT (ADMIP) (J. Asanuma, D. Ojima, Ailikun, K. Yorozu, Y. Chen, K. Ichii, A. Itoh, M. Kondo, Q. Li, K. Mabuchi, S. Miyazaki, K.

Tachiiri, X. Zhang)

09:15-09:30 **[H1-014]** IMPACT OF SOIL PARAMETERS ON REPRODUCIBILITY OF HYDROLOGICAL PROCESSES BY LAND SURFACE MODEL (Shin MIYAZAKI, Kazuaki YOROZU, Jun ASANUMA and Masayuki KONDO)

09:30-09:45 **[H1-015]** DEVELOPMENT AND APPLICATION OF COMPREHENSIVE DOWNSCALING METHODS FOR HOKKAIDO REGION, JAPAN (Tomohito J. YAMADA, Masaru INATSU, Tomonori SATO, Kazuki NAKAMURA, Shin MIYAZAKI and Naoki MATSUOKA)

09:45-10:00 **[H1-016]** INFLUENCE OF LAND SURFACE SCHEME IN REGIONAL CLIMATE MODEL ON ESTIMATING SNOW WATER EQUIVALENT OVER MOUNTAINOUS LANDSCAPE IN CENTRAL JAPAN (Masatoshi Kuribayashi, Nam-Jin Noh, Taku M. Saitoh, Ichiro Tamagawa, Yasutaka Wakazuki, Hiroyuki Muraoka)

10:00-10:30 Discussion

Break-out Session A1: Linking Regional Flux Networks (2) (Chair: Shenggong Li, Rapporteur: Akira Miyata)

11:00-11:15 Malaysia (Lulie Melling)

11:15-11:30 TaiwanFlux (Ke-Sheng Cheng)

11:30-11:45 ThaiFlux (Amnat Chidthaisong)

11:45-12:00 OzFlux (Eva van Gorsel) - online participation

12:00-12:15 Vietnam (Juliya Kurbatova)

12:15-12:30 Discussion

Break-out Session A2: Effects of Climate Extremes and Human Disturbances on Ecosystems (2) (Chair: Hugo Berbery, Rapporteur: Giorgio Alberti)

11:00-11:15 **[A2-017]** SPATIAL AND TEMPORAL PATTERNS OF NITROGEN DEPOSITION AND THEIR CONTROL FACTORS IN CHINA FROM 1990S TO 2000S (Yanlong Jia, Guirui Yu, Nianpeng He)

11:15-11:30 **[A2-018]** LAND USE CANGES AND ITS EFFECTS ON CARBON AND NITROGEN DYNAMICS IN SOUTH AND SOUTH EAST ASIA REGION (Atul K. Jain and Bassil El-Masri)

11:30-11:45 **[A2-019]** CHANGING TERRESTRIAL CARBON ASSIMILATION GEOGRAPHY AND SEASONALITY IN EAST ASIA (Gwangyong Choi)

11:45-12:00 **[A2-020]** NET CO2 EXCHANGE BEHAVIOR OF YOUNG PINUS ROXBURGHII PLANTATION AS INFLUENCED BY REMOVAL OF UNDERSTOREY (Nilendu

Singh, N.R. Patel, B.K. Bhattacharya, P. Soni and J.S. Parihar)

12:00-12:15 **[A2-021]** CARBON BALANCE OF A NATURAL DISTURBED FOREST IN NORTHERN JAPAN (Munemasa Teramoto, Naishen Liang, Takashi Hirano, Zhenghong Tan, Kenta Higashi)

12:15-12:30 Discussion

Break-out Session H2: Capacity Building with New Data and Methods (Chair: Min-Hui Lo, Rapporteur: Baek-Min Kim)

11:00-11:15 **[H2-022]** DEVELOPMENT OF GLOBAL FAPAR/ LAI ESTIMATION ALGORITHM FOR JAXA'S NEW SATELLITE SENSOR (GCOM-C1/ SGLI) (Yuhsaku Ono, Hiroshi Murakami, Hideki Kobayashi, Kenlo Nishida Nasahara, Koji Kajiwara, Yoshiaki Honda)

11:15-11:30 **[H2-023]** PARTITIONING EVAPOTRANSPIRATION OF RAINFED DRYLAND RICE (ORYZA STIVA L) BASED ON OXYGEN ISOTOPE RATIO OF EVAPORATIVE FLUXES (B. Nay-Htoon, M. Dubbert, J. Ko, and C. Werner)

11:30-11:45 **[H2-024]** NEW PRECIPITATION DATASET FOR ESTIMATING CHANGES IN THE MASS OF GLACIERS IN HIMALAYAS AND SURROUNDINGS (Megumi Watanabe, Shinta Seto, Yukiko Hirabayashi and Shinjiro Kanae)

11:45-12:00 **[H2-025]** SPATIAL DISTRIBUTION OF DEBRIS COVER ON GLACIERS IN THE ALPS AREA USING ASTER IMAGERY (Omi Noguchi, Yong Zhang, Satoshi Watanabe and Yukiko Hirabayashi)

12:00-12:15 **[H2-026]** REPRESENTATION OF REALISTIC VARIABILITY OF CMIP5 RUNOFF SIMULATIONS (Satoshi Watanabe, Hyungjun Kim, Yukiko Hirabayashi, and Shinjiro Kanae)

12:15-12:30 Discussion

Break-out Session K1: Networking Ecological Observation and Modeling in Korea (Chair: Meehye Lee, Rapporteur: Hyun Seok Kim)

11:00-11:15 **[K1-027]** INTEGRATED LAND ECOSYSTEM-ATMOSPHERE PROCESS STUDY: KICKOFF OF ILEAPS-KOREA (Hyun Seok Kim, Meehye Lee, Deugsoo Kim, Kwang Soo Kim, Soyoung Kim, Sangjun Im, Joon Kim, Seawung Kim, Alex Guenther) - invited

11:15-11:30 **[K1-028]** DATA MANAGEMENT AND TECHNICAL SUPPORT FOR KOFLUX AND ILEAPS-KOREA NETWORK BY NATIONAL CENTER FOR AGROMETEOROLOGY (NCAM) (Minseok Kang, Seung-Jae Lee, Hyun Seok Kim, Kwang Soo Kim, Inbok Lee, Moonseong Kang, Joon Kim, Eun Woo Park)

11:30-11:45 **[K1-029]** EVALUATION OF WATER AND ENERGY BALANCE IN THE KOREA

PENNINSULA CONSIDERING DIFFERENT IRRIGATION SYSTEMS (J. A. Chun, Q. Wang, Y. Shin, K. Kim, S. Li and B. Zaitchik)

11:45-12:00 **[K1-030]** APPLICATION OF A WEATHER DATA CLIENT TO PREDICT RICE YIELD USING THE ORYZA 2000 MODEL (Junwhan Kim, Chung-Keun Lee, Kwang Soo Kim)

12:00-12:15 **[K1-031]** AGRO-METEOROLOGICAL INFORMATION SERVICE AND CLIMATE CHANGE IN KOREA (Kyomoon SHIM, Myungpyo JUNG, Yongseok KIM, Seokcheal KIM, Kyuho SO)

12:15-12:30 **[K1-032]** POPMODEL, A FIRST TRIAL FOR OMNIPOTENT SIMULATOR (Kyungsan Choi and Dong-Soon Kim)

12:30-13:30 *Lunch Break*

Poster Session PO1

13:30-14:30 AsiaFlux, HESSS, and KSAFM poster session

Break-out Session A3: Current Issues in Flux Monitoring (1) (Chair: Youngryel Ryu, Rapporteur: Hideki Kobayashi)

14:30-14:45 **[A3-033]** REMOVAL OF SCATTERED RADIATION IN CANOPY GAP FRACTION MEASURE-MENTS FROM LAI-2200 PLANT CANOPY ANALYZER (Hideki Kobayashi, Youngryel Ryu, Dennis D. Baldocchi, Jon M. Welles, John M. Norman)

14:45-15:00 **[A3-034]** ASSESSING THE SPATIAL REPRESENTATIVENESS OF EDDY COVARIANCE FLUX OBSERVATION STATIONS OF TERRESTRIAL ECOSYSTEMS IN CHINA (Wang Shaoqiang, Chen Diecong, Zhou Lei, He Honglin, Shi Hao, Yan Huimin, Su Wen)

15:00-15:15 **[A3-035]** UNCERTAINTY ANALYSIS OF MODELED CARBON AND WATER FLUXES IN A SUBTROPICAL CONIFEROUS PLANTATION (Xiaoli Ren, Honglin He , Li Zhang, Min Liu, David J. P. Moore, Fan Li, Guirui Yu, Huimin Wang)

15:15-15:30 **[A3-036]** INCORPORATION OF TOPOGRAPHIC EFFECTS ON MODIS-DERIVED SOLAR RADIATION MODEL (Galam Lee and Youngryel Ryu)

15:30-15:45 **[A3-037]** CONTINUOUS MEASUREMENTS OF METHANE FLUX AT A LARCH FOREST BY MICROMETEOROLOGICAL AND CHAMBER TECHNIQUES (M. Ueyama, Y. Takai, R. Takeuchi, Y. Takahashi, R. Ide, M. Ataka, K. Takahashi, and Y. Kosugi)

15:45-16:00 **[A3-038]** THE AMERIFLUX MANAGEMENT PROGRAM AND TECHNICAL QA/QC FOR THE AMERIFLUX NETWORK (W. Stephen Chan, Sebastien Biraud, Deb Agarwal, Margaret Torn, Dennis Baldocchi, Dave Billesbach, Dario Papale, Steve Wofsy, Dave Billesbach)

Break-out Session A4: Carbon Tracking in Asia (1) (Chair: Kazuhito Ichii, Rapporteur: Seung-Jae Lee)

14:30-14:45 **[A4-039]** DEVELOPMENT OF GREENHOUSE GAS TRACKING SYSTEM IN EAST ASIA (J. Hong, T. Lauvaux, J.-W. Hong, and H. M. Sung, C.-H. Cho)

14:45-15:00 **[A4-040]** APPLICATION OF CARBON TRACKING SYSTEM BASED ON ENSEMBLE KALMAN FILTER FOR CARBON FLUX ANALYSIS IN ASIA (Hyun Mee Kim, Jin Woong Kim, Chun-Ho Cho)

15:00-15:15 **[A4-041]** CONTINENTAL SOURCES AND SINKS INTENSIFY THE STEEP SEASONAL AND LATITUDINAL GRADIENT OF ATMOSPHERIC CARBON DIOXIDE OVER EAST ASIA (Changsub Shim, Jeongsoon Lee, Yuxuan Wang)

15:15-15:30 **[A4-042]** LAND COVER COMPOSITION AROUND ASIAFLUX SITES AND CARBONTRACKER-ASIA NET CO2 FLUX EVALUATION (S.-J. Lee, J. Kim, K. Ichii, and C.-H. Cho)

15:30-15:45 **[A4-043]** MODEL-DATA SYNTHESIS OF TERRESTRIAL CARBON CYCLES TO QUANTIFY CARBON BUDGET IN ASIA (K. Ichii, M. Kondo, S.-J. Lee, W. Ju, A. Ito, T. Sasai, H. Sato, Ueyama, C.-H. Cho, P. K. Patra, N. Saigusa, J. Kim)

15:45-16:00 Discussion

Break-out Session H3: Natural and Human-induced Changes of Hydrologic Cycles (Chair: Tomohito Yamada, Rapporteur: Pat Yeh)

14:30-14:45 **[H3-044]** RESPONSES OF REGIONAL CLIMATES TO AGRICULTURAL IRRIGATION IN CALIFORNIA (Min-Hui Lo) – invited

14:45-15:00 **[H3-045]** SMALLEST EURASIAN SNOW-COVER EXTENT IN MAY 2012 AND ITS IMPACT ON BLOCKING AND DROUGHT OVER EAST ASIA (Baek-Min Kim and Ah-Ryeon Yang) – invited

15:00-15:15 **[H3-046]** GLACIER MASS CHANGES FROM GRACE SATTELITE AND NUMERICAL MODELS (Hidetoshi Maeda, Hyungjun Kim, Yukiko Hirabayashi)

15:15-15:30 **[H3-047]** HOW ECOSYSTEM-LEVEL WATER USE EFFICIENCY AND ITS COMPONENTS IN RESPONSE TO SEASONAL DROUGHT (Mi Na, Wen Xuefa, Wang Huimin, Zhang Yushu, Cai Fu)

15:30-15:45 **[H3-048]** DEVELOPMENT OF INTEGRATED WATER RESOURCES MODEL TO ESTIMATE ANTHROPOGENIC IMPACTS ON TERRESTRIAL WATER CYCLE

(Shunji KOTSUKI and Kenji TANAKA)

15:45-16:00 Discussion

Break-out Session K2: Biometeorological Modeling and Assessment (in Korean) (Chair: Kwang Soo Kim)

14:30-14:45 **[K2-049]** DEVELOPMENT OF FORECASTING MODEL FOR SYMPTOM INDEX OF POLLEN ALLERGIC PATIENTS (M. J. Kim, K. R. Kim, H. -S. Jung, J. -W. Oh)

14:45-15:00 **[K2-050]** CATTLE SHED ENERGY SIMULATION USING THE ENERGYPLUS MODEL (J. M. Chun, K. R. Kim, S. Y. Lee, W. S. Kang, H. S. Jung)

15:00-15:15 **[K2-051]** REDEVELOPMENT OF THE DSSAT MODEL USING C++ FOR FACILITATION OF OPEN SOURCE SOFTWARE DEVELOPMENT (Kwang Soo Kim, Haneul Jeong)

15:15-15:30 **[K2-052]** ESTIMATION OF THE POTENTIAL EPIDEMICS OF RICE LEAF BLAST AND SHEATH BLIGHT UNDER THE RCP8.5 CLIMATE CONDITION IN KOREA (Kwang-Hyung Kim, Jaepil Cho, Wooseop Lee, Jongpil Kim, Hyojin Lee)

15:30-15:45 **[K2-053]** ASSESSMENT OF RICE YIELD CHANGE WITH CMIP5 PROJECTIONS (Yonghee Shin, Jongahn Chun, Kwanghyung Kim)

15:45-16:00 Discussion

Break-out Session A3: Current Issues in Flux Monitoring (2) (Chair: Benjamin Ruddell, Rappoteur: Minseok Kang)

16:30-16:45 **[A3-054]** THERMODYNAMIC ENTROPY BUDGET OF EAST ASIAN FOREST ECOSYSTEMS AT VARIOUS STAGES OF ADAPTIVE CYCLES (Minseok Kang, Joon Kim, Chunho Cho, Jung Hwa Chun, Takashi Hirano, and Guirui Yu)

16:45-17:15 **[A3-055]** INFORMATION CLOSURE APPLIED TO EXPLAIN ENERGY BALANCE RESIDUALS OF AN EDDY-COVARIANCE FLUX TOWER'S OBSERVATIONS (Benjamin Ruddell) – invited

17:15-17:30 **[A3-056]** VARIABILITY OF FLUXES AT DIFFERENT TEMPORAL SCALES IN A COMPLEX HILLY TERRAIN (C. Nrisimha Ramkiran, T. Narayana Rao and A. V. Chandrasekhar)

17:30-17:45 **[A3-057]** SPATIAL COUPLING CORRELATIONS BETWEEN THE TERRESTRIAL ECOSYSTEM CARBON EXCHANGE FLUXES (Zhi Chen, Guirui Yu)

17:45-18:00 **[A3-058]** APPLICATION OF PROCESS NETWORK ANALYSIS TO DELINEATE ECOHYDRO-LOGICAL AND BIOGEOCHEMICAL PROCESSES IN A RICE PADDAY IN SOUTH KOREA (Juyeol Yun, Joon Kim, and Sehee Kim)

Break-out Session A4: Carbon Tracking in Asia (2) (Chair: Seung-Jae Lee, Rapporteur: Kazuhito Ichii)

16:30-16:45 **[A4-059]** IMPACT OF CANOPY PHENOLOGY ON CARBON BUDGET IN A DECIDUOUS BROAD-LEAVED FOREST WITH UNDERSTORY EVERGREEN DWARF BAMBOO UNDER NEAR FUTURE CLIMATE CONDITION (Taku M. Saitoh, Shin Nagai, Jun Yoshino, Nobuko Saigusa, Ichiro Tamagawa, Hiroyuki Muraoka)

16:45-17:00 **[A4-060]** ENVIRONMENTAL CONTROLS ON THE INTERANNUAL VARIATIONS OF ECOSYSTEM CARBON EXCHANGE WITHIN THE TEMPERATE AND SUBTROPICAL FORESTS IN ASIA (Leiming Zhang, Guirui Yu, Shenggong Li, Xuefa Wen, Yuling Fu, Junhui Zhang, Junhua Yan)

17:00-17:15 **[A4-061]** INTERANNUAL CHANGES OF TEMPERATURE AND CO2 EXCHANGE IN AN ALPINE MEADOW ON THE TIBETAN PLATEAU IN RECENT 12 YEARS (Mingyuan DU, Yingnian Li, Fawei Zhang, Liang Zhao, Song Gu, Seiichiro Yonemura, Yanhong Tang)

17:15-17:30 **[A4-062]** ESTIMATION AND EVALUATION OF RESPIRATORY COMPONENT FLUXES IN EAST ASIA FROM 2001 TO 2010 (M. Kondo, K. Ichii)

17:30-17:45 **[A4-063]** APPLICATION OF HYPERSPECTRAL REMOTE SENSING IN STUDY OF TERRESTRIAL ECOSYSTEM CARBON FLUX (Quanzhou Yu, Shaoqiang Wang, Kun Huang, Lei Zhou)

17:45-18:00 **[A4-064]** ESTIMATING BALANCED CARBON DIOXIDE BUDGET OF TROPICAL PEATLAND REGION WITH SATELLITE BASED DATA (Haemi Park, Wataru Takeuchi)

Break-out Session A5: Challenges in Quantifying Greenhouse Gas Emissions across Soil Surface (Chair: Liukang Xu, Rapporteur: Naishen Liang)

16:25-16:45 **[A5-065]** THE CARBON BALANCE OF UNDERSTORY COMMUNITIES IN A LARCH FOREST (Zheng-Hong Tan, Naishen Liang, Munemasa Teramoto),

16:45-17:00 **[A5-066]** MAIN AND INTERACTIVE EFFECTS OF MULTIPLE GLOBAL-CHANGE FACTORS ON SOIL RESPIRATION AND ITS COMPONENTS: A META-ANALYSIS (Xuhui Zhou, Lingyan Zhou, Meng Lu) – invited

17:00-17:15 **[A5-067]** QUANTIFICATION OF SOIL CARBON STOCKS AND FLUX IN THE SEOUL FOREST PARK (Jeehwan Bae and Youngryel Ryu)

17:15-17:30 **[A5-068]** INFLUENCE OF SNOW-COVER AND SOIL-FROST VARIATIONS ON CO2 FLUX AT NON-VEGETATION AGRICULTURAL LAND (S. Ohkubo, Y. Iwata, T. Hirota)

17:30-17:45 **[A5-069]** PARTITIONING OF SOIL CO2 EFFLUX IN A RUBBER PLANTATION (D. Satakhun, D. Epron, F. Gay, P. Kasemsap and S. Thanisawanyankura)

17:45-18:00 **[A5-070]** SOIL CARBON BUDGET IN RAINFED AND IRRIGATED RICE FIELD IN WESTERN PART OF THAILAND (Nittaya CHA-UN, Amnat CHIDTHAISONG and Sirintornthep TOWPRAYOON)

Break-out Session H4: Understanding Water and Carbon Dynamics (Chair: Markus Reichstein, Rapporteur: Zhongmin Hu)

16:30-16:45 **[H4-071]** PARTITIONING OF EVAPOTRANSPIRATION THROUGH OXYGEN ISOTOPIC MEASUREMENTS OF WATER POOLS AND FLUXES IN A TEMPERATE GRASSLAND (Zhongmin Hu, Xuefa Wen, Xiaomin Sun, Linghao Li, Guirui Yu, Xuhui Lee, Shenggong Li)

16:45-17:00 **[H4-072]** HYSTERESIS RESPONSES OF EVAPOTRANSPIRATION TO METEOROLOGICAL FACTORS CHANGES IN DIEL TIME SCALE: PATTERNS AND CAUSES (Han Zheng, Guirui Yu, Qiu-feng Wang, Xianjin Zhu, and Ying-nian Li)

17:00-17:15 **[H4-073]** TREND OF LAND SURFACE EVAPOTRANSPIRATION BASED ON REMOTE SENSING IN CHINA DURING 1981 TO 2010 (Xingguo Mo, Suxia Liu, Zhonghui Lin, Shi Hu)

17:15-17:30 **[H4-074]** MEASUREMENT OF EVAPORATION AND CARBON DIOXIDE EXCHANGE IN DRY DIPTEROCARP FOREST THAILAND (Sukanya KAMMALES, Montri SANWANGSRI, Amnat CHIDTHAISONG, Nittaya CHAUN)

17:30-17:45 **[H4-075]** SEASONAL AND INTERANNUAL VARIATION OF WATER USE EFFICIENCY ACROSS VEGETATION AND CLIMATE TYPES (Tingting Shi, and Yingping Wang)

17:45-18:00 Discussion

18:15-20:50 **Young Scientist Meeting**
(Hosts: Zhongmin Hu, Minseok Kang, and Keisuke Ono,
Guests: Hugo Berbery, Kazuhito Ichii, Ray Leuning, Taikan Oki,
Markus Reichstein, Benjamin Ruddell, and Murugesu Sivapalan)

Friday, 23 August

Break-out Session A6: Communicating Carbon and Water Science to Society (Chair: Prabir Patra, Rapporteur: Youngryel Ryu)

09:00-09:15 **[A6-076]** SOCIAL MEDIA AND LOW CARBON CAMPAIGN IN ASIA (Aliyu Salisu Barau, A.N.M. Ludin)

09:15-09:30 **[A6-077]** AIR QUALITY DEGRADATION BY FIRECRACKER DURING DIWALI FESTIVAL IN BHILAI CITY, CENTRAL INDIA (Balram Ambade)

09:30-09:45 **[A6-078]** CARBON UPTAKE AND WATER PRODUCTIVITY FOR DRY-SEEDED RICE AND HYBRID MAIZE GROWN WITH OVERHEAD SPRINKLER IRRIGATION (M C R Alberto, R J Buresh , T Hirano, A Miyata, R Wassmann, J R Quilty, T Q Correa, Jr., and J Sandro)

09:45-10:00 **[A6-079]** CHANGES OF GREENHOUSE GAS FLUXES IN THE PROCESS OF LAND USE CONVERSION FROM PADDY TO UPLAND FIELD (Yuan Ye, Huimin Wang, Xiaoqin Dai)

10:00-10:15 **[A6-080]** CONTRIBUTION OF BIOMASS BURNING TO AIR POLLUTANTS BY EMISSION INVENTORY AND AMBIENT MEASUREMENT: THE PEARL RIVER DELTA REGION, CHINA AS A CASE (M. Shao, Y. S. Zhang, B. Yuan, W. T. Chen, S. H. Lu)

10:15-10:30 Discussion

Break-out Session A7: Tropical and Sub-tropical Ecosystems: Vulnerability and Resilience (1) (Chair: Takashi Hirano, Rapporteur: Nobuko Saigusa)

09:00-09:30 **[A7-081]** MASS AND ENERGY EXCHANGE OVER CENTRAL INDIAN DECIDUOUS FORESTS USING EDDY COVARIANCE FLUX MEASUREMENTS (CS Jha, R Suraj Reddy, TR Kiran Chand, and VK Dadhwal) – invited

09:30-09:45 **[A7-082]** EFFECTS OF DISTURBANCES ON THE BALANCES OF CARBON DIOXIDE AND WATER IN TROPICAL PEAT ECOSYSTEMS (Takashi Hirano, Suwido Limin and Mitsuru Osaki)

09:45-10:00 **[A7-083]** LAND-ATMOSPHERE FLUXES OF CARBON DIOXIDE AND METHANE FROM THREE ECOSYSTEMS IN TROPICAL PEATLAND OF SARAWAK, MALAYSIA (Lulie Melling and Angela Tang)

10:00-10:15 **[A7-084]** ENERGY AND CO2 FLUXES AT THE FIRST VIETNAMESE EDDY COVARIANCE SITE IN TROPICAL SEASONAL FOREST (Kurbatova J., Ba Duy Dinh, Avilov V., Deshcherevskaya O., Novichonok A., Phong Luu Do, Cong Huan Tran, Kuznetsov A.)

10:15-10:30 **[A7-085]** EFFCTS OF CLIMATIC FACTORS AND ECOSYSTEM RESPONSES ON THE INTER-ANNUAL VARIABILITY OF EVAPOTRANSPIRATION OF A CONIFEROUS PLANTATION IN SUBTROPICAL CHINA (Mingjie Xu, Huimin Wang, Xuefa Wen, Xianjin Zhu, Wenjiang Zhang, Xiaoqin Dai, Yidong Wang, Tao Zhang, Yunfen Liu, Guirui Yu)

Joint Session J1: Human Society, History, Culture, and Water in Changing World (Co-chairs: Murugesu Sivapalan and Ray Leuning, Rapporteur: Shinichiro Nakamura)

09:00-09:15 **[J1-086]** LONG-TERM VARIATION AND SOURCE ANALYSIS OF RADIOACTIVE CESIUM IN THE OHORIGAWA RIVER (Rei Yamashita, Michio Murakami*, Keisuke Sueki, Mahua Saha, Goro Mouri, Soulichan Lamxay, Haechong O, Yukio Koibuchi, Hideshige Takada)

09:15-09:30 **[J1-087]** THE CHRONICLE OF THE CALCULATING METHOD OF PROJECT DESIGN FLOOD IN JAPAN (Shinichiro NAKAMURA, Taikan OKI)

09:30-0945 **[J1-088]** COPING WITH FLOODING: THE CASE OF BARANGAY MALINTA, LOS BANOS, LAGUNA, PHILIPPINES (F. MALABAYABAS and R. BACONGUIS)

09:45-10:00 **[J1-089]** SIMULATING THE IMPACTS OF FLOOD ON WHEAT-CASE STUDY IN CHINA (Sanai Li and A.M. Tompkins)

10:00-10:15 **[J1-090]** DETERMINANTS OF FARM-LEVEL ADAPTATION TO CYCLONE AND FLOOD: A SURVEY OF FARM HOUSEHOLDS IN ODISHA, INDIA (Chandra Sekhar Bahinipati)

10:15-10:30 Discussion

Joint Session J2: Joint iLEAPS/IGAC/WMO initiative: Interdisciplinary Biomass Burning Initiative (IBBI) – Asian perspective (Co-chairs: Min Shao and Jianmin Chen, Rapporteur: Meehye Lee)

09:00-09:20 **[J2-091]** POLLUTANTS EMISSION BY AGRICULTURAL STRAWS BURNING IN CHINA (Jianmin Chen, Hefeng Zhang)

09:20-09:40 **[J2-092]** CONTRIBUTION OF BIOMASS BURNING TO AIR POLLUTANTS BY EMISSION INVENTORY AND AMBIENT MEASUREMENT: THE PEARL RIVER DELTA REGION, CHINA AS A CASE (M. Shao, Y. S. Zhang, B. Yuan, W. T. Chen, S. H. Lu)

09:40-10:00 **[J2-093]** FOREST FIRE PREVENTION FOR MITIGATING GHG EMISSIONS (Saharjo, Bambang Hero)

10:00-10:15 **[J2-094]** HUMAN DIMENSIONS OF FIRE ON TROPICAL PEATLANDS: REFLECTIONS FROM THE EX MEGA RICE PROJECT AREA IN CENTRAL KALIMANTAN, INDONESIA (S. Atmadja, Y. Indriatmoko, A.P. Vayda)

10:15-10:30 **[J2-095]** IMPACT OF FIRE EMISSIONS IN SOUTH ASIA ON AIR QUALITY IN THE REGION (Chinmay Jena, Sachin D. Ghude, Gabriele G. Pfister, D. M. Chate, G. Beig and Rajesh Kumar)

Break-out Session A7: Tropical and Sub-tropical Ecosystems: Vulnerability and Resilience (2) (Chair: Nobuko Saigusa, Rapporteur: Takashi Hirano)

11:00-11:30 **[A7-096]** RESPONSES OF CO2 FLUXES IN DRY DIPTEROCARP FOREST TO CLIMATE VARIABILITY (CHIDTHAISONG Amnat, SANWANGSRI Montri and HANPATTANAKIT Phongthep) – invited

11:30-11:45 **[A7-097]** TEMPORAL AND SPECIAL VARIATION OF NPP IN GUANGDONG PROVINCE EVALUATED BY IMPROVED CASA MODEL (Luo Yan, Wang Chunlin, Zhou Guoyi)

11:45-12:00 **[A7-098]** PREDICTING GEOGRAPHIC DISTRIBUTION AND HABITAT SUITABILITY DUE TO CLIMATE CHANGE OF SELECTED THREATENED FOREST TREE SPECIES IN THE PHILIPPINES (Kristine Garcia, Rodel Lasco, Amor Ines, Bradfield Lyon, and Florencia Pulhin)

12:00-12:30 Discussion

Break-out Session A8: Process Studies from Leaf to Canopy (Chair: Young-Hee Lee, Rapporteur: Keisuke Ono)

11:00-11:15 **[A8-099]** CHARACTERIZING TEMPERATURE RESPONSES OF PHOTOSYNTHETIC PHYSIOLOGY IN FLAG AND THIRD LEAVES OF WHEAT (Wei Xue, Jonghan Ko, and John Tenhunen)

11:15-11:30 **[A8-100]** SEASONAL VARIATION OF STOMATAL COUNDUCTANCE AT CANOPY-SCALE IN RELATION TO CROP PHENOLOGY (Atsushi Maruyama, Tsuneo Kuwagata and Keisuke Ono)

11:30-11:45 **[A8-101]** CANOPY-SCALE RELATIONSHIPS AMONG LEAF NITROGEN CONTENT, PHOTOSYNTHESIS, AND STOMATAL CONDUCTANCE IN IRRIGATED RICE (Keisuke Ono, Atsushi Maruyama, Tsuneo Kuwagata, Masayoshi Mano, Takahiro Takimoto, Kentaro Hayashi, Toshihiro Hasegawa, and Akira Miyata)

11:45-12:00 **[A8-102]** RESPONSE OF PHOTOSYNTHETIC PARAMETERS IN SUBTROPICAL FORESTS TO DROUGHT (Lei Zhou, Shaoqiang Wang, Yonggang Chi, Qingkang Li)

12:00-12:15 **[A8-103]** INCORPORATING SEASONALLY VARYING SURFACE ORGANIC LAYER INTO VERSION 4 OF THE COMMUNITY LAND MODEL (Young-Hee Lee and Y. Li)

12:15-12:30 Discussion

Joint Session J3: Bridging the gap between local measurement and large scale modeling (Chair: Hyungjun Kim, Rapporteur: Kazuhito Ichii)

11:00-11:20 **[J3-104]** ELK-TESTING LANDSURFACE MODELS BY INTEGRATION OF LOCAL AND GLOBAL OBSERVATIONS (Markus Reichstein) – invited

11:20-11:40 **[J3-105]** RECONCILING TOP-DOWN AND BOTTOM-UP CARBON FLUXES OF SOUTH ASIA (Prabir Patra, J. G. Canadell, and Cooperating members) – invited

11:40-12:00 **[J3-106]** ESTIMATION OF TERRESTRIAL WATER STORAGE FROM HYDROLOGIC MODELING, GRACE, AND LAND-ATMOSPHERE WATER BALANCE ANALYSIS (Pat Yeh) – invited

12:00-12:15 **[J3-107]** DEVELOPMENT OF A NEW MODEL OF PAN EVAPORATION (Wee Ho Lim, Michael L. Roderick, Graham D. Farquhar, Shinjiro Kanae)

12:15-12:30 Discussion

Joint Session J4: iLEAPS-GLP-AIMES joint initiative: Interactions among Managed Ecosystems, Climate, and Societies (IMECS) – Asian perspective (Co-chairs: Toshichika Iizumi and Hideaki Shibata , Rapporteur: Hyun-Seok Kim)

11:00-11:20 **[J4-108]** GLOBAL DATASET OF HISTORICAL YIELDS: TOWARD LINKING YEAR-TO-YEAR VARIATIONS OF CROP YIELDS WITH RECENT CLIMATE EXTREMES (Toshichika Iizumi and Masayuki Yokozawa)

11:20-11:50 **[J4-109]** ECOSYSTEM PROCESSES AND FUNCTIONS OF CHANGING LAND SYSTEM AND CLIMATE EXTREME (Hideaki Shibata)

11:50-12:10 **[J4-110]** BIOGENIC VOCS EMISSIONS AND THEIR IMPACTS ON SURFACE OZONE IN THE PEARL RIVER DELTA REGION, CHINA (Wang Xuemei, Situ Shuping, Guenther Alex, Turnipseed Andrew, Jiang Xiaoyan, Wu Zhiyong, Zhou Guoyi, Bai Jianhui, Wang Xinmin)

12:10-12:30 **[J4-111]** IMPACTS OF LULCC ON REGIONAL CLIMATE IN CHINA (Wei-Dong GUO)

Special Session S1: Using EddyPro^{TM} (Li-Cor. Inc.)

12:30-13:30 *Lunch Break*

Poster Session PO2

13:30-14:30 AsiaFlux, HESSS, and KSAFM poster session

Closing Session

14:30-16:00	**Summary and Synthesis (Chairs and Rapporteurs)**
	Outstanding Student Poster Award
16:00-16:30	*Break*
16:30-17:30	**The Way Ahead: Opportunities & Challenges**
17:30-18:00	**Closing**

Poster Session PO1 and PO2

[PO-112] APPLCATION OF THE CHARACTERISTICS OF FRACTIONAL UNCERTAINITY ON EDDY COVARIANCE MEASUREMENT TO DATA QUALITY CONTROL (Daisuke KOMORI, Wonsik KIM, and Jaeil CHO)

[PO-113] A STUDY OF CO_2 FLUX IN AFFORESTED CROPLANDS PLANTED WITH THREE TREE SPECIES IN TAIWAN (Mei-Ling Tang, Ming-Tung Hsueh, Jeng-Lin Tsai, Ben-Jei Tsuang, Pei-Hsuan Kuo)

[PO-114] FOREST EVAPOTRANSPIRATION AND CO_2 FLUX OVER LARCH FORESTS WITH DIFFERENT CANPY STRUCTURE AT EASTERN SIBERIA (Ayumi Kotani, Takeshi Ohta, Trofim C. Maximov, Alexander V. Kononov)

[PO-115] RADIAL DISTRIBUTION OF SAPFLUX DENSITY TO UPSCALE STAND WATER USE (Minkyu Moon, Juhan Park, Sungsik Cho, Daun Ryu, Taekyu Kim, Hyunseok Kim)

[PO-116] REAL-WORLD ERROR AND UNCERTAINTIES ACROSS THE AMERIFLUX NETWORK: SYNTHESIS OF 10 YEARS OF SITE INTERCOMPARISONS (Wai-Yin Stephen Chan, Sebastien Biraud, Dave Billesbach, Chad Hanson, Margaret Torn)

[PO-117] THE EFFECT OF CLIMATE CHANGE ON ECONOMY OF FISHERY INDUSTRY ON CASPIAN LITTORAL STATES (Kourosh Haddadi Moghaddam)

[PO-118] SATELLITE-BASED ANALYSIS ON ECOSYSTEM RESPONSE TO EXTREME CLIMATE EVENTS USING IMAGERY IN MONGOLIA (Nayoung DO, Sinkyu KANG)

[PO-119] ESTIMATING CHANGE OF INTER-ANNUAL GREEN-UP VARIABILITY IN MONGOLIA (Tserenchunt Battumur, Chuluun Togtokh, Sinkyu Kang, Gantsetseg Batdelger and Nayoung Do)

[PO-120] RESPONSES OF ECOSYSTEM CARBON CYCLE TO BIOTIC DISTURBANCE FROM LEAF TO ECOSYSTEM LEVELS: A META-ANALYSIS (Baocheng Zhang, Xuhui Zhou, Yanjen Bai, Linyan Zhou, Bo Li)

[PO-121] ECOSYSTEM FLUX MEASUREMENT OF YOUNG RUBBER PLANTATION IN NORTH-EASTERN REGION OF THAILAND (C. Chayawat, J. Phattaralerphong, D. Sutakhun, J. Sathornkich, T. Pakoktom, F. Gay, and P. Kasemsap)

[PO-122] ESTIMATING NET ECOSYSTEM EXCHANGE AT A TROPICAL ESTUARINE WETLAND ECOSYSTEM BY COMBINING REMOTE SENSING AND FIELD DATA (Sung-Ching Lee, Cho-Ying Huang, Jehn-Yih Juang)

[PO-123] THE EFFECT OF PLUM RAIN EVENTS ON NEE OF SEASONAL EVERGREEN FOREST (Shih-Chi Hsu, Yi-Ying Chen, and Ming-Hsu Li)

[PO-124] APPLICATION OF AN INTEGRATED FLUX DATABASE FOR ASIA: EMPIRICAL UPSCALING AND MODEL EVALUATION (K. Ichii, M. Ueyama, M. Kondo, Y.H. Lee, A. Ito, P.K. Patra, T. Sasai, H. Sato, T. Hirano, J. Kim, N. Saigusa, M. Alberto, J. Asanuma, M.S. Bret-Harte, C. Edgar, S.E. Euskirchen, S.J. Han, Y.J. Hsia, M. Kang, K. Kitamura, Y. Kominami, H. Kondo, A. Kotani, Y. Kosugi, S.G. Li, Y.N. Li, T. Maeda, Y. Matsuura, A. Miyata, Y. Mizoguchi, T. Ohta, T.M. Saitoh, T. Shimizu, K. Takagi, Y. Tang, H. Wang,

Y. Yasuda, G.R. Yu, Y. P. Zhang, F.H. Zhao , N. Zimov, S.A. Zimov)

[PO-125] EFFECTS OF RESIDUAL BIOMASS BURNING ON THE CO_2 FLUX FROM A PADDY FIELD (Hiroyuki Murakami, Yuki Kawamoto, Naoki Wakikuromaru, Keisuke Ono, and Toru Iwata)

[PO-126] AN INTEGRATED FLUX DATABASE FOR ASIA (M. Ueyama, K. Ichii, N. Saigusa, T. Hirano, M. Alberto, J. Asanuma, M. S. Bret-Harte, C. Edgar, S. E. Euskirchen, S. J. Han, Y. –J. Hsia, M. Kang, J. Kim, K. Kitamura, Y. Kominami, H. Kondo, A Kotani, Y. Kosugi, S. –G. Li, Y. N. Li, T. Maeda, Y. Matsuura, A. Miyata, Y. Mizoguchi, T. Ohta, T. M. Saitoh, T. Shimizu, K. Takagi, Y. Tang, H. Wang, Y. Yasuda, G. –R. Yu, Y. –P. Zhang, F. -H. Zhao, N. Zimov, S. A. Zimov)

[PO-127] EFFECT OF RESIDUAL BIOMASS BURNING ON THE METHANE EMISSION FROM A SINGLE-RICE CROP FIELD (Naoki Wakikuromaru, Atsuhiro Kunishio, Yuki Kawamoto, Toru Iwata)

[PO-128] AN INFRA-RED LASER HIGH RESOLUTION SPECTROMETER TO MEASURE FLUXES OF CH_4, N_2O, AND CO_2 AND $\delta^{13}C/^{12}C$ OF CO_2 ENCOUNTERED IN VARIOUS ECOSYSTEMS (PEATLANDS AND HYDROCARBON CONTAMINATED SOILS) (C. Guimbaud, C. Noel, B. di Angelo, Z. Yin, P. Gaudry, S. Gogo, M. Chartier, C. Robert, F. Jégou, V. Catoire, J.C. Gourry, F. Laggoun Defarge, I. Ignatiadis)

[PO-129] QUANTITATIVE RELATIONSHIP BETWEEN GREENHOUSE GAS EMISSIONS AND ASSOCIATED MICROBIAL POPULATIONS UNDER AEROBIC AND ANAEROBIC CONDITION (Seok Ho Jung, Jong Chan Park, Cho Won Kim, Bo Min Kang, Eun Jin Lee, Jin Hee Ryu, Gwang Hyun Han)

[PO-130] SOIL CO_2 EFFLUX IN A TEMPERATE DECIDUOUS FOREST IN KOREA (Jae-ho Lee, Jung-hwa Chun, Jae-seok Lee)

[PO-131] SOIL RESPIRATION IN RICE AND BARLEY DOUBLE CROPPING PADDY-FIELD IN KOREA (Sung-hyun MIN, Jae-ho LEE, Kyo-moon SHIM, Yong-seok KIM, Jae-seok LEE)

[PO-132] EFFECTS OF “OPEN BURNING” ON THE GREENHOUSE GAS EXCHANGE FROM A SINGLE-RICE PADDY FIELD IN JAPAN (Yuki Kawamoto, Hiroyuki Murakami, Naoki Wakikuromaru, Keisuke Ono, Hayashi Kentarou, Toru Iwata)

[PO-133] SEASONAL VARIATIONS OF CARBON DIOXIDE AND ENVIRONMENTAL FACTORS ON A TIDAL FLAT IN SUNCHEON BAY, KOREA (Park Sa Kim, Dong Hwan Kang, Byung Hyuk Kwon, Kwang Ho Kim, and Min Seong Kim)

[PO-134] BIOMASS BURNING DETECTION BY AIRCRAFT MEASUREMENTS OVER MALAYSIA (G. Krysztofiak, V. Catoire, C. Guimbaud, P.D. Hamer, K. Grossmann, V. Marécal, M. Dorf, A. Reiter, H. Schlager, S. Eckhardt, M. Lichtenstern, T. Jurkat, D. Oram, B. Quack, E. Atlas and K. Pfeilsticker)

[PO-135] MONITORING PADDY RICE INFORMATION THROUGH AN UNMANNED AERIAL VEHICLE SYSTEM (Seungtaek Jeong, Jonghan Ko, Jongkwon Kim)

[PO-136] SOILS IN THE SOYANG LAKE WATERSHED: SOIL SAMPLING DESIGN AND EARLY SOIL DESCRIPTION (Oeverdieck, Hannes; Jeong, Gwan Yong; Liess, Mareike; Huwe,

Bernd)

[PO-137] INFLUENCE OF PLANT COMPETITION ON BIOCHEMICAL AND AGRONOMIC ATTRIBUTES OF SOYBEAN (Hafiz Muhammad Rashad Javeed, Abdullah A. Jardat, Muhammad Shahid Ibni Zamir, Xiaolai Xie)

[PO-138] WATERSHED MANAGEMENT AND NATURAL RRESOURCE CONSERVATION: SHIVALIK FOOTHILLS OF NORTHERN INDIA (Khajuria Anupam, Yoshikawa Sayaka, and Kanae Shinjiro)

[PO-139] AN APPLICATION OF INVERSE LAGRANGIAN DISPERSION ANALYSIS METHOD ON THE CALCULATION OF LATENT AND SENSIBLE HEAT FLUX (Changjie Jin, Anzhi Wang, Yiwei Diao, Dexin Guan)

[PO-140] SIMULATIONS OF FREE AIR CO2 ENRICHED SORGHUM GROWTH AND INTERACTIONS WITH WATER (Tongcheng Fu, Jonghan Ko and Han-Yong Kim)

[PO-141] LAND AND SEA BREEZE ASSOCIATED TEMPERATURE GRADIENT BETWEEN ISHIKARI AREA AND YUHUTSU AREA HOKKAIDO IN JAPAN (Taiki Fukushima Tomohito Yamada Shin Miyazaki)

[PO-142] PROJECTING HYDROLOGICAL IMPACTS OF CLIMATE CHANGE - HOW CAN WE PREPARE FOR THE CHANGE? – (Yukiko Hirabayashi, Roobavannan Mahendran, Sujan Koirala, Lisako Konoshima, Yong Zhang, Dai Yamazaki, Satoshi Watanabe, Hyungjun Kim and Shinjiro Kanae)

[PO-143] USE OF STOCHASTIC TYHOON MODEL FOR ESTIMATING FUTURE CHANGE OF POPULATION EXPOSED BY TYPOON WINDS IN THE WESTERN NORTH PACIFIC REGION (Y. Iseri, K. Kusuhara, Y. Imada, T. Sato, W.H. Lim, A. Iwasaki and S. Kanae)

[PO-144] ESTIMATION OF EVAPOTRANSPIRATION BASED ON SATELLITE REMOTE SENSING DATA OVER THE CONTINENTAL US FOR ALL SKY CONDITIONS (Keunchang Jang, Sinkyu Kang, and John S. Kimball)

[PO-145] THE EFFECTS OF CHANGES IN NET RADIATION AND VAPOR PRESSURE DEFICIT ON INTERANNUAL VARIATION OF GROSS PRIMARY PRODUCTIVITY AND EVAPOTRANSPIRATION IN KOREAN PENINSULA (Soohyun Jeon, Youngryel Ryu)

[PO-146] MESOSCALE WEATHER PATTERNS LEADING TO EXTREME SNOWFALL INTENSITY EVENTS IN SAPPORO CITY OF NORTHERN JAPAN (Murad Ahmed Farukh)

[PO-147] THE INTERACTION BETWEEN VELOCITY AND DENSITY PROFILES IN THE ATMOSPHERIC BOUNDARY LAYER (Yoshikazu KITANO)

[PO-148] SEASONAL VARIATION OF LEAF TRAITS IN WOODY PLANTS OF AN URBAN PARK (Hyungsuk Kim, Youngryul Ryu)

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[PO-156] SITE QUALITY EVALUATION OF SAWTOOTH OAK [QUERCUS ACUTISSIMA CARRUTH.] FOR PRACTICAL APPLICATIONS AT UNSTOCKED LAND IN KOREA (Su-Young Jung, Kwang-Soo Lee, Byung-Oh Yoo, Eun-Ji Bae, Sang-Hyun Lee)

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[PO-158] THE ANATOMICAL PROPERTIES OF DAMAGED PINUS THUNBERGII BY MATSUCOCCUS THUNBERGIANAE (Nam-Euy Hong, Kyung-Rok Won, Kwang-Soo Lee, Song-Ho Chong, Byung-Oh Yoo, Hee-Seop Byeon)

[PO-159] THE PHYSICAL AND MECHANICAL PROPERTIES OF DAMAGED PINE WOOD(PINUS THUNBERGII) BY MATSUCOCCUS THUNBERGIANAE (Kyung-Rok Won, Byung-Oh Yoo, Su-Young JUNG and Hee-Seop Byeon)

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[PO-162] INTEGRATED RESEARCH OF BIOGEOCHEMICAL CYCLES INTERACTIONS IN 50-YEAR-OLD *PINUS KORAIENSIS* STANDS OF MT. TAEHWA (Hyun Seok Kim[1,2], Joon Kim[2], Philsun Park[1], Soyoung Kim[3], Meehye Lee[4], Seawung Kim[5], Alex Guenther[6], Deugsoo Kim[7], Jaeseok Lee[8], Juhan Park[1], Taekyu Kim[3], Sangwook Seo[3])

[PO-163] APPLYING THREE DIFFERENT LITTER DECOMPOSITION FUNTIONS FOR ALDER LEAF UNDER DIFFERENT SOIL MOISTURE CONDITIONS (T. K. Yoon, N. J. Noh, S. Han, J. Lee, S. Kim, Y. Son)

[PO-164] BASE TEMPERATURE FOR THE APPLICATION OF THE GROWING DEGREE DAY MODEL TO ESTIMATE FLOWERING OF SEVERAL LANDSCAPE WOODY PLANTS (Jae Soon Kim, Myeong Il Jeong, Seung Won Han, Ha Kyung Jang and Hyun Hwan Jung)

[PO-165] REVISING THE DSSAT/CERES-RICE MODEL TO SIMULATE THE EFFECTS OF ELEVATED CO2 ON GROWTH, DEVELOPMENT AND YIELD OF PADDY RICE (Q. Wang, J. A. Chun, D. Fleisher, D. Timlin, S. Li, K. H. Kim and Y. H. Shin)

[PO-166] COMPARATIVE ASSESSMENT OF CARBON DIOXIDE FLUXES OF FLOODED AND DRAINED MANAGEMENT CONDITIONS AT RICE PADDY FIELD IN KOREA (Kyomoon Shim, Sunghyun MIN, Yongseok KIM, Myungpyo JUNG, Seokcheal KIM, Kyuho SO)

[PO-167] INFLUENCE OF FERTILIZER COMBINATION ON TOTAL AND HETEROTROPHIC SOIL RESPIRATION IN RED PINE STANDS (Jaeyeob Jeong, Nanthi S. Bolan, Ravi Naidu, and Choonsig Kim)

[PO-168] THE INFLUENCE OF PLANT GROWING ON THE DAILY TEMPERATURE CHANGES OF GREEN ROOF IN SUMMER (Ha-Kyung Jang, Seung-Won Han, Jae-Soon Kim, Myung-Il Jeong)

[PO-169] THERMAL EFFECT MEASUREMENTS FOR LANDSCAPE PLANTS ON HIGH TEMPERATURE STATUS (Seung-Won Han, Ha-Kyung Jang, Jae-Soon Kim, Myung-Il Jeong)

[PO-170] IN-DEPTH EXAMINATION OF SCS CURVE NUMBER METHOD ON STEEP FORESTED WATERSHEDS (Sangjun IM, Byungku AHN, Dongyeob KIM, Eunjai LEE)

[PO-171] VULNERABILITY ASSESSMENT OF AN APPLE ORCHARD ACCORDING TO ABNORMAL CLIMATE (Seong-Tak Yoon, Young-Ju Oh, Myung-Hyun Kim, Kee-Kyung Kang, Young-Eun Na)

[PO-172] VERTICAL AND HORIZONTAL VARIATIONS OF THE SEASONAL CHANGES IN CANOPY STRUCTURE AND THE LEAF TRAITS (Youngkeun Song, Galam Lee, Soohyun Jeon, Youngryel Ryu)

PLENARY SESSION

[PL1-001]

COMMUNICATING (CLIMATE) SCIENCE

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Science and technology have profoundly transformed our understanding of world in the last 350 years. Science has revealed that the Earth is not the centre of the universe but is instead a small, blue planet in the Milky Way, one of a countless number of galaxies in the Universe. Science has shown that life on Earth is constantly evolving and that massive extinctions have occurred during the 4.5 billion years of the Earth's existence. Human civilization has developed rapidly since the last glacial maximum about 12 thousand years ago but both science and history show that continued existence of our current civilization is not guaranteed, despite our technological innovations in harnessing the world's resources through the use of cheap fossil fuels.

The benefits of science and technology have come at a cost to the ecosystems that sustain humans and other life on Earth. Life on land is sustained by a thin layer of soil 1-2 m deep, beneath a shallow troposphere 14-18 km deep, while much of marine life is constrained to the upper layer of the oceans. All of these ecosystems are now under threat, caused by 150 years of industrial emissions of greenhouse gases and other pollutants, massive land clearing and over-exploitation of all resources. Human population is now around 7 billion and expected to increase to 9 billion by mid-century. Population, technology and resource consumption are causing Global Change, of which Climate Change is one part.

Many people do not accept the humans are causing Climate Change, despite the overwhelming evidence. In this presentation, I explore why providing scientific evidence alone is insufficient to overcome this lack of acceptance and discuss how climate and social scientists can engage in public debate to convince people that the climate is changing and how we can work to diminish the rate of change.

[PL1-002]

SOCIO-HYDROLOGIC MODELING TO UNDERSTAND AND MEDIATE THE COMPETITION FOR WATER BETWEEN HUMANS AND ECOSYSTEMS: MURRUMBIDGEE RIVER BASIN, AUSTRALIA

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Competition for water between humans and ecosystems is set to become a flash point in coming decades in all parts of the world. An entirely new and comprehensive quantitative framework is needed to establish a holistic understanding of that competition, thereby enabling development of effective mediation strategies. This paper presents a case study centered on the Murrumbidgee river basin in eastern Australia that illustrates the dynamics of the balance between water extraction and use for food production and efforts to mitigate and reverse consequent degradation of the riparian environment. Interactions between patterns of water management and climate driven hydrological variability within the prevailing socio-economic environment have contributed to the emergence of new whole system dynamics over the last 100 years. In particular, data analysis reveals a pendulum swing between an exclusive focus on agricultural development and food production in the initial stages of water resource development and its attendant socio-economic benefits, followed by the gradual realization of the adverse environmental impacts, efforts to mitigate these with the use of remedial measures, and ultimately concerted efforts and externally imposed solutions to restore environmental health and ecosystem services. A quasi-distributed coupled socio-hydrologic system model that explicitly includes the two-way coupling between human and hydrological systems, including evolution of human values/norms relating to water and the environment, is able to mimic broad features of this pendulum swing. The model consists of coupled nonlinear ordinary differential equations that describe the interaction between four state variables describing the co-evolution of storage capacity, irrigated area, human population, and a measure of ecosystem health. The resulting model is used to generate insights into the dominant controls of the trajectory of co-evolution of the coupled human-water system, to serve as a theoretical framework for more detailed analyses of the system, and to generate organizing principles that may be transferable to other systems in different climatic and socio-economic settings.

[PL1-003]

NEW APPROACHES AND CONCEPTS TOWARD BETTER UNDERSTANDING OF COMPLEX COUPLED HUMAN NATURAL SYSTEMS

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The reductioninstic approach that aims to develop differential equations and discretized numerical models are successful in classical applications of engineering and physics, but may be limited in complex coupled natural-human (CNH) systems where the equations may never be known with sufficient accuracy, or at all. These systems are characterized by nearly infinite connections or disconnections at many scales of space and time, by feedback between parts, by evolution conditioned on history, and often by anticipatory or social behaviors. Unfortunately, most of the 21st century's grand scientific challenges and important applications of research require a fundamental understanding of complex CNH systems. The water resources, sustainability, climate, ecological, and natural resource economic problems of concern to the land surface ecosystem research community are excellent examples. To address these challenges and produce land surface ecosystem research worth listening to- research that can truly benefit society, nature, and the economy by providing fundamental advances beyond what the 20th century paradigm could offer- a variety of new approaches may be needed. These approaches must seamlessly and quantifiably integrate robust social, environmental, and economic fundamentals, or at least illuminate the principle connections or disconnections, scales, feedbacks, and controls. The concepts of networks, economics, ecosystems, and control theory have provided good starting points, and examples are given of this type of work.

[PL2-004]

DROUGHTS IN SOUTHERN SOUTH AMERICA: LARGE-SCALE DYNAMICS AND REGIONAL PROCESSES

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Southeastern South America is among the most fertile regions in the world, with a large diversity of crops, including wheat, corn, sugar cane and soybean. Agricultural production has significantly increased in the last two decades, in part due to technological advances but also because of more beneficial climate conditions. However, the region is subject to high climate variability, implying the frequent production of floods and droughts. Previous studies have linked the region's precipitation anomalies to the Pacific sea surface temperature anomalies (El Nino-Southern Oscillation, ENSO mode) that force changes in the large scale circulation through changes in the Walker circulation, the regional Hadley cells and location and intensity of the storm tracks. A cold Pacific is known to induce dryness over southern South America. It is shown here that the Pacific forcing is a necessary but not sufficient condition for droughts. The drought region over southern South America becomes stronger, and its shape better defined, when the cold Pacific is complemented with a warm North Tropical Atlantic (NTA mode) involving two mechanisms: (a) by enhancing the regional Hadley cell circulation with a stronger ascending branch around 0-20° N and increased descending motions approximately between 5-40 degrees south (collocated with the increased dryness); and (b) by influencing the moisture transports over large areas.

While the remote forcings act as the main driver of extremes, land-atmosphere feedbacks can contribute to the lifecycle of droughts. Regional model simulations of a severe drought event that took place during 2008 reveal that vegetation changes due to the drier conditions modify the spatial distribution of properties like green vegetation fraction, albedo, surface roughness length, stomatal resistance and the deeper ground conditions like root depth and soil moisture. In all, their realistic representation in models leads to reduction in model biases and thus better representation of drought. It is suggested that a key aspect of drought awareness is the need to monitor diverse variables that not only represent climate conditions, like a deficit of water or soil moisture, but that also can describe the vegetation health and other properties of the land cover.

Due to the increased vulnerability of the region to climate extremes, the climate research community is facing complex challenges that require identifying research themes critical for improving our understanding of sources and intrinsic levels of predictability on intraseasonal, interannual, decadal and longer time scales. Likewise efforts need to be placed in improving the overall understanding and prediction of climate extreme events and their impacts on key environmental services and on society. Lastly, strategies need to be defined to narrow the gap between current predictive capabilities in the region and estimated limits of predictability. To this end, during next year a Planning Conference will be held with the support of the World Climate Research Programme (WCRP) contributing to the development of Climate Services in the region to (a) improve our knowledge on the climate system, the interactions among its components and the limits of predictability, and (b) to enhance our ability to interact with other disciplines, particularly decision makers and social scientists in order to translate basic climate knowledge into actionable science.

[PL2-005]

CLIMATE EXTREMES AND THE CARBON CYCLE

Markus Reichstein[1)], Michael Bahn[2)], Philippe Ciais[3)], Dorothea Frank[1)], Miguel D. Mahecha[1)], Sonia I. Seneviratne[4)], Jakob Zscheischler[1)]

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The terrestrial biosphere is a key component of the global carbon cycle and its carbon balance is strongly influenced by climate. Ongoing environmental changes are thought to increase global terrestrial carbon uptake. But evidence is mounting that rare climate extremes can lead to a decrease in ecosystem carbon stocks and therefore have the potential to negate the expected increase in terrestrial carbon uptake. Here we explore the mechanisms and impacts of climate extremes on the terrestrial carbon cycle, and propose a pathway to improve our understanding of present and future impacts of climate extremes on the terrestrial carbon budget.

In addition to direct impact on the carbon fluxes of photosynthesis and respiration via extreme temperature and (or) drought, effects of extreme events may also lead to lagged responses, such as wildfires triggered by heat waves and droughts, or pest and pathogen outbreaks following wind-throw caused by heavy storms, reduced plant health due to drought stress or due to less frequent cold extremes in presently cold regions. One extreme event can potentially override accumulated previous carbon sinks, as shown by the Western European 2003 heat wave..

Extreme events have the potential to affect the terrestrial ecosystem carbon balance through a single factor, or as a combination of factors. Climate extremes can cause carbon losses from accumulated stocks, as well as long-lasting impacts on (e.g. lagged effects) on plant growth and mortality, extending beyond the duration of the extreme event itself. The sensitivity of terrestrial ecosystems and their carbon balance to climate change and extreme events varies according to the type of extreme, the climatic region, the land cover, and the land management.

Extreme event impacts are very relevant in forests due to the importance of lagged and memory effects on tree growth and mortality, the longevity of tree species, the large forest carbon stocks and their vulnerability, as well as the long recovery time to re-gain the stock level previous to the extreme event impact. Given shorter regrowth times, grasslands are expected to recover more quickly from extremes than forests. Yet, degradation feedbacks come into play, where drought triggers loss of vegetation and heavy rain or wind causes subsequent erosion. Thus, an increase in the frequency of extreme events in some regions may contribute to e.g. desertification of semi-arid to arid grassland, in particular when (over-) grazing is an additional pressure. Croplands are also exposed to extremes with impacts on carbon cycling that are harder to disentangle as negative effects can be mitigated through evasive and adaptive farm management actions provided that sufficient resources are available.

In most climatic zones, productivity and carbon sequestration potential of terrestrial ecosystems are strongly influenced by droughts that are a main source of inter-annual variation in terrestrial carbon sequestration. The expected regional impact of future climate extremes depends on changes in the occurrence probability of extremes, the compounded effects and timing of different extremes, the vulnerability of each land-cover type, the current mean climate in relation to the functioning of the ecosystem under consideration, and the ability to apply adaptive management.

[PL3-006]

WATER CYCLE CHANGE AND THE HUMAN FINGERPRINT ON THE WATER LANDSCAPE OF THE 21ST CENTURY: OBSERVATIONS FROM A DECADE OF GRACE

Jay Famiglietti

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Over the last decade, satellite observations of Earth's water cycle from NASA's GRACE (Gravity Recovery and Climate Experiment) mission, have provided an unprecedented view of global hydrological change and freshwater availability. Since its launch, the mission has helped to confirm that precipitation, evaporation and continental discharge rates are increasing, that the mid-latitudes are drying while the high and low latitudes are moistening, and that the hydrologic extremes of flooding and drought are becoming even more extreme. Importantly, GRACE has exposed the human fingerprint of water management practices such as groundwater use and reservoir storage, which raises many important issues for climate, water, food and economic security. Moreover, the GRACE mission has enabled us to peer beneath Earth's surface and characterize the worldwide depletion of groundwater aquifers, raising significant concerns about the potential for heightened conflict over transboundary water resources. In this talk I review the basics of how the GRACE mission observes terrestrial and global hydrology, what new information the mission has provided since its launch in 2002, and the implications for the future of water availability and sustainable water resources management.

[PL3-007]

INTEGRATED MODELING FOR WATER CYCLES AND FOOD SECURITY UNDER ANTHROPOCENE

Taikan OKI

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Yadu Pokhrel, Naota Hanasaki, Hyungjun Kim and Shinjiro Kanae

Anthropogenic climate change is one of the multiple stressors on water resources. Non-climatic drivers such as population increase, urbanization, economic developments, and land use and land cover changes also challenge the sustainability of the freshwater resources management through increasing the water demand or decreasing its availability.

Integrated hydrology and water resources modelling systems are now under development, and they can consider human activities, such as storing and releasing water in reservoir, irrigation withdrawals, and environmental flow, in the system. Such a system was applied to assess how future human beings can adapt to the changes in hydrological regime, and it was found that irrigation, particularly ground water pumping, has a potential to alleviate possible damage due to decrease in available freshwater resources. Reasonable assumptions in the future scenario how much water would be stored in reservoirs for irrigation and how much cropland area will be equipped with irrigation facility would be the key to reduce the uncertainty in future projections of the balance between water demand and supply.

However, nonrenewable groundwater withdrawals for irrigation, together with artificial reservoir water impoundment, climate-driven changes in terrestrial water storage and the loss of water from closed basins, could have contributed a sea-level rise of about 0.77mm/y between 1961 and 2003, about 42% of the observed sea-level rise.

In terms of water scarcity, total population under high water stress (HWSP) in the future under global warming condition is mainly dependent on the future socio-economic scenario and not the degree of human-induced climate change, represented by a metric of global mean temperature increase.

ORAL
SESSION

[A2-008]

A BROAD VIEW ON FOREST RESPONSE TO GLOBAL CHANGE: EXPERIMENTS, MODELS, CONCEPTS

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Forests play a vital part in shaping the future carbon and water cycles by responding to changing environmental conditions. Numerous approaches have tried to characterise these responses, ranging from greenhouse trials to large field experiments and models of various levels of complexity. Scenarios for the future carbon and water cycle often vary, depending on the perspective they are looked at and the methodologies used. This talk takes you on a journey across a wide range of spatial and temporal scales and methodologies from which you can look at forest responses to global change.

Starting at the leaf level, I will show that responses to for example CO2 may differ greatly as we move up in spatial scale, sometimes because second-order responses are triggered, which may eventually dominate the primary response. Vegetation models tend to be based on leaf-level processes such as rates of photosynthesis, which overlooks larger-scale ecological drivers of vegetation dynamics. Field experiments may provide more realistic answers, but we still subject small islands of forest to future conditions and thus forcedly disregard large-scale feedback. For example, atmospheric feedback effects are substantial and have the power to reverse initial response patterns, as is evidenced by the coupling of a regional climate model with a dynamic vegetation scheme. Concurrent changes in several environmental drivers further complicate the picture and make us predominantly rely on ecosystem models. One way forward may be global meta-analyses and the distillation of general response patterns to provide robust conceptual models of forest response to global change.

[A2-009]

EFFECTS OF CLIMATIC VARIABILITY ON DISTRIBUTION OF PLANT FUNCTIONAL GROUPS IN MONGOLIA

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Mongolia has divided into 6 main natural zones based on topography, climate variables and vegetation, such as the high mountain, taiga, forest-steppe, steppe, desert-steppe and desert. We used 132 sites located within 30 km radius of the weather stations and compared the number of plant species belong to PFGs versus monthly based average of cumulative P and T during growing season between 2004 and 2010. Field measurements of plant species occurrences were made by point frame method in selected sites. We divided plant functional groups (PFGs) into Annuals (AS), Perennial Forbs (PF), Perennial Grasses (PG), Semi-shrubs and shrubs (SS). PFGs were analyzed with natural zones and climate variability. Analysis showed that species number of AS, PF and PG was highest in the steppe zone whereas species number of SS was in the desert-steppe zone. The species number of AS and SS was lowest in the taiga zone and that of PF was in the desert zone but lowest species number of PG found in both taiga and desert zones. As well, correlation analysis showed that species number of SS increased in areas with low precipitation (r_s=-0.26 p=0.02) and high air temperature (r_s=0.33, p=0.003) and species number of PG has no significant correlation with precipitation and air temperature. Our results indicate that species number of SS increased from the steppe zone to desert-steppe zone but species number of other groups decreased.

[A2-010]

EFFECTS OF DROUGHT AND ICE RAIN ON POTENTIAL PRODUCTIVITY OF A SUBTROPICAL CONIFEROUS PLANTATION FROM 2003 TO 2010 BASED ON EDDY COVARIANCE FLUX OBSERVATION

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Increasing occurrences of climate extreme events urge us to study their impacts on terrestrial carbon sequestration. Ecosystem potential productivity deficits could characterize such impacts and display the ecosystem vulnerability and resilience to the extremes in climate change, whereas few studies have analyzed the yearly dynamics of forest productivity potential deficits. Based on a perfect-deficit approach, we used in situ eddy covariance flux data and meteorological observation data at Qianyanzhou(QYZ) station from 2003 to 2010 to explore the relationship between potential productivity and climate extremes, such as droughts in 2003 and 2007, ice rain in 2005, and ice storm in 2008. We found (1) the monthly canopy photosynthetic capacity (CPC) deficits could be mainly explained by air temperature (Ta) deficits (R^2=0.45, p<0.00001), (2) a significant correlation was noted between seasonal CPC deficits and co-current Ta deficits (R^2=0.45, p<0.00001), especially in winter (R^2=0.79, p=0.003), (3) drought in summer exerted a negatively lagged effect on potential productivity (R^2=0.59, p=0.02), but at a short-time scale, and (4) annual CPC deficits captured the impacts of climate extremes on the forest ecosystem potential productivity, and the two largest potential productivities deficits occurred in 2003 (relative CPC deficits = 0.3354) and in 2005 (relative CPC deficits = 0.3541), respectively. With the perfect-deficit approach, the forest ecosystem vulnerability and resilience to extremes was analyzed in a novel way.

[A2-011]

GRAZING AND FIRE EFFECTS ON *CARAGANA MICROPHYLLA* DENSITY IN MONGOLIAN STEPPES

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Mongolian steppe was classified semi-steppe, typical steppe and semi-desert steppe, based on climatic aridity. We examined the effects of grazing and fire on *Caragana microphylla* density in the central and eastern Mongolian steppes. Generally, its density corresponds with aridity index. This correspondence was dramatically altered by grazing and/or fire. Increasing and decreasing patterns of *C. microphylla* density associated to both grazing and fire disturbance in the eastern steppes. These patterns were to light and heavy grazing disturbance in both central semi- and typical steppes. Moderate grazing disturbance calls more heterogenous *C. microphylla* density in the central semi- and typical steppes. Only decreasing pattern associated to low grazing disturbance in the semi-desert and eastern steppes. Moderate grazing disturbance calls larger variability of *C. microphylla* density than light and heavy. However *C. microphylla* density increased with fire-free period to be short, its density does not exceed 8 individuals in the eastern steppes. A competitive suppression of tall grass serves to decrease this shrub density after fire. The results indicate that aridity affects for *C. microphylla* density in the semi-desert steppe and grazing in the central semi- and typical steppes but fire is more frequent than grazing in the eastern steppes. Then, grazing in the central semi- and typical steppes and fire in the eastern steppes called heterogeneous (mixed dense and sparse) and homogenous (sparse) density of this shrub.

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[A2-012]

COMMUNICATING THE EFFECT OF CLIMATE CHANGE ON RAINFALL EXTREMES

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Climate change has had profound effects on almost all natural and anthropogenic processes, in various spatial and temporal scales. Many studies have been conducted and reports and papers about climate change effects were published. However, the projected effects of climate change on rainfall extremes by different studies are far from being consistent, and in some cases even differ in order of magnitudes. How much confidence do we have on climate model outputs? How much does the general public know about the effects of climate change from the reports or journal papers of climate change studies? Climate change studies often involve multidisciplinary collaborations and jargons used by researchers of one discipline may be misinterpreted by researchers of other disciplines. In addition, analysis methods widely used in one discipline may not be very familiar to researchers of other fields. All these problems hinder precise and effective communication of the effects of climate change among researchers and between researchers and the general public. In this presentation the importance of effective and precise communication of the effects of global warming on rainfall extremes will be demonstrated using existing literature. Two key issues, i.e. the data support and data uncertainties, will be emphasized with exemplar cases to address their importance in assessing the effects of climate change.

[H1-013]

A TEST BED OF LAND SURFACE WATER/ENERGY/ECOSYSTEM MODELS IN DRY CLIMATE - RESULTS FROM ASIAN DRYLAND MODEL INTERCOMPARISON PROJECT (ADMIP) –

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In order to improve predictions of landsurface processes at Asian dryland, Asian Dryland Model Intercomparison Project (ADMIP) were organized to inter-compare numerous landsurface process models in off-line mode with observed forcing data. Two target sites at semi-arid grassland, Kherlen-bayan Ulaan in Mongolia and Tongyu in China, both of which are registered to Asiaflux and GEWEX-CEOP, were selected as the target sites of the intercomparison. The micrometeorological observations at these sites were collected and archived. Tested models of ADMIP include both landsurface models (LSMs) and terrestrial ecosystem models (TEMs). The former solves heat and water balance at the surface, while the latter predict the carbon budget of the surface vegetation.

The intercomparison was divided into several intercomparison stages, where different degree of information was given to the models. At the intercomparison stage 0.5, where no *a priori* knowledge was given to the models, performances of the models with their default parameter set were mutually compared. At stage 1.0, the values of parameters that are found in literatures are given to the models, so that performance of the models with common parameter set was compared each other. The presentation will focus on the results from the stage 0.5, while some preliminary insights from stage 1.0 will be also given.

[H1-014]

IMPACT OF SOIL PARAMETERS ON REPRODUCIBILITY OF HYDROLOGICAL PROCESSES BY LAND SURFACE MODEL

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Semi-arid and arid areas are particularly exposed to the impacts of climate change on fresh water (IPCC, 2007). Temporal changes of precipitation, soil water storage and evapotranspiration have close relationship with the fresh water resources (e.g. amount of river runoff and water availability). The region with strong coupling between soil moisture and precipitation was transitional zones between dry and wet climates (Koster at al., 2004). The land surface model (LSM) has great role on the land-atmosphere interaction in the general circulation model (GCM). In the previous studies regarding the performance of LSM in semi-arid and arid climate in Asia are few (e.g. Dan et al., 2008; Asanuma et al., 2010). An international research project, Asian Drylands Landsurface Process Model Intercomparison Project (ADMIP) has been carried out since 2010 funded by APN and MEXT of Japan. In this study, we evaluated the reproducibility of hydrological process by LSM Minimal Advanced Treatments of Surface Interaction and RunOff (MATSIRO; Takata et al, 2003) forced by the meteorological data provided by ADMIP project at grassland in semi arid climate in China and Mongolia. The aim of this study is to investigate the impact of soil parameters on the reproducibility of hydrological processes by LSM.

The testing of MATSIRO was carried out offline mode (i.e., decoupled from complex interactions in the full 3D model and forced by observed meteorological data) over the grassland sites at Tongyu (44.416 deg. N, 122.867 deg. E , altitude: 184m) in China and Kherlen Bayan Ulaan (KBU; 47.2127 deg. N, 108.7424 deg. E, altitude: 1235m) in Mongolia. The meteorological forcing data at two sites was provided by ADMIP project. The monthly leaf area index derived from the Terra/MODIS satellite with validation using ground data and soil parameters were also provided by ADMIP project. Two kinds of experiments have been carried out, which LSM was run with the default parameters (CTL) and observed parameters (OBS) for soil physics and hydrology, and vegetation.

The soil temperature (Ts) of CTL run was higher than the observed value when the soil was thawing phase. This overestimation of Ts in thawing phase was diminished in the OBS run. As the OBS run used the observed soil thermal conductivity, the amount of heat conduction into the soil becomes appropriate in OBS run. The simulated soil moisture (SM) was lower than the observed SM in summer while the simulated SM was higher than the observed SM in winter season especially when the soil was frozen. The SM was measured by the TDR that is sensitive to the dielectric constant. As the dielectric constant of ice is same as air, the observed value of SM by TDR drop dramatically when the soil freeze. The simulated sensible heat flux (H) was overestimated in spring and summer on CTL run. The simulated H and observed matched well on OBS run. However, the simulated H was quite higher than observed in winter on OBS run. This increase of H in winter on OBS run likely related that soil thermal conductivity of OBS run was five and three times of CTL run at Tongyu and KBU, respectively. The soil heat flux (G) of OBS run becomes quite higher than the CTL run both at Tongyu and KBU. The simulated latent heat flux (LE) was well reproduced both CTL run and OBS run at Tongyu and KBU. Although we investigated only for MATSIRO in this study, the further investigation will be available after ADMIP output come out. This will contribute more understanding of the hydrological processes as well as biological processes.

[H1-015]

DEVELOPMENT AND APPLICATION OF COMPREHENSIVE DOWNSCALING METHODS FOR HOKKAIDO REGION, JAPAN

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The water resource in Hokkaido may be drastically changed, such as running down of snowfall or off the melting season, and the area is the most affected in Japan by global warming, according to the "report on recent climatic change in the world-reviews and outlook for the future 2005" by Japan Meteorological Agency. It is urgent to plan climate change adaptations, and detailed simulation of regional climate is mandatory. This study aims to develop downscaling methods of flood control and water utilization, and to develop a software to refer hydrological and weather information obtained through the project for climate change adaptation measures.

[H1-016]

INFLUENCE OF LAND SURFACE SCHEME IN REGIONAL CLIMATE MODEL ON ESTIMATING SNOW WATER EQUIVALENT OVER MOUNTAINOUS LANDSCAPE IN CENTRAL JAPAN

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Mountainous area over central Japan is one of the snowiest regions all over the world. The heavy snow sometimes causes serious snow disasters, while it provides plentiful water resources in snowmelt season. In addition, snow cover is one of the important factors controlling the dynamics of ecosystem functions such as carbon, water, and heat budgets via its influence on forest phenology. Snow cover condition can be measured by satellite remote sensing regularly, though it is subjected to cloud cover. On the other hand, there are no reliable observations about the amount of water resources, because there are scarcely observation sites measuring snow water equivalent. Even if there are some observation data of snow depth, majority of the observation sites locate in areas with an altitude of less than 1000 m. Airborne lidar observation is useful to estimate the spatial distribution of snow depth. But it cannot measure continuously, and the observation area is quite limited.

To evaluate the snow water equivalent over the mountainous area, regional climate model is an effective method. In addition, it is also useful to perform future prediction under several climate conditions. For example, Kawase et al. (2012) reported that both of snowfall and snowmelt would increase during the winter at elevation higher than 1500 m under the climate in the late 20th century, using WRF version 3.2.1 (Weather Research and Forecast model) adopted Noah-LSM as land surface process scheme. But, the simulation of snowmelt process is strongly depending on land surface process scheme. Noah-MP, which is the renewed version of Noah-LSM, was added to the land surface process option from WRF version 3.4 released in April 2012. Noah-MP can simulate multi-stratified structure of snowpack, whereas Noah-LSM treats snowpack as a bulk layer (Niu et al., 2011). The model reproducibility about snow depth, snow density, and snow water equivalent was improved at the mountainous area of Vermont in America by adopting Noah-MP as land surface process scheme (Niu et al., 2011).

In this study, we focused on the difference between Noah-LSM and Noah-MP for the temporal variation of snow water equivalent in the mountainous area over central Japan from September 2006 to August 2008, using WRF version 3.4.1. First, we tried to validate the modeled data at the Tokamachi site (138.767°E, 37.133°N, 200 m a.s.l.) of Forestry and Forest Products Research Institute, where measures daily snowpack density and snow water equivalent. The simulated snow depth, snow water equivalent, and snow depth by Noah-MP scheme were more consistent with these observation data than the simulated data by Noah-LSM, which underestimates snow depth, snow density, and snow water equivalent. Second, we tried to validate the modeled data at the Takayama site (137.423°E, 36.146°N, 1420 m a.s.l.) of AIST and Gifu University (TKY site of AsiaFlux), at which WRF could reproduce precipitation in cold season better than any other high elevation sites. Both of the calculated snow depth by Noah-MP and Noah-LSM were consistent with the observation from the beginning of snowfall to the time of maximum snow depth. But, Noah-LSM tends to underestimate snow depth during snowmelt season. As a result, the calculated snow water equivalent by Noah-LSM would be too little. We consider that the reason of better calculation by Noah-MP is multi-stratified structure of snowpack. Whereas the Noah-LSM treats snowpack as a bulk layer, the Noah-MP can resolve snowpack up to three layers, depending on the snow depth.

Consequently, the monthly snow water equivalent over the mountainous area in central Japan estimated by Noah-MP is about 1.30, 1.33, 1.44, 1.67, 2.05, and 3.07 times larger than the values estimated by Noah-LSM in January, February, March, April, May, June, respectively. In particular, the difference of absolute amount of snow water between Noah-MP and Noah-LSM is quite large from February to May, because the speed of snowmelt simulated by Noah-LSM is faster than that simulated by Noah-MP.

[A2-017]

SPATIAL AND TEMPORAL PATTERNS OF NITROGEN DEPOSITION AND THEIR CONTROL FACTORS IN CHINA FROM 1990S TO 2000S

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Anthropogenic nitrous pollutant emission was significantly increased in China during the last decades, which result in the nitrogen (N) deposition accelerated, greenhouse gas unbalanced, in turns, seriously threaten the human and ecosystem health and biological diversity. Understanding the spatio-temporal pattern and their control factors of N deposition in China can provide background for the researches on the interactions between the carbon and nitrogen cycles, and is useful for accurately predicting and evaluating the trend of N deposition in the future. In this study, based on nationwide wet N deposition datasets from about 300 site-network observations, we construct the national-scale N deposition maps by kriging interpolation in China from 1990s to 2000s .The effects of anthropogenic emissions (N fertilizer and energy consumption) and environmental factors (precipitation and wind) on the spatial and temporal patterns of N deposition were analyzed . Furthermore, we set a regression function for predicting N deposition in the future.

[A2-018]

LAND USE CANGES AND ITS EFFECTS ON CARBON AND NITROGEN DYNAMICS IN SOUTH AND SOUTH EAST ASIA REGION

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The distribution of sources and sinks of carbon over land is dominated by land use and land use changes (LULUCs) such as deforestation, reforestation and agricultural management. Despite the importance of LCLUC in determining long-term net terrestrial fluxes of carbon, estimates of carbon fluxes due to LCLUC are uncertain relative to other terms, such as fossil emissions and ocean flux, in the global carbon budget. This is particularly true in tropical regions, due to lack of spatially explicit and consistent LCLUC data. This study implements satellite based LCLUC data with a geographically explicit terrestrial carbon-nitrogen model ISAM (Integrated Science Assessment Model) to examine the response of vegetation and soil carbon and nitrogen stocks to recent LCLUCs in South and South East Asian Region.

We used spatially explicit satellite derived LCLUCs maps, created using various satellite data sets to estimate forest area change estimates. ISAM's terrestrial component cycles consist of fully prognostic carbon and nitrogen dynamics associated with LCLUC, vegetation, litter (above and below ground) decomposition, and soil organic matter. he modeled carbon cycle includes feedback processes such as CO2 fertilization, climate effects on photosynthesis and respiration and increased carbon fixation by nitrogen deposition; whereas the model nitrogen cycle includes all the major processes associated with nitrogen, including immobilization, mineralization, nitrification, denitrification, leaching.

By quantifying the spatial distribution of net carbon and nitrogen sources and sinks, this study helps to determine how much carbon is being stored or released in south and south east Asian region, particularly in the context of the Kyoto protocol, which allows a country to apply the carbon stored in its forests and other ecosystems toward its budgeted reduction in carbon dioxide and other greenhouse gases.

[A2-019]

CHANGING TERRESTRIAL CARBON ASSIMILATION GEOGRAPHY AND SEASONALITY IN EAST ASIA

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In this study, current and future changes in the spatial extent and intra-annual cycles of photosynthetic activities of vegetation in different climate zones of East Asia are examined. The extension of growing season length attributable to an earlier thermal spring onset is identified in the time series of vegetation indices across East Asia derived from remote sensing data such as NOAA AVHRR and NASA MODIS imagery. This indicates that the timing of atmospheric carbon uptake by photosynthetic activities of vegetation in East Asia has been advanced. However, inter-annual climate variability in different climate zones during the East Asian summer monsoon period led to heterogeneous spatial patterns and intra-annual cycles of terrestrial carbon assimilation. For instance, spatial extent of carbon assimilation in steppe zones has shrunk in recent decades due to droughts, while there was no obvious shift in other ecosystem zones. Modeled future climate change scenario data project that poleward shifts of ecosystems associated with lengthened growing seasons will be observable in the warmer 21st century though the cold air advection from high latitudes due to melting Arctic sea ice may disturb these change patterns in the near-term future.

Keywords: Terrestrial carbon assimilation, climate zone shift, growing seasons, Arctic climate change.

[A2-020]

NET CO_2 EXCHANGE BEHAVIOR OF YOUNG *PINUS ROXBURGHII* PLANTATION AS INFLUENCED BY REMOVAL OF UNDERSTOREY

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The understorey species in subtropical pine forest with distinct needle fall and emergence phenophase plays crucial role in carbon balance of the system. Dekadal (at 10-day interval) net canopy assimilation and nighttime respiration rate of overstorey (*Pinus roxburghii*) and understorey (*Lantana camara*) including soil respiration were considered to account net CO_2 exchange behavior of young pine patch (8.5 years) at Forest Research Institute, Dehradun, India covering a full annual growth cycle from November 2010 to December 2011. Results indicate that system remained a net source of CO_2 (5.08±1.72 µmol $CO_2\,m^{-2}\,s^{-1}$) from November 2010 to April 2011. This may be due to winter physiological dormancy of pine (degreening needles) and the removal of understorey. During rest of the period, it acted as net sink of carbon (- 8.43±6.48 µmol $CO_2\,m^{-2}\,s^{-1}$) with maximum potential during post monsoon period. Net canopy assimilation of pine varied between 1.2 (December) and 10.5 (October) µmol $CO_2\,m^{-2}\,s^{-1}$ with maximum during post monsoon. Net canopy assimilation of understorey varied between 3.7 (April) and 17.3 (September) µmol $CO_2\,m^{-2}\,s^{-1}$. We here in this study want to stress that it is post monsoon period which experiences maximum productivity. Inter and intra-seasonal nighttime respiration rate of the ecosystem species varied little and remained in range of 1.0 to 2.5 µmol $CO_2\,m^{-2}\,s^{-1}$. Soil respiration showed large variation (5.2 – 10.5 µmol $CO_2\,m^{-2}\,s^{-1}$) with maximum during later part of the monsoon and minimum during winter. Present study clearly brought out the role of understorey in maintaining carbon balance in an ecosystem. Therefore, it is concluded that unscientific clearance of understorey in name of land management practices should be avoided and long–term study must be carried out for understanding of controls on carbon balance and fluxes in subtropical Himalayan coniferous forests.

[A2-021]

CARBON BALANCE OF A NATURAL DISTURBED FOREST IN NORTHERN JAPAN

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Global soil organic carbon was estimated to be 1,500 Gt, and this value is the double of the carbon in the atmosphere. Soil respiration (*R*s) is the second largest carbon flux in global terrestrial ecosystem, and was estimated to be more than 98 ± 12 Gt C yr^{-1}. Therefore, a little changing of *R*s will result in the alternation of global carbon balance.

Natural disturbance can changes the carbon flux pattern in the ecosystem dramatically. Typhoon is one of the causes of natural disturbance and sometimes damages heavily on the forest ecosystem. Eastern Asian regions (include Japan) are frequently damaged from typhoon under the influence of Asian monsoon, and typhoon disturbance has huge impact on the forest ecosystem. However, understanding for the effect of typhoon disturbance on *R*s is very limited.

In 2004 September, very strong typhoon (Songda) attacked Tomakomai flux site in Hokkaido, northern Japan. Due to this natural disturbance, Tomakomai flux site was destroyed completely, and most of standing trees (45 year-old larch) were fallen down at the time. We started to collect data of *R*s and understory photosynthesis from 2001 by using a multi-channel automated chamber system. After the typhoon disturbance, we continued the measurement to understand ecosystem carbon balance following the vegetation recovering.

The measurement in 2012 was conducted during non-snowing season from May 10th to November 20th. Averaged *R*s during measurement period was 2.91 μ mol CO_2 m^{-2} s^{-1} and 2.76 μ mol CO_2 m^{-2} s^{-1} in control and trenched (heterotrophic respiration, R_h) plot, respectively (Fig. 1). R_h contributed 94.6 % of *R*s. During measurement period, the accumulative *R*s was estimated to be 5.9 tC ha^{-1}. The accumulative NEP (large chambers with vegetation inside) during same measurement period was 2.3 tC ha^{-1}. The NEP value was almost equal to the NEP value before typhoon disturbance. From those results, a certain level of vegetative recovery of this flux site was suggested after 8 years following Typhoon disturbance.

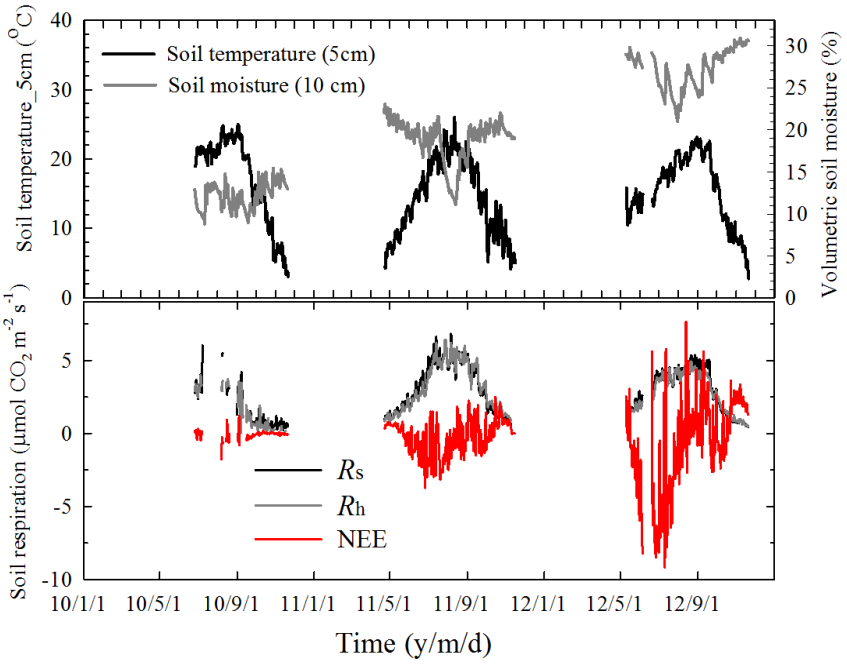

Fig. 1 Seasonal changes in soil temperature and soil moisture (upper), and soil respiration rates and NEE (net

[H2-022]

DEVELOPMENT OF GLOBAL FAPAR/ LAI ESTIMATION ALGORITHM FOR JAXA'S NEW SATELLITE SENSOR (GCOM-C1/ SGLI)

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Japan Aerospace Exploration Agency (JAXA) is planning to launch a new earth observation satellite, GCOM-C1 (Global Change Observation Mission 1st-Climate), in Japanese fiscal year 2015. GCOM-C1 aims at observing physical quantities for the long-term monitoring of the carbon cycle and the radiation budget. SGLI (Second-generation Global Imager), which has 19 channels in the wavelength range from near ultraviolet to thermal infrared, is carried in GCOM-C1. In the GCOM-C1 science project, FAPAR (Fraction of Absorbed Photosynthetically Active Radiation) and LAI (Leaf Area Index) are scheduled to be produced from SGLI data as standard products. Here, FAPAR is defined as the fraction of the incoming PAR absorbed by vegetation (dimensionless unit) and LAI is defined as the sum of the vegetation leaf area (one side) per unit ground surface area (dimensionless unit).

In this paper, we report the current status of the development of a new algorithm to estimate FAPAR and LAI based on a vegetation radiative transfer simulated FLiES (Kobayashi and Iwabuchi, 2008) and in-situ data (leaf reflectance/ transmittance, vegetation bidirectional reflectance, LAI, etc.) for GCOM-C1. We show the details of an algorithm and the estimated results using the data of MODIS (Moderate Resolution Imaging Spectroradiometer) onboard Terra (EOS AM-1) launched by NASA.

[H2-023]

PARTITIONING EVAPOTRANSPIRATION OF RAINFED DRYLAND RICE (ORYZA STIVA L) BASED ON OXYGEN ISOTOPE RATIO OF EVAPORATIVE FLUXES

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Rice (Oryza Stiva L), a grass which can be grown everywhere except Antarctica, is the second largest produced cereal with ample habitat. Because of the higher production of greenhouse gases (Methane and Nitrous Oxide) by conventional paddy rice production and because of the water scarcity, water use efficient and water saving rice production techniques are under researched. An important parameter for plant production is water use efficiency (WUE), which can be assed in different ways depending on the scale and process under investigation. Evapotranspiration [ET] is an important parameter to define water use efficiency of crop. ET is mostly calculated and modelled based on Penman – Monteith equation (1948). Now, by the use of a cavity ring down spectrometer, we measured ET directly in the field. Moreover, evaporation and canopy transpiration are partitioned based on measured δ18O E from bare soil plots and δ18O ET from crop canopy. Our aim is to add more knowledge on WUE analysis of rice production by using a newly developed stable isotope technology and to analyse the ecohydrological process of rice production by tracing the δ18O movement along the soil, plant and atmosphere. Our preliminary data shows that the measured diurnal ET fluxes of dry rice during different growth stages have strong correlation with the calculated ET by FAO Penman-Monteith equation (R2= 0.98). Further, our calculated canopy transpiration fluxes has strong correlation with measured leaf transpiration (R2=0.97). Our ET measurement can be done directly on the crop, the accuracy of result is higher than that of calculated ET. Moreover, we are measuring and analyzing the δ18O movement along the soil-plant-atmosphere continuum, we can prove the high accuracy of measured ET fluxes.

Keywords: Evapotranspiration, Oryza Stiva L, δ18O, Penman-Monteith equation

[H2-024]

NEW PRECIPITATION DATASET FOR ESTIMATING CHANGES IN THE MASS OF GLACIERS IN HIMALAYAS AND SURROUNDINGS

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Estimates of changes in the mass of glacier in High Mountain Asia (e.g., Himalayas, Karakorum and etc.) are important for the assessment of water resources in major river basins of Asia (e.g., Ganges, Brahmaputra and etc.). This is often achieved by using a mathematical model that sufficiently represents the physical basis of a glacier. The reliability of the estimates of mass change of glacier is highly dependent on the precipitation input. The spatial variation of precipitation at mountain ranges is higher than those at low lands. However, reliable precipitation dataset is not well established due to limited precipitation gauge measurements in these areas. Here, our research includes two steps. Firstly, we developed a precipitation dataset for the mountain ranges in Himalayas and surroundings with fine spatial resolution. It is based on fine satellite radar observed precipitation data (spatial resolution: approximately 0.05°) which directly estimates precipitation in broad area even on land as against microwave or infrared radiometers estimates. The satellite data was corrected for rainfall and snowfall separately by precipitation gauge observations. Then we combined the satellite based data and reanalysis data on the basis of gauge observations. Secondly, we estimate changes in the mass of glaciers in these areas using a glacier model with the new precipitation dataset.

[H2-025]

SPATIAL DISTRIBUTION OF DEBRIS COVER ON GLACIERS IN THE ALPS AREA USING ASTER IMAGERY

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Melt-water from mountain glaciers is an important water resource and is a major contributor to global sea level rise. In high mountain regions, many glaciers have extensive debris cover in their ablation zones, which influences regional-scale patterns of glacier mass balance and ice dynamics, because debris cover strongly affects ice melting. Hence, for estimating the ice melt rate, we need to consider the spatial distribution of debris cover on the glaciers. ASTER-derived thermal resistances of debris layers, defined as debris thickness divided by the thermal conductivity of the debris layer, can be used as a proxy for debris thickness over large areas. Here, we use it to estimate the spatial distribution of debris cover and assess its impact on the ice melt rate on the whole glaciers in the Alps. Also, we evaluated the accuracy of our estimations in comparison with other method for estimating debris covered glacier area.

Glaciers in the Alps area (46°N,8°E : Fig.1 right) were chosen as our target area because of the following reasons. First, good quality (few cloud cover) ASTER images exist. Secondly, lots of previous researchers have done their studies in this region, so it's easy to compare our result with them. As glacier outline data, latest version (June edition ver.2, 2012: http://www.glims.org/RGI) of RGI (Randolph Glacier Inventory) was used for defining the glacier outline.

In general, thermal resistance of the debris layer R [m^2K/W] is defined as debris thickness divided by the thermal conductivity of the debris layer. Due to poor knowledge of large-scale spatial distribution of debris thickness and its properties, we calculate the thermal resistance from the surface temperature of the debris layer derived from ASTER TIR (thermal and infrared) five bands, and the net radiation estimated from ASTER VNIR (visible and near-infrared) three bands and downward short and long wave radiation data of CERES (Clouds and the Earth's Radiant Energy System: http://flashflux.larc.nasa.gov) in ASDC (Atmospheric Science Data Center), which correspond to the nearest time and location of ASTER acquisition. The pixel size of ASTER TIR image is 90m and thermal resistance is calculated using the same resolution. One ASTER image covers an area of about 60km square, and 40 images have been used for covering the whole Alps region, including comparison and verification of the results. When there is a covering of cloud and snow, we cannot extract the debris properly from satellite images, we downloaded the data in glacier melting season in Alps region since 2009.

In Alps region, glacier area is about 1800km^2. Our result indicated that about 35% of the whole glaciers in the Alps area are covered with debris.

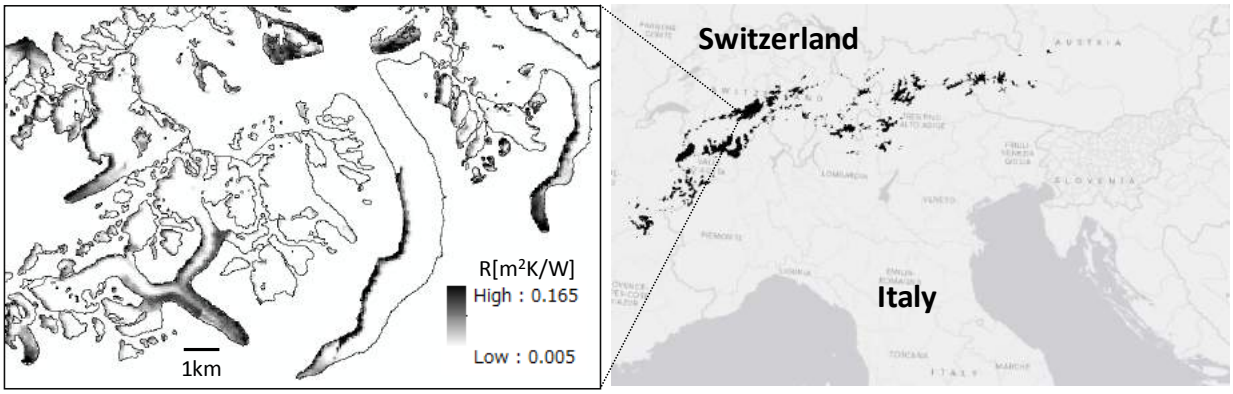

Fig.1 The spatial distribution of thermal resistance and glacier area in the Alps. An example of spatial distribution of thermal resistance in one selected area (left) and distribution of glaciers in the Alps (right).

[H2-026]

REPRESENTATION OF REALISTIC VARIABILITY OF CMIP5 RUNOFF SIMULATIONS

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An approach for representing realistic variability of Coupled Model Intercomparison Project Phase 5 (CMIP5) runoff simulation is evaluated in this study. The bias of runoff simulated by General Circulation Models (GCM) is generally not negligible if the runoff obtained is used for the simulation of river discharge. Thus, it is obtained from the land surface simulation using the forcing dataset from GCM simulations with bias-correction method that runoff to assess the impact of climate change on river discharge. Various previous studies adopt this approach.

This study proposes another approach that corrects the variability of runoff simulated by GCMs using reference runoff of which reasonability is validated in the previous studies simulated by the reanalysis data. The availability of this approach is evaluated by the comparison between corrected and reference data. Our trial is reasonable because it reduce the uncertainty of land surface simulation caused by the uncertainty of bias-corrected forcing dataset. Furthermore, the runoff bias-correction enables us to easily use many runoff datasets from various GCM simulations for impact assessment because it reduces the process of land surface simulation, which is necessary to obtain runoff. .

The process proposed to correct variability has two phases, the variability of monthly runoff is corrected first, and then the variability of daily anomaly, which is calculated from corrected monthly runoff, is corrected. The correction is conducted as follows; the difference of mean and standard deviation between GCM and reference data is calculated in the reference period; the realistic mean and standard deviation of GCM data in the target period is estimated from the difference in the reference period and the change of GCM output from the reference to the target period. These processes are similar with the method of bias correction for climate variables in the previous studies. Although such previous bias-correction methods use some statistical distributions, we do not use because the result obtained is not better.

To check the efficiency of our proposed method, the method is applied to the runoff during 1994-2009 simulated by MIROC5 with the reference data during 1979-1993. The figures show the difference between corrected and reference data. The approach in this study successfully removes the large difference in the GCM for many regions. The validation of the river discharge which is simulated with this runoff using observed river discharge can make clear the degree of availability of the bias-correction of runoff.

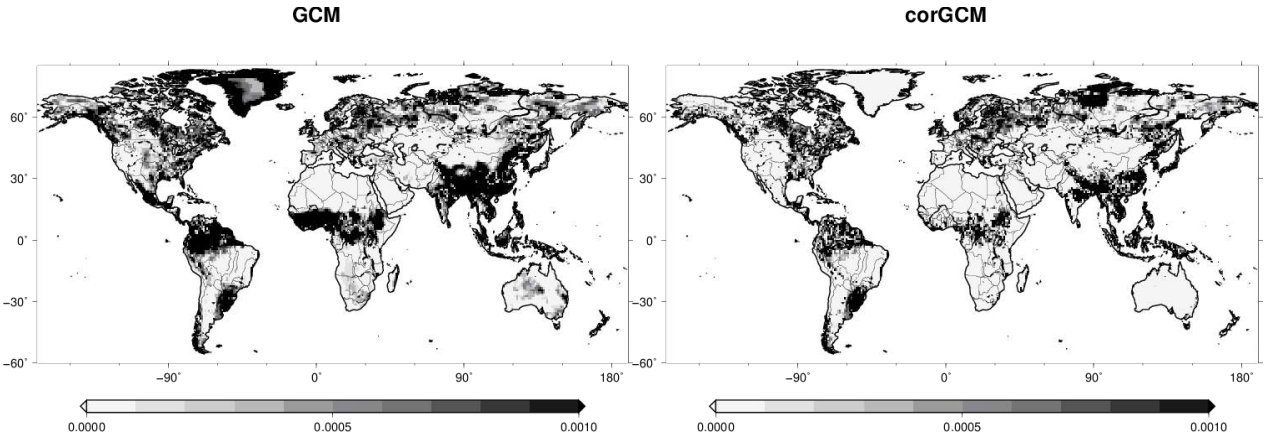

Figure: Differences in the largest monthly runoff during 1994-2009 between reference and GCM or GCM corrected data. Unit [Kg m-2 s-1]. GCM data(Left) GCM corrected(Right).

[K1-027]

INTEGRATED LAND ECOSYSTEM-ATMOSPHERE PROCESS STUDY: KICKOFF OF ILEAPS-KOREA

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On 23 August 2013, iLEAPS-Korea will be launched with a full support of KoFlux which is networked with regional AsiaFlux and global FLUXNET. As a national committee of iLEAPS, the iLEAPS-Korea shares the vision and goals, and pursues the scientific foci of iLEAPS:

(1) Vision

iLEAPS is an international crossdisciplinary research program aimed at improved understanding of processes, linkages and feedbacks in the land-atmosphere interface affecting the Earth System. iLEAPS facilitates scientific collaboration, synthesis, and distribution of results to scientific, political and public audiences.

(2) Goals

The goals can be summarized by the following key questions:

- How do interacting physical, chemical, and biological processes transport and transform energy, momentum and materials through the land-atmosphere system?
- What are the implications for the dynamics of the Earth System?
- How did the terrestrial-ecosystem/atmosphere system function under pre-industrial conditions, and how are human activities influencing it?
- To what extent does the vegetation determine its physical and chemical environment on various temporal and spatial scales?

The research scope of iLEAPS-Korea encompasses the integrated land ecosystem - atmosphere processes and their interactions and feedbacks in hydrologic cycle, climate change, and air quality with national and regional emphasis. It will bring the two communities from ecological and atmospheric sciences together and join expertise in atmospheric chemistry, agricultural and forest meteorology, and ecology. The target species are biologically and chemically active trace constituents including O_3, VOCs, nitrogen oxides, and aerosols as well as long-lived gases such as CO_2, CH_4, and N_2O. The scientific focus of the former is transformation processes of ozone and aerosol in the mixed plumes of biogenic and anthropogenic emissions and their effect on regional air quality and climate change. In addition, iLEAPS-Korea will focus on the successional change of ecosystem and its effect on the resilience and sustainability of ecosystem and atmospheric processes, particularly under urbanization and extreme events such as heat waves, dry spells, summer monsoon, and typhoon.

We expect to work together with iLEAPS-China and iLEAPS-Japan to bring out the synergy toward an establishment of a regional platform, i.e., iLEAPS-Asia.

[K1-028]

DATA MANAGEMENT AND TECHNICAL SUPPORT FOR KOFLUX AND ILEAPS-KOREA NETWORK BY NATIONAL CENTER FOR AGROMETEOROLOGY (NCAM)

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National Center for AgroMeteorology (NCAM) is an incorporated organization at Seoul National University through the partnership with Korea Meteorological Administration (KMA), Rural Development Administration (RDA), and Korea Forest Service (KFS). Its mission is to develop and deliver information to KMA, RDA and KFS on the options and trade-offs for a sustainable future of agricultural and forest ecosystems under a changing environment. NCAM's vision is to support individuals and organizations to be prepared to engage wisely in sustainability challenges from local to global scales by envisioning and implementing sustainable solutions to the current and future agricultural, forest and environmental problems in ecological-societal systems. The core services and R&D include: (1) satellite- and model-based high-resolution, digital climatology mapping of structure and function of agricultural and forest ecosystems; (2) synthesizing measurement and modeling of plant and animal production, outbreak and risk of diseases and insect pests; (3) monitoring of energy, water and carbon cycles through multi-purpose tower-based networks (e.g., KoFlux/AsiaFlux, iLEAPS); (4) transdisciplinary education in 'Agricultural & Forest Meteorology' in collaboration with Seoul National University (http://agfm.snu.ac.kr); and (5) workshops, training courses, and internships. In this presentation, we highlight the data management and technical support for KoFlux and iLEAPS-Korea Network by NCAM. Through the synergy of adaptive monitoring, management, and governance, NCAM will play a critical role in enhancing ecosystem services, mitigating disasters, and adapting to climate and environmental changes.

[K1-029]

EVALUATION OF WATER AND ENERGY BALANCE IN THE KOREA PENNINSULA CONSIDERING DIFFERENT IRRIGATION SYSTEMS

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The food security can be improved through increasing agricultural land or by more intensive agricultural managements including irrigation practices. The objectives of this study were to incorporate practical irrigation schemes into NASA Land Information System (LIS) and to investigate the impacts of the irrigation schemes on land surface states and fluxes including evapotranspiration, soil moisture, and run off in the Korean Peninsula, by applying the tool to the region. For this year, the Noah-LSM (Noah 3.2-Land Surface Model) in the LIS was selected to incorporate three irrigation schemes such as non-irrigation, flood irrigation, drip irrigation, and sprinkler irrigation schemes. However, drip irrigation and sprinkler irrigation schemes were not applied for this study, since these schemes are not commonly used in this region. The flood irrigation scheme was developed that irrigation can be turned on when the soil moisture at the first layer falls below the threshold value (25% above wilting point for this study). Moderate Resolution Imaging Spectrometer (MODIS) vegetation index were used to estimate crop growing seasons for a global experiment. The Noah-LSM was simulated to the region for 10 years (2001 to 2010) after 20 years of spin-up and investigated the hydrologic and energy flux estimates in the region. The flood irrigation scheme increased latent heat flux (Qle) and ground heat flux (Qg). However, the scheme decreased sensible heat flux (Qh). Evapotranspiration in this region with the flood irrigation scheme showed a tendency to increase over the growing season. The scheme also increased soil moistures at the first three soil layers (from surface to 0.6m deep), while there was no apparent tendency at the fourth soil layer (from 0.6 to 1.0m deep). Although the impacts of the flood irrigation scheme on land surface state and fluxes had not been evaluated against observed data, the results from the experiments showed the proposed irrigation scheme can be used to qualitatively investigate those impacts on hydrology in the Korean Peninsula.

[K1-030]

APPLICATION OF A WEATHER DATA CLIENT TO PREDICT RICE YIELD USING THE ORYZA 2000 MODEL

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Crop yield prediction has been made using a crop growth model that relies on four categories of input data including soil data, crop data, management data, and weather data. Most crop models are a single column model, which requires individual weather inputs for each site of interest. The objectives of this study were to develop a weather data service client that generates weather input files for a crop growth model and to use the client in order to predict rice yield at the national scale. The weather data service client was designed and implemented to download daily weather data from the web-based weather database managed by Korean Meteorological Administration (KMA) and to generate weather input files for the ORYZA 2000. In total, 4950 input files were generated to predict rice yield in 2011 and 2012 using the weather data service client. To generate nearly 5000 weather input files, 12 configuration files were used. It would take more than a month for a skilled person to download weather data from the KMA database and to reorganize those data to the input data format for the ORYZA2000 manually. Using the weather data service clients, two days were needed to generate all of the files.

Keywords: weather database, service client, weather input data

[K1-031]

AGRO-METEOROLOGICAL INFORMATION SERVICE AND CLIMATE CHANGE IN KOREA

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Agro-meteorological information is part of a continuum that begins with scientific knowledge and understanding, collection of data, changing data into useful information, dissemination of information, and ends with products that are used by end-users. Agricultural production is for a large part still dependent on weather and climate despite the impressive advances in agricultural technology over the last half a century. More than ever, agro-meteorological services have become essential because of the challenges provided to many forms of agricultural production by increasing climate variability and associated extreme events as well as climate change, all of which affecting the socio-economic conditions, especially of developing counties. Detailed observations/monitoring and real-time dissemination of meteorological information, and derived indices and operational services are important for tactical agro-meteorological decisions in short term planning of agricultural operations at different growth stages. A well organized, where possible automatic production and co-coordinated dissemination of this information and related advisories and services are essential. National Academy of Agricultural Science (NAAS) has established the agricultural meteorological information service (AMIS) network since 2009, and provided access to current and historical agro-meteorological data from NAAS's automated weather stations (AWS) with useful information for agricultural activities. The agricultural meteorological data and products provided by NASS can help improve production and product quality, optimize resource use, and reduce environmental impact. AMIS network includes 126 automated weather stations located mostly in farm region, such as paddy field, upland field, and orchard, which are planned to increase by 200 stations until 2017. Standard weather variables include air temperature, relative humidity, soil temperature, rainfall, wind speed, wind direction, solar radiation, leaf wetness, and soil moisture. These variables are recorded every 60 seconds and summarized every 10 minutes by a data logger, and transmitted to NAAS's DB server using CDMA wireless communication. The data loggers are powered by a battery that is recharged through a solar panel during the daytime. Communications are handled through cell phone data telemetry and the internet. Following data processing, the agricultural meteorological information is disseminated via the web site (http://weather.rda.go.kr). Our services will give detail information, not only agro-meteorological data, but agro-meteorological information, such as suggestions for future weather, crop growth and development condition, analysis of weather impact on crops, and agro-meteorological crop and disaster forecasting. State-of-the-art monitoring and information technologies will help farmers make more informed decisions. Better decisions can result in higher yield; reduced productions cost; more efficient use of resources, such as water; and reduced agro-meteorological disaster.

[K1-032]

POPMODEL, A FIRST TRIAL FOR OMNIPOTENT SIMULATOR

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Almost half of century has passed since insect, disease, crop modeling were started in vigor. Lots of models were developed but only a few models were used for a forecast or an evaluation. Even those models were not well used because of the problems related with the reliability, availability, serviceability, and so on. The crucial and basic problems in modeling is the deficiency in a simulator to simulate or build them easily, which hold up the development of modeling techniques and delayed the practical usage of those model. Recently several simulation programs become used to build and/or simulate models of insect, disease, and/or crop in the world. However, those programs have a limitation in containing all kinds of model with a common template and complicated stage linkage could not be built or simulated. The more programs have a capacity to build and/or simulate various models, the harder users comprehend whole structure models and use the programs. Therefore an epoch-making simulator is need in modeling. So I thought that the two factor as an omnipotent simulator to be used in insect, disease, and/or crop model is one is building stages or basic unit of model with various linkage and another is a common template of stages or basic unit of model. I created an algorism for the first factor and programmed PopModel with C/C++ and Windows API language to test the algorism of making and linking stages freely in 2012. Although PopModel was incomplete and left unfinished, many insect models can be built and simulated easily with the program. In 2013, I created an algorism for the second factor and started to develop PopModel 1.0 BASE. PopModel 1.0 BASE, designed as a calculator and also simple simulator, was made and now it is in the middle of advancing and tuning the algorism having the potential of including all kinds of models of stage or basic. Finally I created and tested two epoch-making algorisms. And I plans to develop PopModel 1.0 COMPLETE including those two systems as a specific simulator for each organism model and/or combined organism models.

[A3-033]

REMOVAL OF SCATTERED RADIATION IN CANOPY GAP FRACTION MEASUREMENTS FROM LAI-2200 PLANT CANOPY ANALYZER

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Gap fraction measurements from optical sensors such as LAI-2200 Plant Canopy Analyzer are contaminated by radiation that is scattered by plant elements and ground surfaces. We propose a simple one-dimensional, invertible, bidirectional transmission model to remove scattering effects from gap fraction measurements. The newly developed model considers single scattering effect of the beam and diffuse lights on leaves and soil background. Specular reflectance on leaf surface is also considered. The simple model showed that (1) the scattering factor is highest when the leaf area index (LAI) is low (1–2 m^2 m^{-2}) in a non-clumped canopy, (2) potential errors in estimating the LAI increase with an increase in LAI, and bright land surfaces (e.g., snow and bright soil) and (3) bright stems (e.g., birch) can contribute significantly to scattering effects. By applying the simple model with LAI-2200 data collected in an oak-grass savanna ecosystem, we found that the scattering factor causes significant underestimation of the LAI (up to 26% for sunny conditions, 7.7% for diffuse sky conditions) and significant overestimation of the apparent clumping index (up to 14% for sunny conditions, 4.3% for diffuse sky conditions). The proposed inversion scheme provides an opportunity to quantify gap fractions, LAI, and apparent clumping index even under sunny conditions.

[A3-034]

ASSESSING THE SPATIAL REPRESENTATIVENESS OF EDDY COVARIANCE FLUX OBSERVATION STATIONS OF TERRESTRIAL ECOSYSTEMS IN CHINA

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Eddy covariance (EC) technique is the most direct way to measure the exchanges of carbon dioxide (CO_2), water vapor, and energy flux between terrestrial ecosystems and atmosphere, which can be used to explore CO_2 exchanges between terrestrial ecosystems and atmosphere and its controlling mechanism. We used the multivariate geographic clustering approach to generate flux-ecoregions with different clustering number (25, 50, 75, 85, 100, 150, 200 clusters) in China based on 11 variables affecting carbon flux, including meteorological factor, soil factor, a biotic factor of topography, actual vegetation (Leaf area index (LAI) and Enhanced vegetation index (EVI)) and vegetation productivity variables (Gross primary productivity, GPP). Based on the spatial distribution pattern of the existing flux observation station in China and the comparative analysis between newly generated flux ecoregions and the existing geographical regionalization, the results showed that the existing 85 eddy covariance flux observation stations in China cannot reflect the spatial and temporal characteristics of carbon flux of all ecosystems because of the country's complex topography and the diverse ecosystem types. It is also recommended that the number of the flux-ecoregions be 100-150. Considering the building and operating costs of the flux towers, the number of eddy flux tower stations can be added to 150 sites. Thus, the optimized flux network is supposed to represent major ecosystems and facilitate the integration of flux and remote sensing data, consequently, improve the accuracy of upscaling CO_2 and water vapor flux observations from tower to regional scales to better exam the simulation result of the process based ecosystem model.

[A3-035]

UNCERTAINTY ANALYSIS OF MODELED CARBON AND WATER FLUXES IN A SUBTROPICAL CONIFEROUS PLANTATION

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Estimating the carbon and water fluxes between forest ecosystems and the atmosphere requires process-based ecosystem models, which inevitably suffer from uncertainties. It is critical to examine the uncertainties associated with these models; however, few studies have performed uncertainty analysis to systematically quantify the uncertainties of model predictions. This paper proposed a methodological framework for uncertainty analysis of forest ecosystem models, and applied it in Qianyanzhou (QYZ) subtropical coniferous plantation based on the simplified photosynthesis evapotranspiration (SIPNET) model. We selected 20 key parameters from 42 parameters of SIPNET model using one-at-a-time (OAT) sensitivity analysis method, and then estimated their uncertainty distributions using Markov Chain Monte Carlo (MCMC) technique. Based on that, the uncertainties of output variables were quantified and partitioned through the application of Monte Carlo and Sobol' method. The uncertainties of predicted net ecosystem exchange (NEE), gross photosynthesis (GPP), ecosystem respiration (RE), evapotranspiration (ET) and transpiration (T) were 61%, 20.6%, 12.7%, 14.2% and 19.9% respectively. Maximum net CO2 assimilation rate (Amax) and carbon content of leaves (SLW), contributed more than two thirds of the uncertainties of NEE, GPP, ET and T, and almost one third of the uncertainty of RE. They are the only two parameters classified as highly sensitive for all output variables of interest, which should be focused on in the further efforts to reduce uncertainty. The results indicated a direction for future model development and data collection. Although there were still limitations in the uncertainty analysis framework illustrated in this paper, it did provide a paradigm for systematic quantification of ecosystem model uncertainty.

[A3-036]

INCORPORATION OF TOPOGRAPHIC EFFECTS ON MODIS-DERIVED SOLAR RADIATION MODEL

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Solar radiation is the main source of energy for the Earth and important variable for hydrological, ecological, and climatological modeling. Many of the model estimate terrestrial solar radiation assuming with flat surface condition. However, incoming solar radiation on the identical surface has biases and local gradients comparing with it on real surfaces. These local gradients of solar radiation have corresponding influences on land-surface energy balance, ecosystem structural and functional properties. From this perspective, the topographic effects are important to estimate realistic terrestrial solar radiation. In this study, we have two purposes. Firstly, we incorporate the effects of topography on beam, diffuse and reflected radiation components with input of Breathing Earth System Simulator (BESS) in the Korean Peninsula. Before then, we evaluate flat surface radiation with Automatic Weather Station (AWS). The parameters for the adjustments are calculated by using Global Multi-resolution Terrain Elevation Data 2010. Secondly, we extrapolate daily solar radiation from instantaneous solar radiation by using the ratio between solar radiation on inclined surfaces and extraterrestrial solar radiation. After then, we compare the horizontal surface radiation and tilted surface radiation. Also, we estimate the impact of topographic effects on gross primary productivity (GPP) and Evapotranspiration (ET) in the Korean peninsula.

[A3-037]

CONTINUOUS MEASUREMENTS OF METHANE FLUX AT A LARCH FOREST BY MICROMETEOROLOGICAL AND CHAMBER TECHNIQUES

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Micrometeorological measurements of methane (CH_4) flux at forest ecosystems are challenging, even if state of the art laser-based analyzers can be applicable. Currently, the detection limit of analyzers causes the major limitation to apply the eddy covariance (EC) method for measuring small fluxes at forests. Here, we overcome this difficulty by combining a laser-based analyzer with the hyperbolic relaxed eddy accumulation (HREA) method. Measured canopy-scale CH_4 fluxes were compared with those by the dynamic closed chamber system to clarify the important environmental drivers of the fluxes.

The measurements were conducted at a larch forests in the northern foothill of Mt. Fuji, Japan. The HREA system with a 5-height profiler was installed at August, 2011 (*Ueyama et al*., in press), and the dynamic closed chamber system was installed at October, 2012. Laser-based $CH_4/CO_2/H_2O$ analyzers (GGA-24r-EP and FGGA-24r-EP, Los Gatos Research Inc., USA) were combined with each system. Based on the daily calibration, sensitivity of both analyzers did not change during the study period. The HREA system was validated by simultaneous measurements of CO_2 fluxes by the HREA and EC methods.

The CH_4 fluxes by the both methods showed that the forest acted as a CH_4 sink during the vegetation growing season (Fig. 1). Based on monthly mean diurnal variations, the magnitude of the sink by the HREA method tended to be greater in daytime than nighttime; the daytime uptake of the growing season was from 2 to 8 nmol m^{-2} s^{-1}. This was close to the detection limit of our HREA method, 2.93 nmol m^{-2} s^{-1}. Even though this precision was better than those previously reported by EC studies, individual half hourly fluxes had considerable uncertainties.

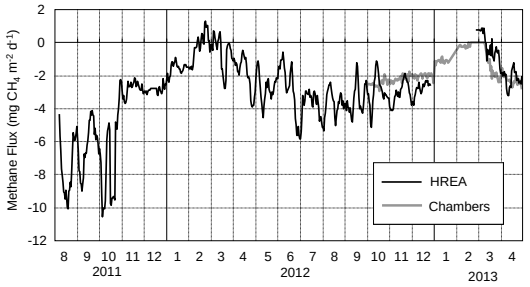

Fig 1. Seasonal variation of CH_4 flux.

Based on the profile measurement, the observed sink by the HREA method mostly occurred at the forest soil. This was consistent with the chamber measurement. The CH_4 fluxes showed a clear seasonal variation (Fig. 1), where the magnitude of the sink was greater in the growing season from May to November than the other winter months. Both the HREA and chamber measurements showed that the magnitude of the sink was almost negligible in the winter period, suggesting that low temperatures restricted the activities of CH_4 oxidation. On the other hand, soil temperatures did not explain the variations in the CH_4 fluxes during the growing season, but the magnitude of the sink tended to be smaller in higher soil water content, suggesting that change of soil porosity associated with soil water content could be an important driver of the CH_4 fluxes during the growing season. Annual CH_4 sink by the HREA method was 673 ± 231 mg CH_4 m^{-2} yr^{-1}, which was middle range of previous studies at Japanese forest soil: 34 to 2049 mg CH_4 m^{-2} yr^{-1} with average of 767 mg CH_4 m^{-2} yr^{-1} (*Morishita* et al., 2007).

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[A3-038]

THE AMERIFLUX MANAGEMENT PROGRAM AND TECHNICAL QA/QC FOR THE AMERIFLUX NETWORK.

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AmeriFlux's goal is to develop a network of long-term CO2 flux sites for quantifying and understanding the role of the terrestrial biosphere in global climate change. The AmeriFlux Management Program based at the Lawrence Berkeley National Lab includes a technical QA/QC team which conducts a number of activities to strengthen the network. The technical team serves as a resource to the community by providing standardized protocols, establishing data quality goals, and resolving instrument outages/issues. Additionally, the group conducts site comparisons using a portable eddy covariance system, provides calibrated gas standards, and maintains reference sensors. The technical team actively builds and strengthens relationships with vendors and investigators. Future collaborations with other flux networks (e.g., ICOS, AsiaFlux) are planned to strengthen the global network of flux observations.

[A4-039]

DEVELOPMENT OF GREENHOUSE GAS TRACKING SYSTEM IN EAST ASIA

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Carbon tracking system is a synthetic tool to keep track of carbon uptake and release at the Earth surface by combining data assimilation system, in-situ observation, and atmospheric model. Because of its ability to monitor and to diagnose natural and anthropogenic sources and sinks of greenhouse gases, it enables us to better understand the carbon cycle and its interaction with the climate system. These systems also support decision making aimed at limiting anthropogenic emission of greenhouse gases for sustainable societies. In terms of the carbon cycle and its feedback to the climate system, terrestrial ecosystems play an important role both as sources and sinks through photosynthesis and respiration and the terrestrial ecosystem model is one of the main modules in the carbon tracking system. Therefore, better representation of the terrestrial ecosystem can reduce uncertainties of the carbon tracking system. In this presentation, we briefly introduce our current steps forwards developing the carbon tracking system and discuss model properties in East Asian region.

[A4-040]

APPLICATION OF CARBON TRACKING SYSTEM BASED ON ENSEMBLE KALMAN FILTER FOR CARBON FLUX ANALYSIS IN ASIA

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Estimation of surface carbon fluxes is important to understand the mechanism of surface carbon source and sink. In Asia, a lot of anthropogenic CO2 emissions are occurred from large industrial areas. There are also large uptake regions such as forests in boreal and temperate regions. However, inverse modeling studies focusing on Asia using state-of-the-art data assimilation systems are relatively rare. In this study, to investigate the capability of CarbonTracker developed by NOAA as an analysis tool for estimating surface carbon fluxes in Asia, experiments with two nesting domains are performed and compared. The CarbonTracker is an inverse modeling system that estimates surface carbon fluxes using an ensemble Kalman filter with atmospheric CO2 measurements as a constraint. One experiment has a nesting domain centered in Asia (ASI experiment), and the other in North America (NAM experiment). Both experiments are conducted from January 2000 to December 2006. In general, the results show that setting a nesting domain centered in Asia region enables detailed estimations of surface carbon fluxes in Asia. The annual averages and seasonal patterns of optimized biosphere fluxes of two experiments are similar, but the magnitude of optimized biosphere fluxes of two experiments is different. The magnitude of seasonal averaged optimized biosphere flux of ASI experiment is larger than that of NAM experiment. Weekly aggregated optimized fluxes over the Asia nesting domain in ASI experiment show more diverse patterns than that in NAM experiment, which implies that more detailed analysis of optimized surface carbon flux is available over Asia in ASI experiment. Compared with observations, the proper prior ensemble spreads are simulated in both experiments. Model CO2 concentration calculated by the optimized flux of ASI experiment is more consistent with observed CO2 concentrations in Asia. Finally, calculated background atmospheric CO2 concentration in Asia is more consistent with observed CO2 concentration in ASI experiment than that in NAM experiment.

[A4-041]

CONTINENTAL SOURCES AND SINKS INTENSIFY THE STEEP SEASONAL AND LATITUDINAL GRADIENT OF ATMOSPHERIC CARBON DIOXIDE OVER EAST ASIA

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Here we demonstrate a sharp contrast to the seasonal and latitudinal gradient of atmospheric CO_2 over East Asia, where there are relatively few ground-based observations. The Greenhouse gases Observing SATellite (GOSAT) column-averaged dry air CO_2 mole fraction (xCO_2) retrieved by NASA's Atmospheric CO_2 Observations from Space (ACOS) (2009-2011) program and GEOS-Chem nested-grid CO_2 results are used. The strong anthropogenic emissions mainly from China and intensive vegetation uptake from northeastern Asia lead to a clear seasonal change of the xCO_2 between spring maximum and summer minimum (>10 ppm). In particular, the steep latitudinal gradient of summer time CO_2 (-0.5 ppm/degree) in the vicinity of the Korean Peninsula (32°N-44°N) is likely attributed to the large difference in CO_2 exchanges between northeastern forest and the northwest Pacific region. This study represents the current progress to understand sub-continental scale atmospheric CO_2 variabilities with recent satellite retrievals and nested-grid modeling.

[A4-042]

LAND COVER COMPOSITION AROUND ASIAFLUX SITES AND CARBONTRACKER-ASIA NET CO_2 FLUX EVALUATION

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This study briefly explores how land cover (LC) types are distributed near 88 AsiaFlux sites using the 500-m resolution Moderate Resolution Imaging Spectroradiometer (MODIS) land-cover dataset. Relative percentages of LC types in 1^o x 1^o grid cells, whose center has a flux site, were computed. Based on the relative percentage information, LC richness and equitability were estimated for every grid cells containing each AsiaFlux site. Representativeness of each site LC is also our interest and it was checked by inspecting a LC agreement between each site and the surrounding 1^o x 1^o area. We computed LC composition for 1^o x 1^o latitude-longitude grid cell containing an AsiaFlux site and compared it with that having the site at its center.

As for LC richness, we found that 51% of the AsiaFlux sites had all types of LC around it, and 88% of them had more than 16 LC types. The AsiaFlux network has the average LC equitability of 14.5%, and the maximum and the minimum equitability sites are the Lien-Hua-Chih Hydrometeorological Study Site (LHC, 33.9%) and King Sejong Station Site (STK, 5.3%), respectively. We found that a total of 22 sites (25%) have the same LC as the 1^o x 1^o surrounding environment. We showed that the two kinds of LC composition methods were practically same as each other, except for a LC class “Snow and Ice”. These findings can be useful for planning a new flux tower installment and for selecting the most proper AsiaFlux site to evaluate grid-based biogeochemical models. Some of the AsiaFlux sites were applied to evaluate the CarbonTracker-Asia net CO2 flux, and the pros and cons of such evaluation will be mentioned together with upscaling and downscaling issues.

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[A4-043]

MODEL-DATA SYNTHESIS OF TERRESTRIAL CARBON CYCLES TO QUANTIFY CARBON BUDGET IN ASIA

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Asia, which is characterized by monsoon climate and intense human activities, is one of the prominent understudied regions in terms of terrestrial carbon budgets and mechanisms of carbon exchange. To better understand terrestrial carbon cycle in Asia, we analyzed outputs from various approaches: satellite-based observations (AVHRR and MODIS), empirically upscaled estimations (Support Vector Regression), terrestrial biosphere models (e.g. Biome-BGC, BEAMS, BEPS, SEIB-DGVM, VISIT models), and atmospheric inversion analysis (e.g. TransCom, CarbonTracker-Asia). We focused on the two difference temporal coverage: long-term (30 years; 1982-2011) and decadal (10 years; 2001-2010; data intensive period) scales. The regions of covering Siberia, Far East Asia, East Asia, Southeast Asia and South Asia (60-80E, 10S-80N), was analyzed in this study for assessing the magnitudes, interannual variability, and key driving factors of carbon cycles.

In this presentation, we will report the progress of synthesis effort to quantify terrestrial carbon budget in Asia. The results include estimation of terrestrial carbon budget in Asia, analysis of key mechanisms of terrestrial carbon budget using ecosystem models, identifying anomalies in carbon budget due to meteorological anomalies. In addition, further efforts to reduce uncertainties in estimating carbon budget in Asia will be discussed in the presentation.

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[H3-044]

RESPONSES OF REGIONAL CLIMATES TO AGRICULTURAL IRRIGATION IN CALIFORNIA

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Characterizing climatological and hydrological responses to agricultural irrigation continues to be an important challenge to understanding the full impact of water management on the Earth's environment and hydrological cycle. Previous simulation studies have used either regional models with prescribed lateral boundary conditions, which are unable to provide insight into the remote impacts of irrigation from individual, large aquifers; or global models, to simulate the effect of global-scale irrigated land simultaneously, masking the contributions of individual aquifers to regional and global climate change. Similarly, observational studies are limited in their ability to provide important mechanistic understanding. In this study we use a global climate model, combined with realistic estimates of regional agricultural water use, to simulate the local and remote impacts of irrigation in California's Central Valley. We find that the resulting increase in evapotranspiration and water vapor export significantly impact the atmospheric circulation in the southwestern U. S. monsoon region, including strengthening the regional hydrological cycle and the changes in stratocumulus cloud over near the California coast. This in fact causes asymmetric responses of the regional climate to California’s Central Valley irrigation.

[H3-045]

SMALLEST EURASIAN SNOW-COVER EXTENT IN MAY 2012 AND ITS IMPACT ON BLOCKING AND DROUGHT OVER EAST ASIA

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Snow-cover extent over Northern Hemisphere lands retreated rapidly in May and June, leaving the Arctic Ocean coastline nearly snow-free. June 2012 set a record low for snow-cover extent (for a 45-year period of record spanning 1967-2012) by a significant margin. Snow-cover extent for June 2012 was more than 1 million square kilometers below the previous record set in 2010. May 2012 had third lowest snow extent for the period of record. This rapid and early retreat of snow-cover exposed large, darker underlying surfaces to the sun early in the season, fostering higher air temperatures and warmer surface.

Given the tremendous decrease of snow-cover extent over Eurasian continent, we investigated the impact of the large reduction of snow-cover on the atmospheric circulation using Global/Regional Integrated Model system (GRIMs). Using different combination of model surface boundary conditions such as sea-ice, sea surface temperature (SST), and snow-cover, relative contribution of snow-cover on the atmospheric circulation was examined.

Even though each component of boundary condition played a significant role for the surface air-temperature over Eurasian continent in spring 2012, the regional droughts occurred over western Russia and East Asia were properly simulated only if we prescribed the realistic snow-cover boundary condition for the model. Darker surface directly exposed to sunlight absorbed sufficient energy to increase lower surface-temperature. Moreover, the expanded air-column due to the surface warming helped to form upper-level high-pressure locally, which constitutes a regional blocking signature (anti-cyclonic vortex that remains at the same place more than a week). Model results with proper snow boundary condition also showed the wave energy propagation downstream from the blocking High region reproducing the observed Eurasian surface air-temperature pattern.

[H3-046]

GLACIER MASS CHANGES FROM GRACE SATTELITE AND NUMERICAL MODELS

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Mountain glaciers play an important role for fresh water resources as well as global mean sea level rise because they may be melting rapidly under present climatic conditions. However, the mass changes of mountain glaciers are still poorly known. Previous studies based on observations[1] and model simulations[2] tried to estimate glacier mass changes, but the range of uncertainty is large and it comes from insufficient measurement of glacier mass balance and climatic forcing data.

Here we estimate the glacier mass changes using changes in Earth's gravity field observed from space by the Gravity Recovery and Climate Experiments (GRACE). Using GRACE satellite, some previous studies tried to detect the glacier mass changes independent from the field measurements and models. We used three types of datasets, CSR (The University of Texas Center of Space Research), GFZ (Deutsches GeoGorschungs Zentrum) and JPL (Jet Propulsion Laboratory in California Institute of Technology) from 2004 to 2010.

Since GRACE detects the sum of all terrestrial water storage (TWS) components changes from gravity change, we firstly excluded other components using a retrospective simulation of a land surface model (Minimal Advanced Treatments of Surface Interaction and Runoff: MATSIRO[3]) coupled with a global river routing model (CaMa-Flood, Yamazaki et al., 2011) driven with observation-based atmospheric forcing. The sum of simulated soil moisture, snow mass and river storage (called TWS from MATSIRO in this paper) does not include the effect of glacier mass changes or artificial water withdrawal. Therefore, we estimate the glacier mass changes from the difference between TWS from GRACE and TWS from MATSIRO. Before comparison, we applied the filters to the output data of MATSIRO to make it comparable with GRACE data, because the filters are applied to GRACE data to reduce the errors.

We estimated -110Gt/year glacier melting from 2004 to 2010 in the world. The glacier areas are selected from Randolph Glacier Inventory (RGI, http://www.glims.org/RGI/randolph.html). This value is similar to the result -127Gt/year from the global glacier model (HYOGA2)[2], but the different values in some areas compensate each other. Dyurgerov and Meiyer also estimated the glacier mass changes[1] -211Gt/year from extrapolation of limited field measurements. Although their time series does not coincide with this study, their estimate seems large compared to our results and this may be because their results mainly represent small fraction of glaciers. This paper shows new results of glacier mass changes and therefore we believe that this information will be helpful to understand the glacier mass changes.

Acknowledgment
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[H3-047]

HOW ECOSYSTEM-LEVEL WATER USE EFFICIENCY AND ITS COMPONENTS IN RESPONSE TO SEASONAL DROUGHT

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Water and carbon fluxes and, as a consequence, productivity of terrestrial ecosystems are strongly influenced by drought. As the water and carbon fluxes are strongly linked by their passage through the stomata, water use efficiency (WUE), the ratio of CO_2 assimilation to water losses, has been identified as an effective integral trait for assessing ecosystem response to drought. However, differences in water-sensitivity of component process make water use efficiency predictions challenging. To examine responses of WUE and its components to water limitations and higher temperature, a study of ecosystem-level processes including gross primary production (GPP) and evaportranspiration (ET) in a sub-tropical evergreen coniferous plantation during 2003~2008 was conducted through use of long-term eddy covariance datasets. A process-based ecosystem model was applied in this study to quantify the degree of temperature and soil water availability effects on GPP. Our results showed that during the active growing season (June to August), GPP and ET would not decrease remarkably and successively unless extreme drought was occurred (mean soil relative extractable water (REW) <0.4). Low precipitation at the peak of the growing season, as in the summer of 2003 and 2007, decreased carbon fixation. Differences in the temperature-sensitivity of component processes make water use efficiency showing variety. Process of water consumption (ET) responsive to high temperature and drought lags process of carbon fixation (GPP). Simulations allowed us to isolate the individual contributions of drivers' (canopy temperature and canopy water potential) influences on leaf photosynthesis variance for hourly timescales. Model results suggest that, it is the influences of canopy temperature and canopy water potential that induce the decrease of GPP when extreme seasonal drought occurred. The effect of canopy temperature on leaf photosynthesis almost happened in the afternoon (e.g. 2003 and 2007) with the decrease percentage from 20 to 40. The effect of canopy water potential on leaf photosynthesis in 2003 is aggressive than that in 2007. Canopy water potential depressed the leaf photosynthesis by 40%-60% and 20%-30% at noon time in 2003 and 2007, respectively.

[H3-048]

DEVELOPMENT OF INTEGRATED WATER RESOURCES MODEL TO ESTIMATE ANTHROPOGENIC IMPACTS ON TERRESTRIAL WATER CYCLE

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In recent years, rapid growths of the world population and economy have increased anthropogenic impacts on global water cycles. The aim of this study is to develop an integrated water resources model to estimate anthropogenic impacts on terrestrial water cycle. The authors have developed water resources model, which comprises a hydrological land surface, river routing, irrigation, and reservoir operation models. A land surface model (Simple biosphere model including urban canopy [1]) calculates the hydrological land surface and irrigation processes. River routing model uses kinematic equations to calculate river discharge with intakes and drainages in channels. The reservoir operation model [2] has been integrated into river routing process. Terrestrial impacts of irrigations and reservoir operations have been estimated using the model in this study. The authors have performed terrestrial water cycle simulation from 1994 through 2003 using reanalyzed meteorological forcing and land surface parameters.

Irrigation maintains water levels in paddy fields and soil moisture on croplands within the appropriate ranges for each crop defined by crop calendars. The crop calendars, which are used in hydrological land surface analysis, have been generated by phonological analysis of normalized difference vegetation index (NDVI). Our crop calendars generated for six crops (rice, spring wheat, winter wheat, maize, cotton, and soybean) agree well with crop calendars commonly used in many countries. To estimate vapor supply from irrigated croplands, the authors have performed global land surface simulations with and without irrigation using the crop calendars. The vapor supply from the land surface has been also estimated by the atmospheric water balance method using reanalyzed climate conditions. The estimated vapor supply differs by 40% between estimation with and without irrigations on large scale irrigation fields. The vapor supply estimated with irrigation agrees well with estimated vapor supply from atmospheric water balance on irrigated fields in north China and United States, suggesting that land surface models including irrigation reproduce vapor supply better than with the models including no irrigation. Our study demonstrates that atmospheric conditions in global and regional climate models can be improved by adding irrigation process into their land surface modeling.

Reservoirs regulate river discharge in order to satisfy water demands in downstream, to prevent floods and inundations, and to generate electric powers. A global river channel networks have been scaled up from 1 km resolution flow direction map to the model mesh size of 20 km resolution, which agree well with statistical catchment areas. Large reservoirs, whose locations are obtained from a global database [3], have been allocated on the global river channel networks. To estimated impacts of reservoir operations, the authors have performed global river discharge simulations with and without reservoirs and irrigations. The simulation with reservoir operation model agrees recorded river discharge better in many stations than the model without the operations. Reservoir operations reduce peak river discharge and increase low river discharge. Reservoir operations have a strong impact on river discharge compared to intakes for irrigated croplands.

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[K2-049]

DEVELOPMENT OF FORECASTING MODEL FOR SYMPTOM INDEX OF POLLEN ALLERGIC PATIENTS

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The increasing number of allergenic pollens as well as degrading air quality cause allergic diseases patients, who have bronchial asthma allergic conjunctivitis, and allergic rhinitis, have severer symptoms. How the effect of allergenic pollens on health will be changed by climate change? It can be modeled by identifying the roles played by the greenhouse gas increase and the mean air temperature rise in relation to the amount of pollens and their allergenicity. The number of daily pollens were observed in cooperation with the Korean Academy of Pediatric Allergy and Respiratory Disease. The pollens are being observed in 6 regions (Seoul, Busan, Daegu, Gwangju, Gangneung, and Jeju) using the Burkard pollen collectors, since 1997 to yield daily forecasting models. The Korea Meteological Administration operates a web-based pollen allergy forecast based on the models and daily weather conditions. The pollen observation network has been expanded to 12 sites.

In this study, we analyzed the correlation between pollen concentration and symptom index of allergic patients, and developed forecast models for the daily allergenic symptom index based on the pollen concentration. Data from 2009 to 2011 were used in model development, and data in 2012 were used for evaluation. Correlation analysis was performed on the 7-day moving average of the observed pollens with a time delay of up to 7 days. Regression models were developed at the 0.15 significance level. As a result from the regression analysis, the 7-day average of weeds pollens without the time delay was the most significant on the daily symptom index whereas that of tree pollens with two days of time delay was the most significant. In 2012, the weeds and trees pollens decreased by 50% and 70%, respectively, whereas the levels of symptom index did not change that much. Despite the timing of the increase in the number of pollens corresponded to that in symptom index, the model underestimates the symptom index level due to the other factors such as weather conditions and spatial difference between the location of out patients and the pollen collection sites.

In conclusion, the forecasting models for daily symptom index followed the daily trend of pollen concentration with some degree of attenuation. It is needed to add more explanatory variables such as plant phenology and vegetation area in the models for further improvement.

[K2-050]

CATTLE SHED ENERGY SIMULATION USING THE ENERGYPLUS MODEL

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Cattle operations are an important part of nation's cattle industry. Stock cattle producers can have benefits from the results of animal science and agronomic research.

Animal productivity is strongly affected by climate change. The main drivers of agricultural responses to climate change are biophysical effects and socio-economic factors. Cattle production is affected biophysically by meteorological variables, including rising temperatures, changing precipitation regimes, and increased atmospheric carbon dioxide levels. Biophysical effects of climate change on livestock industries and agricultural production can be positive in some systems and regions, and negative in others, and these effects will vary through time.

Researchers have developed several models to aid in analyzing cattle environment. Energy consumption analysis of buildings is a difficult task because it requires considerable detailed interactions among the building, HVAC system, and surroundings (weather) as well as obtaining mathematical/physical models that are effective in characterizing each of those items.

This research has simulated the EnergyPlus model for the thermal environments of cattle inside a barn, it also considered cattle shape and climate conditions, including temperature, wind speed, and precipitation. It can be used to simulate the energy consumption variations in the cattle, which are important in milk production as well as in the accuracy of the inside temperature.

The object of this study was to simulate the building energy environment and predict energy consumption for the cattle shed at a high spatial and temporal resolution. The results of the method are aggregated and compared to available AWS observation data.

[K2-051]

REDEVELOPMENT OF THE DSSAT MODEL USING C++ FOR FACILITATION OF OPEN SOURCE SOFTWARE DEVELOPMENT

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Crop growth models have been developed to simulate biophysical processes for a variety of crops. The open source model, which allows many people to collaborate on the development of a piece of software, would have advantages for development and maintenance of crop models. However, crop models written in Fortran tend to have inconsistency between simulation results under different computing environments, which would limit application of the open source model. In this study, the CERES (Crop Estimation through Resource and Environment Synthesis)-rice model in the Decision Support System for Agrotechnology Transfer (DSSAT) model was redeveloped using C++ to improve the file input and output process and to examine if the problem associated with compatibility between computing environments can be avoided. It was found that the crop models written in C++ had better cross-compiler compatibility than the model written in Fortran. This suggested that the crop model written in C++ would facilitate open-source software development for the DSSAT model.

Keywords Crop growth model, open source, cross-compiler

[K2-052]

ESTIMATION OF THE POTENTIAL EPIDEMICS OF RICE LEAF BLAST AND SHEATH BLIGHT UNDER THE RCP8.5 CLIMATE CONDITION IN KOREA

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Rice diseases, which pose annually about 8 % of potential yield losses on Korean rice production, are likely to be affected by temperature and rainfall changes resulting from global climate change. No critical evaluation has yet been made of the impacts of climate change on rice diseases in Korea. This study undertakes a quantitative analysis for two key rice diseases, leaf blast and sheath blight, using a generic epidemiological model, EPIRICE that was developed at the International Rice Research Institute and had been used for tropical Asian region's five rice disease epidemics modeling. The purposes of this study are first to evaluate the EPIRICE model using historical rice disease incidence data, and then to ascertain likely changes in regional disease probabilities (epidemics) in South Korea under a climate change scenario. Predicted changes in temperature, rainfall, and relative humidity in the Korean peninsula for the years of 2011-2100 were previously reported by the Korea Meteorological Administration, based on the IPCC's a high emissions scenario (RCP 8.5). Downscaled daily climate data via PRIDE (PRIsm-based Downscaling Estimation model) technique will be used as inputs into the EPIRICE model for rice leaf blast and sheath blight. Outputs from the model run can be used to estimate the likely magnitude of climate change impacts on disease losses and disease control in South Korea to allow rice farmers and agricultural policy makers to carry out more robust future planning.

[K2-053]

ASSESSMENT OF RICE YIELD CHANGE WITH CMIP5 PROJECTIONS

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Rising temperature and extreme changes in rainfall pattern under climate change scenarios have a direct influence on the crop production system. At first, it is expected that crop productivity generally increases because the suitable rise in temperature as well as the increase of the atmospheric carbon dioxide concentration accelerate the growth of most crops. However, because there are many drylands and non-irrigated fields, in spite of a rise in temperature of less than two degree Celsius, reduction of crop productivity is predicted in the subtropical zone area.

Rice, one of three major cereals together with wheat and maize, is produced over 90% in Asia and most of the rice production is consumed in Asia as well. In order to solve the potential food shortage caused by climate change and rapid population growth, the effort for the stable food supply is needed in the future Asia regions. In this study, the RCP scenario-based CMIP5 climate projections were used to predict the change of global rice yield. The Global Agro-ecological Zones model (GAEZ) developed by FAO and IIASA was used to predict the potential rice yield in world major rice producers. The M-GAEZ model has been modified to consider a CO2 fertilization effect resulting from an increase of the atmospheric CO2 concentration under the climate change scenarios, and adaptation measures such as the selection of the optimum planting date and the best varieties of rice.

As a result of analyzing the rice yield change, when we do not consider the adaptation measures, decreasing yield was predicted toward the end of this century under the RCP8.5 scenario (Fig.1). In the case of China occupying approximately 28% of the world's rice production, the potential rice yield is predicted to decrease approximately 18% in the 2020s, 23% in the 2050s and 32% in the 2080s. In the 2080s, the range of uncertainty in the predictions is larger than other simulated periods. In particular, in the case of Brazil, potential rice yield was predicted a 3% increase in the MRI-CGCM3 model but a 93% decrease in the CanESM2 model. Fig.2 shows the mean rate of rice yield change in world major producers in the different GCM climate projections. There was a large uncertainty range in the predicted results under the RCP8.5 scenario in the 2080s, with a 8.2% decrease in yield in the GFDL-CM3 projection and a 42.7% decrease in the HadGEM2-ES projection. It was also found that the uncertainty range of the rate of rice yield change becomes larger as time goes by.

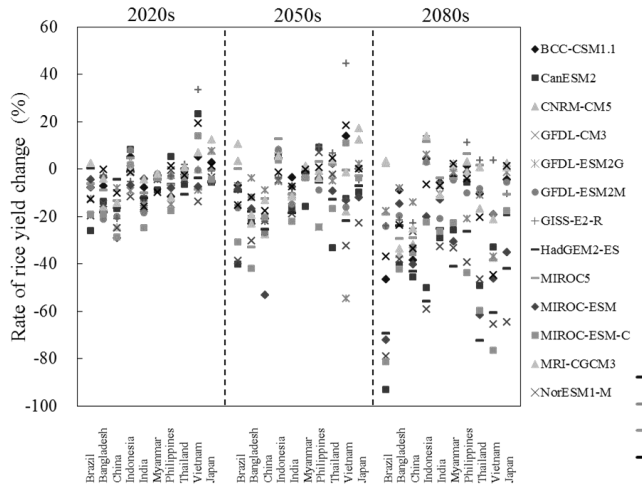

Fig. 1 The future changes of the rate of rice yield in the world's major rice producer under RCP8.5

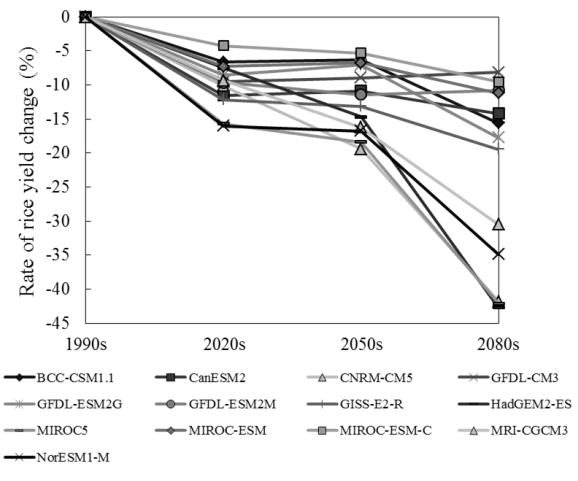

Fig. 2 The mean changes of the rate of rice yield for the major producer with 13 GCMs

[A3-054]

THERMODYNAMIC ENTROPY BUDGET OF EAST ASIAN FOREST ECOSYSTEMS AT VARIOUS STAGES OF ADAPTIVE CYCLES

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Energy and matter exchanges between biosphere and atmosphere have been measured by eddy covariance technique for several decades. Using these data, entropy budget can also be quantified, and yet reports on ecosystem entropy budget rarely exist. Here, using the CarboEastAsia database, we report the multi-year energy and entropy budgets in the East Asian forests ecosystems at various stages of adaptive cycles (i.e., growth, conservation, release, and re-organization/renewal stages in adaptive cycle). Through the conventional analysis of surface energy budget, it is difficult to find a relationship between the interannual variations of surface energy partitioning and system stages. On the contrary, the analysis of thermodynamic entropy budget show that the system entropy of forest ecosystems in growth stage (release stage) kept decreasing (increasing) and its time rate of change was accelerated every year with increasing (decreasing) low entropic energy (i.e., absorbed solar radiation) dissipation by latent heat flux and decreasing (increasing) low entropic energy dissipation by emitted longwave radiation. Meanwhile, the time rate of change in system entropy of forest ecosystems in conservation and re-organization/renewal stages fluctuated with the environmental changes as well as the intensity of disturbances. These findings have important implications for better understanding of ecosystem trajectory and sustainable ecosystem management.

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[A3-055]

INFORMATION CLOSURE APPLIED TO EXPLAIN ENERGY BALANCE RESIDUALS OF AN EDDY-COVARIANCE FLUX TOWER'S OBSERVATIONS

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Scientific observations of the Earth System are imperfect, but are necessary for the scientific community to test hypotheses and develop better models of the system. Some eddy-covariance flux towers provide earth scientists with the rare luxury of directly observing all major components of the energy fluxes in and out of the Earth's surface. However, these observed energy fluxes rarely sum to zero as they should in a deterministic system, so an error residual remains in the observations. This residual has been the subject of numerous studies aimed at understanding and correcting the errors. Presented here is a newly developed approach utilizing information-theoretic statistics to infer the component sources and relative magnitudes of the energy balance residual for different timescales of system dynamics. The dynamics and variability of the system can be used to infer sources of dynamical control and persistence of error in this deterministic system. Applications possibly include a new type of correction that can be applied to flux tower observations.

[A3-056]

VARIABILITY OF FLUXES AT DIFFERENT TEMPORAL SCALES IN A COMPLEX HILLY TERRAIN

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The redistribution of energy across the Earth's surface is accomplished primarily through three processes: sensible heat flux, latent heat flux, and surface heat flux. For understanding these process and their variability in a variety of atmospheric conditions, a 50 m instrumented tower has been erected at Gadanki (13.5 N, 79.2 E), a station located in a complex terrain. The instrumented tower has both slow sensor and fast sensors with a sampling frequency of 1 Hz and 20 Hz, respectively. There are several error sources than can hamper the estimation of fluxes. The data cleaning, therefore, becomes an important step for flux estimations. The primary objective of this study is to understand the variability of fluxes at different temporal scales in a complex hilly terrain. The scale of variation under study includes diurnal to seasonal and to intraseasonal. Further, it is known that the rainfall during the summer monsoon season do not occur as a continuous deluge, rather occurs in quasi periodic spells (called wet spells). In between these spells, the weather is mostly dry with occasional occurrence of thunderstorms. Recent observations have shown that the convective available potential energy is surprisingly higher during the wet spell than dry spell. It is hypothesized that the differences in latent heat flux between wet and dry spells could be the reason for the anomalous behavior. To resolve the above issue, the data are segregated into wet and dry spells using rainfall data at Gadanki and also over southeast India. A total of 45 (83) wet (dry) days from 8 (13) wet (dry) spells are identified from two years (2010 and 2011) of measurements. The paper discusses the variation of CAPE from wet to dry spells in light of fluxes.

[A3-057]

SPATIAL COUPLING CORRELATIONS BETWEEN THE TERRESTRIAL ECOSYSTEM CARBON EXCHANGE FLUXES

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Carbon exchange between the terrestrial ecosystem and the atmosphere is one of the most important ecological processes in the global carbon cycle. While large spatial variation was observed in the carbon exchange fluxes, especially for the net ecosystem production (NEP). Factually, the three main carbon exchange fluxes (gross primary production (GPP), ecosystem respiration (RE), and net ecosystem production (NEP)) are closely correlated. Understanding the interaction between the three carbon exchange fluxes is helpful for accurately understanding their spatial variation and precisely evaluating global carbon balance. In this study, we analyzed the correlations between GPP, RE and NEP based on integrated published data from FLUXNET, ChinaFLUX, AsiaFlux network in order to provide knowledge and insights on the studies on the spatial pattern of global terrestrial ecosystem carbon exchange.

[A3-058]

APPLICATION OF PROCESS NETWORK ANALYSIS TO DELINEATE ECOHYDROLOGICAL AND BIOGEOCHEMICAL PROCESSES IN A RICE PADDAY IN SOUTH KOREA

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Rice paddy is an important echohydrological and biogeochemical system in Asia, which consists of a set of complex processes and structures exchanging energy, mater, and information. Following Ruddell and Kumar (2009), we have evaluated statistical measures of characterizing the organization of the information flows in process networks in a typical rice paddy in Gimje, Korea. We used the 30-minute averages of eddy fluxes of energy, water, CO_2 and CH_4 measured at 5m above ground from July to November in 2011 along with other micrometeorological variables. In this analysis, we selected 15 variables: atmospheric pressure (P_a), net ecosystem CO_2 exchange (*NEE*), gross primary productivity (*GPP*), ecosystem respiration (*RE*), sensible heat flux (*H*), latent heat flux (*LE*), air temperature (*T*), vapor pressure deficit (*VPD*), soil temperature (T_s), soil water contents (*SWC*), soil heat flux (*SHF*), solar radiation (R_g), precipitation (*Precip*), wind speed (*WS*), methane flux (Fch_4). Initially, we processed the data on a monthly basis to delineate the process network for each month but failed to identify individual subsystems, feedback loops, and the associated time lags. Then, we divided the time series data by five specific periods based on the growth stages and the management practices: (1) tillering (from 1 to 24 July, waterlogged, and LAI = 1.2), (2) heading (from 25 July to 18 August, drained, and LAI = 3.0), (3) grain-filling (from 26 August to 18 September, irrigation/drainage, and LAI = 4.6), (4) senescence (from 26 September to 15 October, drained, and LAI = 5.9), and (5) post-harvest (from 27 October to 10 November, barley planted, and LAI = 0). The results of the process network analysis based on these five periods improved significantly by demonstrating distinct subgrouping, feedback loops, the expected time lags, and the hierarchical aggregate of subsystems.

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[A4-059]

IMPACT OF CANOPY PHENOLOGY ON CARBON BUDGET IN A DECIDUOUS BROAD-LEAVED FOREST WITH UNDERSTORY EVERGREEN DWARF BAMBOO UNDER NEAR FUTURE CLIMATE CONDITION

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The growing period length of plants is one of the major interests in studying the current and future carbon cycles in terrestrial ecosystems, since it would directly affect the photosynthetic CO_2 uptake and respiratory CO_2 release in those ecosystems. In this study, we examined the possible effects of growing period length on forest canopy and understory vegetation ecosystem CO_2 budget under future climate conditions, by combining [1] canopy-phenology model based on in-situ canopy observation and its dependency on microclimate and [2] ecosystem carbon cycling model. First, by using daily canopy surface images and air temperature data at the Takayama deciduous broad-leaved forest site (TKY) from 2004 to 2009, we examined the dates of the beginning of leaf expansion, the beginning of autumn leaf color development, and the end of leaf-fall, and their relationships with air temperature. Second, we adapted these relationships between leaf phenology and air temperature to account for the seasonal variation of canopy leaf area index (LAI) under future climatic conditions by referring to the climate projection data based on A1B, A2 and B2 scenarios from CMIP3 Multi-Climate Models. Under the near future condition (2046 – 2065) as compared to the current condition (2002 – 2007), the beginning of leaf expansion and the end of leaf-fall were 10-13 days earlier and 7-9 days later. As a result, the potential growing period was predicted to be enhanced by 17-22 days. We also estimated the photosynthetic period of understory evergreen vegetation (i.e., from the end of snowmelt in spring to the beginning of snow cover in late autumn) under current and near future climate conditions using NCAR/LSM model. Under the near future condition (2046 – 2065) as compared to the current condition (2002 – 2007), the end of snowmelt in spring and beginning of snow cover in late autumn were 8-12 days earlier and 5 days later. As a result, the potential length of photosynthetic period of understory evergreen vegetation was predicted to be enhanced by 13-17 days. Then we introduced simulated phenology of canopy leaf area index into NCAR/LSM model to examine its possible effects on photosynthesis (GPP), ecosystem respiration (RE) and resulting net ecosystem CO_2 budget (NEP) of overstory and understory vegetation in the near future climate. Annual total ecosystem GPP, RE and NEP was greater under the future condition than under the current condition by 9-12 %, 9-13% and 12-17%. The increased GPP, RE and NEP were almost accounted by these increased by overstory vegetation. Our analysis indicates the importance of understanding space-time distributions of canopy phenology dynamics and snow-cover and of their consideration into the mechanistic evaluation of ecosystem functions in the climate studies.

[A4-060]

ENVIRONMENTAL CONTROLS ON THE INTERANNUAL VARIATIONS OF ECOSYSTEM CARBON EXCHANGE WITHIN THE TEMPERATE AND SUBTROPICAL FORESTS IN ASIA

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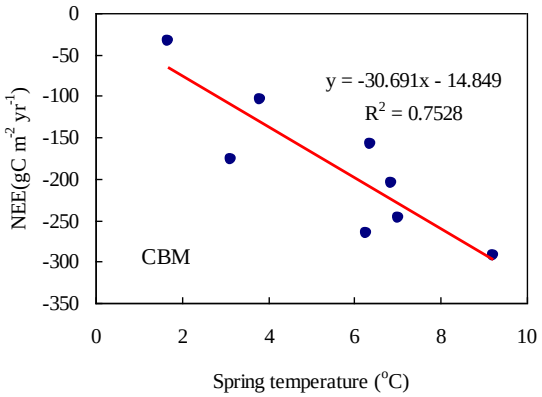
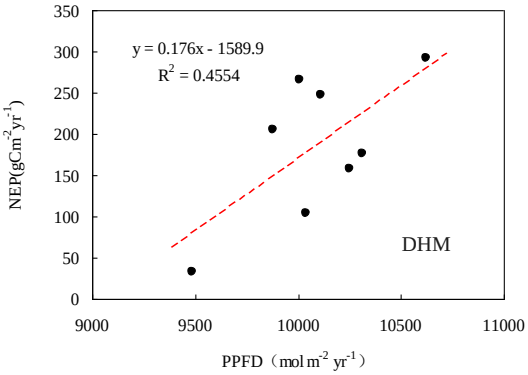
Using the long-term flux measurement conducted by ChinaFLUX from 2002, the interannual variations of ecosystem carbon exchange across different forests in China was studied. The objectives of this study are to evaluate the ecosystem carbon budget of different forests, and elucidate the environmental influences on the interannual variability of ecosystem carbon exchange. The preliminary results indicated that ecosystem respiration (Reco) was much favored with the rising of mean annual temperature (MAT) than gross ecosystem productivity (GEP), which resulted in the decrease of net ecosystem productivity (NEP) of Changbai Mountain temperate mixed forest (CBM). Further analysis showed annual NEP of CBM was mainly manipulated by the spring (April) temperature in CBM. For the Dinghu Mountain subtropical evergreen mixed forest (DHM), ecosystem NEP was positively related with the increase of radiation and the decrease of rainfall. Such variations mainly due to the enhance of canopy photosynthesis capacity under more solar radiation and the decease inspired Reco under rainfall.

Key words: Interannual variations, Ecosystem carbon exchange, Temperature, Radiation, Spring temperature, Rainfall





[A4-061]

INTERANNUAL CHANGES OF TEMPERATURE AND CO2 EXCHANGE IN AN ALPINE MEADOW ON THE TIBETAN PLATEAU IN RECENT 12 YEARS

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Grassland occupies about 50% of the TP and acts as a carbon sink nowadays. Climate warming may increase the productivity of the grassland on the Plateau. It may also accelerate carbon releasing at the same time, especially when grassland degradation occurs. Since August 2001, intensive field observations of energy balance and CO2 flux has been induced on the TP at Haibei Alpine Meadow Ecosystem Research Station (37°37'N, 101°19'E, 3250m a.s.l.) by a Japan–China cooperation project. Preliminary analyses of the first three years data suggest that (1) the Qinghai-Tibetan Plateau plays a potentially significant role in global carbon sequestration, because alpine meadow covers about one-third of this vast plateau, and (2) the annual NEP in the alpine meadow was comprehensively controlled by the temperature environment, including its effect on biomass growth (Kato et al., 2006). Here, 12 years of eddy covariance measurements were used to characterize the interannual changes of the CO2 fluxes above the alpine meadow and its relationship with temperature variations during the 12 years.

As showed in Figure 1a), There are not climate warming trend during the 12 years at the observation point. In contrast, air temperature in April and in October seems decreasing during the 12 years. Therefore, the annual NEE variation with time has no trend during the 12 years. However, the difference between warmest month (12.4 ℃ in July, 2010) and coldest month (9.2 ℃ in July, 2003) in summer was 3.2 ℃ and the difference of NEE between the same two months was -21gC/m^2. This means that climate warming with 3 ℃ in summer would not change the carbon sink and in contrast it would increase the carbon restoration in the alpine meadow on the Tibetan Plateau as showed in Figure 1b).

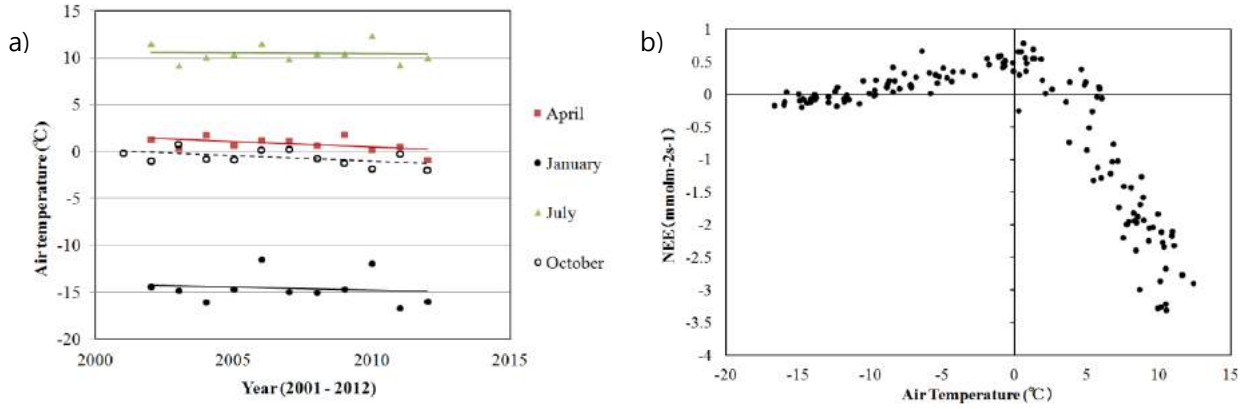

Fig. 1 Changes of monthly mean air temperature with time (left) and relationship between monthly mean air temperature and monthly mean of NEE during recent 12 years (right) showing there was no climate warming and there are different relationships when air temperature is below zero degree or not on the Tibetan Plateau.

References

Kato et al., 2006: Temperature and biomass influences on interannual changes in CO2 exchange in an alpine meadow on the Qinghai-Tibetan Plateau. Global Change Biology, 12, 1285-1298.

[A4-062]

ESTIMATION AND EVALUATION OF RESPIRATORY COMPONENT FLUXES IN EAST ASIA FROM 2001 TO 2010

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Until today, regional and global CO_2 fluxes have been estimated by approaches of different level of complexity, such as empirical upscaling, bio-geochemical model simulation, and inventory based estimation. The recent development of machine learning based regression and a global network of eddy-covariance measurement data allows us to generate reliable observation-based global gross primary product (GPP) and ecosystem respiration (RE). Current global estimates by machine learning based empirical upscaling yielded 113-131 PgC yr^{-1} and 90-102 PgC yr^{-1} for GPP and RE, respectively. Contrary to these fluxes, reliability has not yet been established on an estimate of respiratory component fluxes, autotrophic respiration (AR) and heterotrophic respiration (HR), due to a difficulty associated with direct observations. Soil respiration (SR), on the other hand, is a directly measurable respiratory flux component, and a global network of chamber measurement has enabled us to estimate global SR with empirical upscaling approaches. However, recent estimates of global SR, 75-98 PgC yr^{-1}, are readily excessive compared to an estimate of RE, occupying 83-96% of RE.

To resolve this issue, here we introduce a new assessment of global SR from 2001 to 2010 considering carbon balance. The method was based on empirically upscaled products: GPP and RE estimated by support vector machine regression and 149 FLUXNET site data, and SR estimated by a regression equation driven by annual average air temperature, precipitation, and soil organic carbon. Our estimates were 113.8 PgC yr^{-1} for GPP, 96.6 PgC yr^{-1} for RE, and 92.8 PgC yr^{-1} for SR. Similar to the previous estimates, SR occupied 96 % of RE. On these results, we calibrated SR by setting the upper boundary of SR using observed relation between SR and RE, and then, distributed SR to autotrophic and heterotrophic components by using observed relations between AR and SR, or HR and SR. Through these processes, our preliminary global estimates of SR, AR, and HR were estimated as 66.6 PgC yr^{-1}, 53.1 PgC yr^{-1}, and 44.1 PgC yr^{-1}, respectively.

This initial analysis is to evaluate the derived component fluxes in three major continents: North America, Europe, and East Asia. Through evaluation of global and continental scale carbon balances, we discuss (1) reliability of the derived product by comparing previously reported estimates, (2) similarities and dissimilarities among continents, (3) implications of uniqueness in East Asian ecosystems.

Acknowledgement. The study is financially supported by the Environment Research and Technology Development Fund (RFa-1201) of the Ministry of the Environment of Japan.

[A4-063]

APPLICATION OF HYPERSPECTRAL REMOTE SENSING IN STUDY OF TERRESTRIAL ECOSYSTEM CARBON FLUX

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Eddy covariance technique has been used in the study of ecosystem carbon budge very commonly, but positioning flux tower observations were only limited to discrete point in space and their spatial continuity is poor. There is a limitation in the study of large scale terrestrial carbon fluxes.

At present, the hyperspectral data was rarely used in study of carbon flux. The characteristic of hyperspectral data were with high spatial and spectral resolution. In this study, we chosen Changbaishan(CBS) forest station as our study area. As a part of the ChinaFLUX network, CBS station located in northeast of China, and the ecosystem of CBS is temperate mixed forest.

We used Hyperion data of 2008 and 2009, which were Hyperspectral data provided by NASA EO-1 satellite, to calculate some spectral bio-indicators. Those indicators were used to reflect the forest ecosystem carbon flux feature. These bio-indicators included Normalized Difference Vegetation Index (NDVI), enhanced vegetation index (EVI), G32 and D_{max}. G32 and D_{max} were calculated by eqn. 1 and 2 below respectively.

$$G32 = (R_{750}-R_{445})/ (R_{700}-R_{445}) \quad (1)$$

$$D_{max} = MAX\ (D_{650-750}) \quad (2)$$

The relationships between carbon flux (GPP, Re and NEE) and spectral bio-indicators were explored respectively. Then we found out the best correlation with highest R^2 value and established the robust relationship to inverse the region scales carbon flux. The inversion region carbon flux owned higher resolution and can reflect subtler spatial heterogeneity of carbon flux.

We thought the hyperspectral remote sensing owns large potential for carbon flux study of forest ecosystem.

Keywords : carbon flux; hyperspectral remote sensing; Hyperion; spectral bio-indicator; Changbaishan station

[A4-064]

ESTIMATING BALANCED CARBON DIOXIDE BUDGET OF TROPICAL PEATLAND REGION WITH SATELLITE BASED DATA.

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The peatlands are important for the source of carbon in the world because they are known as the carbon sink as organic matter that wasn't decomposed. However the peatlands can be converted to source of carbon emission as carbon dioxide when they are decomposed by drainage or fire. The drainage of the peat forest is a serious problem because the drainage promotes decomposition of peat soil and fire occurrence. These reasons of CO2 emission are associated with the ground water level. In this study, the ground water table is estimated by mKBDI (modified Keetch-byram Drought Index) which is calculated with satellite-based precipitation (GSMaP) and land surface temperature (MTSAT). On the peatlands, the CO2 emission is hard to estimate because of uncertainties of respiration from peatlands ecosystem. Therefore, the objective of this study is to estimate balanced carbon dioxide budget of tropical peatlands by using satellite based data. The carbon dioxide emission is assessed by NEE(net ecosystem CO2 exchange) which is calculated by GPP (gross primary production) and RE(ecosystem respiration). The 8-days GPP accumulation data from MOD17A2 was used in this study. That is computed by fPAR(fractional photosynthetically active radiation), LAI(leaf area index) and ε(light use efficiency) of MOD15. And the model of previous study is used for estimating the ER. Then the NEE was calculated following equation; NEE=GPP-ER. The amount of fire emission is assessed by MODIS hotspot data and biomass of tropical regions. So the balanced CO2 emission from peatlands are estimated totally via GPP, ER, and FE(fire emission). As the result, the ecosystem respiration from satellite-based data was over estimated with around 10% of in-situ measurements of Palangkaraya in Indonesia. The GPP of MOD17A2 is underestimated from in-situ observation. However the pattern of annual change is in agreement between MOD17A2 and in-situ measurements.

[A5-065]

THE CARBON BALANCE OF UNDERSTORY COMMUNITIES IN A LARCH FOREST

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An automatic chamber system was introduced to investigate carbon balance of understory in a Larch forest with three specific questions: (1) could understory community make a significant contribution to ecosystem carbon sink? (2) what is the magnitude of gross photosynthesis carbon assimilation by understory community and its contribution to canopy photosynthesis? (3) what is the photosynthesis behavior of understory community as its environments is largely different from canopy? The results showed that:

(i) The net carbon balance of understory community (*NEE*) is -19 gC m^{-2} yr^{-1} based on observations mainly in growing season. It indicated that the contribution of understory *NEE* to ecosystem carbon sink is slight and negligible. The opinion that understory community serve as a significant contributor of ecosystem carbon sink was not supported. The uncertainty of NEE was assessed and it convinced our estimation at its high reliability.

(ii) Even though understory herbs have the same amount of biomass as that of canopy leaf, the gross photosynthesis assimilation (*GEE*) of understory community was largely less than that of canopy (-292 gC m^{-2} yr^{-1}). It accounts only around 16% of total ecosystem gross photosynthesis assimilation.

(iii) Understory community showed lower light saturation point (around 100 μmol m^{-2} s^{-1} photosynthetic photons flux density) and high light use efficiency (0.086). It is the results of adjustment for understory light condition.

[A5-066]

MAIN AND INTERACTIVE EFFECTS OF MULTIPLE GLOBAL-CHANGE FACTORS ON SOIL RESPIRATION AND ITS COMPONENTS: A META-ANALYSIS

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Global change usually involves simultaneous changes in multiple environmental factors, which may considerably affect ecosystem structure and functioning and alter ecosystem services to human society. With increased awareness of their potential interactions, some multi-factorial studies have been conducted to investigate their main and interactive effects on carbon (C) cycling in terrestrial ecosystem. However, how multiple global-change factors affected soil respiration (*Rs*) and its components (i.e., autotrophic (*Ra*) and heterotrophic respiration (*Rh*)) remains controversial among individual studies. In this study, we conducted a meta-analysis to examine the main and possible 2- or 3-factor interactive effects with warming (W), elevated CO_2 (E), nitrogen addition (N), increased precipitation (I) and drought (D) on *Rs* and its components from 150 published papers. Our results show that E, W, I and N significantly stimulated *Rs* by 29.23%, 7.19%, 22.95%, and 16.90% ($p<0.05$), respectively, while I depressed it by 16.90% ($p<0.01$). E consistently induced a significant positive effect on both *Ra* and *Rh*, while I affected them with an opposite trend. Among nine two-way interactive effects on *Rs*, **synergistic interaction** (i.e., the effect of combined treatment > the additive effects of single two main factors) occurred in E×N, E×W, I×N, and D×W, while **neutral interaction** (i.e., the effect of combined treatment ≈ the additive one) and **antagonistic interaction** (i.e., the effect of combined treatment < the additive one)was rare, only in I×W for neutral one and in N×W and I×E for the latter. In addition, E×W and E×N displayed synergistic interactions on *Rh*. The more dominance of synergistic interactions in two-way interactive effects on *Rs* and *Rh* may determine a central positive tendency of *Rs* in future, and affect the feedback of terrestrial C cycle to the climate system correspondingly.

Key words: elevated CO_2, interaction, N addition, precipitation, soil respiration, warming

[A5-067]

QUANTIFICATION OF SOIL CARBON STOCKS AND FLUX IN THE SEOUL FOREST PARK

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Quantifying and understanding about soil organic carbon (SOC) stock are an important option helping to mitigate increasing atmospheric CO_2 concentration. However many soil carbon studies are mainly focused on natural forests and pasture ecosystems, and the SOC stocks in urban green space have been less quantified.Although urban soil carbon contents have received less attention, the significant role that it has in the regional carbon cycle cannot be ignored. As urban areas continue to expand around the globe, the importance of monitoring urban SOC stocks will expand as well.In this study, we measure the SOC stocks in the Seoul Forest Park. The study site is located in Seoul, Republic of Korea, with a total area of 116ha. This study has two purposes. First, we estimated the SOC stock in the Seoul Forest Park, to 1 m depth with different vegetation types. Second, we compared the soil carbon concentration between 2003 and 2013, the past 10 years carbon accumulationin the Seoul Forest Park. According to the data, the amount of the total carbon concentration was increased by almost three times since the 2003. This increase is largely due to the increase of forested land with its higher soil organic matter (SOM) when compared to past land use history.In an analysis of variance, the wetland soil had significantly (P<0.001) higher SOC (13.26 kg m^{-2} to 1 m depth) than theforest soil (mixed: 9.21 kg m^{-2}, broad-leaf: 7.27 kg $m^{-2}$and needle-leaf: 7.18 kg m^{-2}) and grass soil (4.23 kg m^{-2}). Our analysis shows that the various vegetation types and their associated soil properties have relate with SOC stocks. Our results provide insights intothe long-term recovery patterns of SOC from the influence of land cover change in the urban park.

[A5-068]

INFLUENCE OF SNOW-COVER AND SOIL-FROST VARIATIONS ON CO_2 FLUX AT NON-VEGETATION AGRICULTURAL LAND

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Changes in cryospheric snow accumulation, snowmelt, and soil freezing and thawing might influence the ground-surface CO_2 flux and cumulative winter CO_2 flux from agricultural land. We continuously observed CO_2 flux using automatically closing chambers at an untreated control plot and a plot with snow removal in northern Japan. Snow was removed completely from the snow-removal plot on each date by manual shoveling on 11, 13, and 19 January and 8 February 2011. We located three soil collars (at points named A, B, and C) in each plot. We periodically moved the one automated chamber among the three points in each plot to reduce the disturbance caused by installation of the chamber. The CO_2 in soil pores at 10-cm depth increased by 6.5 ppmv day^{-1} as soil began to freeze, but it increased dramatically (to 49 ppmv day^{-1}) after snowmelt water infiltrated the soil and froze. The soil-frost layer constrained gas diffusion into the air, and the barrier strengthened as the frozen snowmelt water decreased the air volume in soil pores. Leached gas CO_2 from the freezing snowmelt water also increased gas CO_2 concentration in soil. As the soil thawed, the CO_2 concentration decreased drastically, at 790 ppmv day^{-1}. However, these changes had little effect on CO_2 flux. The soil CO_2 concentration remained stable after snow cover reached 30 cm in the control plot. Low CO_2 flux in both plots occurred during the winter. No clear relation was found between CO_2 flux and snow depth or soil-frost depth because of the small CO_2 source at this site. We also considered how the presence of the chamber influenced soil temperatures and water contents. During the snow-free season, the chamber mitigated diurnal changes in soil temperature. The daily average soil temperature differed from that in the natural state by −1.7 ◦C to 6.3 ◦C. This fluctuation of temperature corresponded to the fluctuation of CO_2 flux, which ranged from 91% to 143% of the CO_2 flux in the natural state based on the temperature response equations. The chamber had little influence on the soil temperature during the snow-cover period, and did not influence soil water content throughout the study period. Cumulative winter CO_2 emissions were 17.2 gC m^{-2} (over 143 days) in the control plot and 13.4 gC m^{-2} (over 151 days) in the treated plot (10.0 and 7.5% of annual accumulation, respectively).

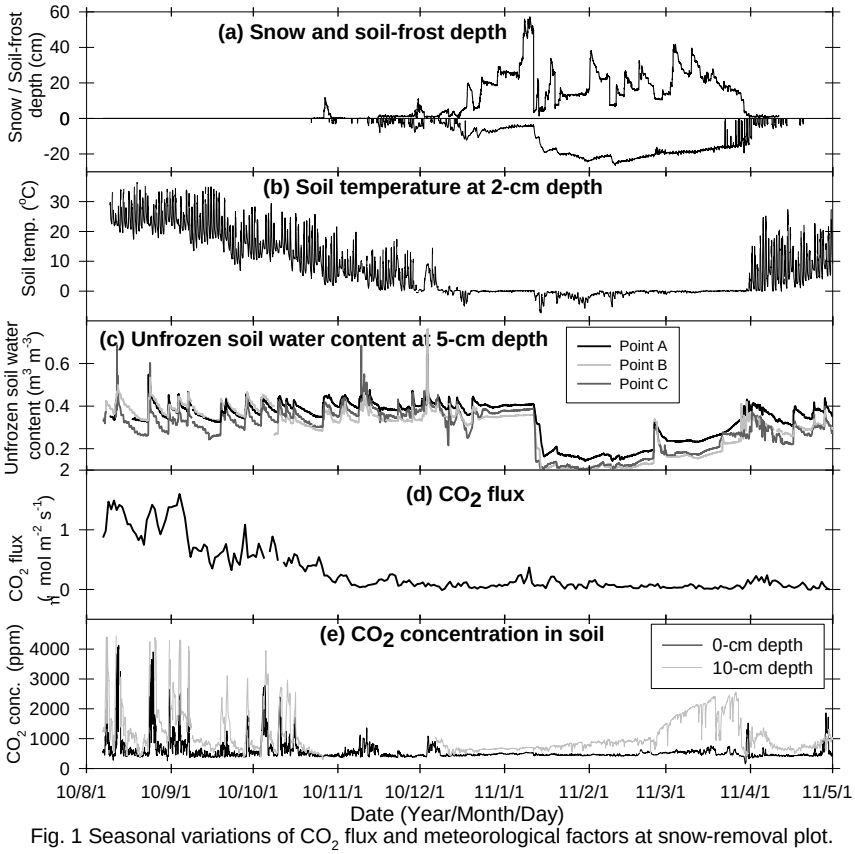

Fig. 1 Seasonal variations of CO_2 flux and meteorological factors at snow-removal plot.

[A5-069]

PARTITIONING OF SOIL CO_2 EFFLUX IN A RUBBER PLANTATION

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This study aims to provide soil respiration (Rs) of rubber ecosystem in Thailand and its partitioning into autotrophic (Ra) and heterotrophic soil respiration (Rh) by using the trenching method. Soil respiration was investigated in the Chachoengsao Rubber Research Station which located in Sanamchaikhet district, Chachoengsao province, and east of Bangkok (13°41′N, 101°04′E). The site is planted with a monoclonal stand (clone RRIM 600). Trees were 15 years old in 2009. Trees have been tapped for latex production for 8 years. Soil respiration of rubber ecosystem was measured 2-week-intervals by using an infrared gas analyzer (IRGA) (Model LI-8100, LI-COR Inc., Lincoln, NE, USA) with a 20 cm survey chamber. Temperature (°C) and volumetric water content (%) of soil at a 5 cm of depth were measured simultaneously with soil CO_2 efflux. Between May 2009 and March 2010, cumulative soil CO_2 efflux was 1.31 kg C m^{-2}. Ra and Rh accounted for 63% and 37% of soil respiration, respectively.

[A5-070]

SOIL CARBON BUDGET IN RAINFED AND IRRIGATED RICE FIELD IN WESTERN PART OF THAILAND

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Rice is accounted as food for over half of the world population and is the most important food crop in Thailand. The total area of rice cultivation is estimated to be about 12.91 million ha representing approximately 47 percent of the cropped land area in Thailand. Most of the rice areas are in lowland and classified as rainfed and irrigated rice ecosystems representing approximately 80 and 19 percent of the rice areas, respectively. Conservation of soil organic carbon (SOC) in rainfed and irrigated rice cropping system is important not only for improving agricultural rice productivity but also for involved in carbon budget. Soil carbon budget (SCB) can be quantified by integrating the amounts of net carbon supply and removal. In this study, we introduced carbon content change in term of SCB in the specific area of rainfed and irrigated rice cropping system in Ratchaburi province, western part of Thailand. The experiment started from January 2010 to December 2011 at the campus of King Mongkut's University of Technology Thonburi (KMUTT) in Ratchaburi Province (13.35 'N and 99.30 'E). This study was designed for two rice cropping systems 1) single rice cropping of rainfed rice including fallow period (FR) and 2) double rice cropping of irrigated rice and follow by rainfed rice (RR). SCBs were calculated by the amounts of net carbon supply and removal. Carbon supply was identified as rice grain, stubble, cow manure, chemical fertilizer and root residue. Carbon that was loss from the soil including gaseous emission of CO_2 and CH_4, rice grain yield and rice straw. The result showed the range of SCBs was -2.074 to 4.355 ton C ha^{-1}. The negative values of SCB indicated that carbon loss from soil while the positive values indicated carbon accumulated into the soil. SCB in double of rice cropping system was more 40 percent higher than in single of rice cropping system. The majority of carbon input was observed in manure and crop residue incorporation. In the other hand, the high carbon removal was seen in rice grain yield and rice straw. Carbon loss from soil in term of CO_2 and CH_4 emission was less than three percent of the carbon removal.

Keywords: Soil Carbon Budget, Rainfed rice, Irrigated rice, Western Thailand

[H4-071]

PARTITIONING OF EVAPOTRANSPIRATION THROUGH OXYGEN ISOTOPIC MEASUREMENTS OF WATER POOLS AND FLUXES IN A TEMPERATE GRASSLAND

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Stable isotopic measurement is promising for partitioning of ecosystem evapotranspiration (ET). This approach, however, is still facing some challenges due to the uncertainties in estimating the isotopic compositions of ET and its components. In this study, by deploying a tunable diode laser analyzer for in-situ measurements of the oxygen isotopic compositions of water vapor, together with sampling water in plant and soil pools, we made an attempt to partition ET via estimating the oxygen isotopic compositions of ET (δ_{ET}) and that of its two components, i.e., plant transpiration (δ_T) and soil water evaporation (δ_E). We investigated the uncertainties in estimating these three terms and their effects on partitioning. Our results indicated that the keeling plot method and flux-gradient method produced inconsistent estimation of δ_{ET}. Flux-gradient method produced more reasonable partitioning results than keeling plot method. 15-25 cm is a reasonable depth for soil water sampling for estimating δ_E at this site. Sampling water at a too shallow depth may bring in biased δ_E estimation when soil moisture is very low. In addition, a simple δ_T model was developed in this study, which illustrated consistent estimations with the traditional model. Most of the variables and parameters in the new model can be measured directly with high accuracy, making it have a potential to be used at other sites. Overall, δ_{ET} was highly responsible to the partitioning result and it still had big uncertainties. Improvement of δ_{ET} measurement should be a priority in future endeavors of ET partitioning via stable isotopic approach.

Keywords: Evapotranspiration partitioning, tunable diode laser, oxygen isotope, ^{18}O-H_2O, temperate grassland, Keeling plot, Flux gradient

[H4-072]

HYSTERESIS RESPONSES OF EVAPOTRANSPIRATION TO METEOROLOGICAL FACTORS CHANGES IN DIEL TIME SCALE: PATTERNS AND CAUSES

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Evapotranspiration (ET) is an important component of hydrological cycle of terrestrial ecosystems. Understanding how ET changes with meteorological factors is essential to better understand the process of water cycle. Here, Using continuous measurements of ET using eddy covariance method over a typical alpine shrubland meadow ecosystem on the Qinghai-Tibetan in China during 2003~2011, we investigated the hysteresis responses of ET to air temperature (T_a), water vapor pressure deficit (VPD) and net radiation (R_n) in diel time scale. Days were divided into two half days (increasing T_a/VPD/R_n in the morning and decreasing T_a/VPD/R_n in the afternoon) using the maximum half-hourly mean T_a/VPD/R_n. We observed a linear or exponential-like pattern of ET in response to T_a, VPD and R_n in both half days. However, at similar T_a and VPD, ET was significantly depressed during the decreasing half days comparing with the increasing half days, causing a clockwise hysteresis pattern in both ET-T_a and ET-R_n relation. This mainly contributed to that the diel courses of T_a and VPD were out of phase with net radiation, which did not caused the significant hysteresis response of ET. The magnitudes of the ET hysteresis loops for both T_a and VPD showed pronounced seasonal dynamics with higher values during the growing season. This result may be attributable to low soil water availability of the evaporating surface when ET was stronger, which decreased the hydrological conductivity in the soil-plant-atmosphere continuum. The resultant hysteresis loop is an important indicator of the existence of limiting factors. As such, net radiation is the direct driver of diel process of ET, while air temperature and VPD are only environmental factors effecting ET. This research demonstrates the systematic presence of hysteresis in the response of ET to meteorological factors, which is of great significance for the improvement of models estimating evapotranspiration.

[H4-073]

TREND OF LAND SURFACE EVAPOTRANSPIRATION BASED ON REMOTE SENSING IN CHINA DURING 1981 TO 2010

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Using satellite observations of Normalized Difference Vegetation Index (NDVI) together with climate data in a physical evapotranspiration (ET) model, spatial-temporal variability of evapotranspiration is investigated in China during 1981–2010. The model predictions of ET are validated with eddy covariance flux measurements and basin water balance calculations. It is estimated that the national mean potential and actual ET values are 916±21 mm yr^{-1} and 415±12 mm yr^{-1} respectively. Annual actual ET pattern is closely associated with vegetation conditions in the eastern part of China, whereas the actual ET is low corresponding with rainfall events and amounts in the sparsely vegetative areas and desert. The trends of potential ET and actual ET are remarkably different over the country and the complementary relation between the potential ET and the actual ET is revealed during the study period. At national scale, actual ET increases during 1980s to mid of 1990s, and then decreases resulted from limitation of precipitation availability. The annual actual ET over major land covers is found to correlate strongly with both precipitation and potential ET.

[H4-074]

MEASUREMENT OF EVAPORATION AND CARBON DIOXIDE EXCHANGE IN DRY DIPTEROCARP FOREST THAILAND

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Dry dipterocarp forest is one of the major forest ecosystems in Thailand and other tropical countries. This ecosystem is unique that it grows in the area with extinct dry season and relatively less precipitation. Understanding the hydrological cycle and interactions with the forest is thus important to improve our knowledge on its responses to future climate change and variability. In this study, we measured evaporation over one year period (January 2012 – December 2012) in Dry Dipterocarp forest, Ratchaburi province Thailand, using pan evaporation and eddy covariance methods. The aim was to study the responses of dry dipterocarp forest in responses to climate variability such as drought. By monitoring the water level at 30 minutes interval we were able to calculate the evaporation rate and thereby determine the short term mass balance of the pan. Over the same time intervals, we also monitored short and long wave radiation, temperature at atmospheric pressure as well as the air vapour pressure and the wind speed at a standard reference height. The total amount of rainfall at the site in 2012 was 935 mm, relatively low compared to the overall average rainfall in Thailand. The annual total evapotranspiration in this forest was 870 mm, with the relatively high value during the summer and rain season. The amount of pan evaporation was similar to the evapotranspiration, being high during the dry and summer seasons.

[H4-075]

SEASONAL AND INTERANNUAL VARIATION OF WATER USE EFFICIENCY ACROSS VEGETATION AND CLIMATE TYPES

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Seasonal and interannual variability of water use efficiency (WUE), gross primary production (GPP) and evapotranspiration (LE) of four vegetation types, which covered four climate types, was investigated using 95 sites (504 site-years) of continuous eddy covariance measurements, including deciduous broadleaf forest (DBF), evergreen broadleaf forest (EBF), evergreen needleleaf forest (ENF) and savannas (SAV). We found that: (1) the magnitude of annual WUE was apparently different across climate types, but cannot be distinguished among vegetation types. WUE was highest in the warm temperate climate with fully humid and warm summer, and low in the climate with hot summer or water stress. (2) the monthly values of WUE are apparently different among DBF, EBF and ENF. In winter and early-spring (November to April), water use efficiency is higher in evergreen needle-leaf forest than that in deciduous broad-leaf forest (Fig. 1a). Comparatively, in summer and early-autumn (June to September), WUE is higher in deciduous broad-leaf forest than that in evergreen needle-leaf forest. Monthly WUE differences across vegetation types are mostly due to the photosynthesis other than transpiration rate of the ecosystem (Fig. 1b and 1c). Within any given climate type, monthly water use efficiency showed different correlation (positive or negative) with the environmental factors (atmospheric temperature, solar radiation and atmospheric vapor pressure deficit).

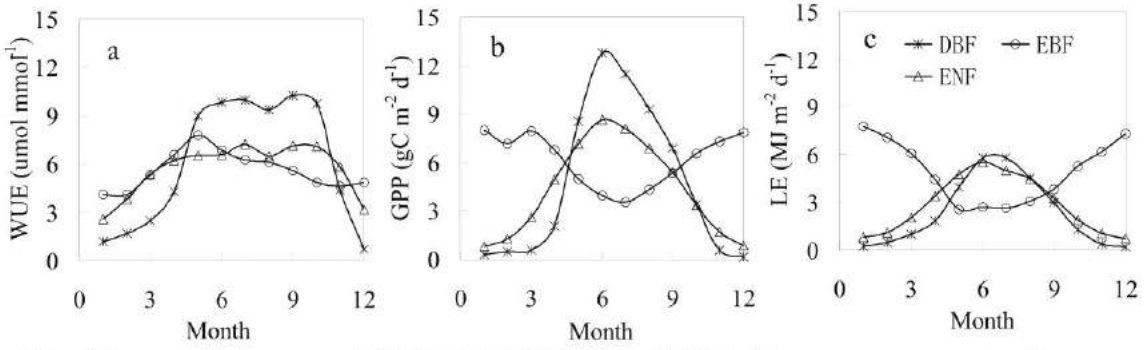

Fig. 1 Seasonal courses of WUE (a), GPP (b) and LE (c) in warm temperate climate, averaged from 64 site-years DBF, 9 site-years EBF and 65 site-years ENF data. The DBF and ENF sites were loacted in northern hemisphere, and EBF sites were located in southern hemisphere.

[A6-076]

SOCIAL MEDIA AND LOW CARBON CAMPAIGN IN ASIA

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The 21st century is defined as the Asian century. This could be true considering the lofty economic, urban and industrial growth as well s weighty environmental challenges going simultaneously. However, many parts of the Asian region come under serious threats of climate change with flood incidence in particular increasing significantly. Many countries design strategies to lower their greenhouse emission levels with some designing low carbon society projects. This paper is interested in reviewing the capacity of Asian countries to achieve low carbon output. Our focus is on the role of the Asian population. We want establish why the population needs to participate and how they should participate in building low carbon society. In doing so, we applied the Strength, Weakness, Opportunities, and Threats (SWOT) to analyze how public campaigns can complement local and regional policies and for low carbon societies. By exploring a number of opportunities and threats to low carbon emission, we find that social media could play a greater role in reaching out to all people across the social stratifications of the Asian society. Social media's potentials do not stop at public knowledge but could be used to report threats and strengthen civil actions for a lower carbon society. Thus, social media could be utilized for social mobilization campaigns for low carbon society projects across the Asia.

[A6-077]

AIR QUALITY DEGRADATION BY FIRECRACKER DURING DIWALI FESTIVAL IN BHILAI CITY, CENTRAL INDIA

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During Diwali festival public used to burn firecrackers to express their happiness and joy. Fireworks in large amounts exaggerate the level of air pollutants and cause significant short-term air quality degradation. In this study pilot experiment and analyzed for EC, OC, PM_{10}, $PM_{2.5}$ and inorganic (sulfate, ammonium, nitrate, potassium, chloride, sodium, calcium and magnesium) chemical components. Initial results show that throughout day and night times for Pre Diwali (day before Diwali) and Diwali day and Post Diwali (After Diwali). On Diwali schedule the short term PM_{10} concentration was between 330 $\mu g/m^3$ (on pre Diwali) to 883 $\mu g/m^3$ (Diwali day), which is about fourteen times higher than the Indian Ambient Air Quality (NAAQ) Standard which is 60 $\mu g/m^3$ and $PM_{2.5}$ Concentration was between 153 $\mu g/m^3$ (pre Diwali) to 241 $\mu g/m^3$ (Diwali). The $PM_{2.5}$ values are more than six times higher than the NAAQ Standard value which is 40 $\mu g/m^3$. OC and EC were also found to be significantly correlated ($r = 0.81$) to each other, illustrative their mutual sources.

Keywords: PM_{10}, $PM_{2.5}$, Diwali, Ions, Firecrackers, NAAQS

[A6-078]

CARBON UPTAKE AND WATER PRODUCTIVITY FOR DRY-SEEDED RICE AND HYBRID MAIZE GROWN WITH OVERHEAD SPRINKLER IRRIGATION

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A growing scarcity of irrigation water could progressively lead to changes in rice production to systems using less irrigation water for rice or more crop diversification. A shift from current production of rice on flooded soils to production of rice on non-flooded soil with water-saving irrigation or to production of more water-efficient crops will have profound effects on carbon, water, and energy exchanges. This study used the eddy covariance technique to examine C uptake and water use efficiencies for water-saving, dry-seeded rice production and production of hybrid maize under overhead sprinkler irrigation as an alternative to flooded rice during two growing seasons. Maize with its C_4 physiology has greater photosynthetic capacity than rice. In 2011, maize had 1.4 times higher net C uptake than rice and twice as much grain yield as rice (10.4 vs 5.3 Mg ha^{-1}). In 2012, lower solar radiation due to increased cloudiness and heavy rainfall during critical growth stages (late vegetative to early reproductive) decreased LAI and resulted to about 20% less net C uptake and maize yield (8.2 Mg ha^{-1}), but the rice yield was unchanged (5.3 Mg ha^{-1}) presumably because of improved crop management which included effective crop establishment at lower seed rate and efficient N application using fertigation. Canopy light use efficiency, crop water productivity (WP_{ET}), and photosynthetic water use efficiency were 1.8, 1.9, and 1.6 times higher for maize than rice, respectively, despite sensitivity of maize to excess water. Net C uptake, evapotranspiration, and WP_{ET} of dry-seeded rice under overhead sprinkler irrigation were comparable to those reported elsewhere for flooded rice. Average total water input (irrigation + rainfall) for rice was only 908 mm, as compared to 1300 - 1500 mm reported in literature for typical puddled transplanted rice.

[A6-079]

CHANGES OF GREENHOUSE GAS FLUXES IN THE PROCESS OF LAND USE CONVERSION FROM PADDY TO UPLAND FIELD

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Subtropical cropland could be a source of greenhouse gas emissions, because it contains large amounts of soil carbon and nitrogen. And these emissions are strongly related to field water management. Measurements of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) fluxes were carried out in the typical red soil field in Jiangxi province, China, in the process of land use conversion from paddy to upland, which phenomenon is common in southern China. Besides, we added experimental plots without vegetation to determine the role of plants in this process.

Our results showed that CO_2 and N_2O fluxes were increased, and CH_4 flux was significantly decreased after the conversion. And the fluxes of these three greenhouse gases all had obvious seasonal trends. For the increase of CO_2 flux, the change of plants accounted for 78%. And for N_2O, it had a much higher emission in the plots without vegetation, because of the absorption of nitrogen by plants. This means plants promoted the increase of CO_2 flux, and inhibited the increase of N_2O flux. The removal of vegetation largely decreased the fluxes in paddy field thereby reducing the difference between paddy and upland. In addition, we found that the use of nitrogen fertilizer promoted all these three greenhouse gas emissions. Land use conversion altered other soil physicochemical properties (e.g. soil temperature, content of nitrate and ammonium nitrogen, pH), and the greenhouse gas fluxes changes could be partly explained by this.

[A6-080]

CONTRIBUTION OF BIOMASS BURNING TO AIR POLLUTANTS BY EMISSION INVENTORY AND AMBIENT MEASUREMENT: THE PEARL RIVER DELTA REGION, CHINA AS A CASE

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Biomass burning in the Pearl River Delta (PRD) region has been of increasing concerns due to its adverse effects on visibility, urban air quality, and human health. Emissions of major agricultural residues burning were studied by laboratory simulations using a self-designed combustion system and dilution chamber. Emission factors of CO_2, CO, PM_{10}, $PM_{2.5}$, OC and EC in $PM_{2.5}$ were measured to be 1105.2±189.3, 53.2±17.9, 14.0±5.1, 12.1±4.4, 10.53±4.87 and 0.49±0.22 g kg^{-1} for rice straw burning in flaming condition, 1024.0±207.9, 110.6±37.9, 20.6±14.2, 18.3±13.5, 8.77±4.81 and 0.37±0.11 g kg^{-1} for rice straw combustion in smoldering condition, and 1152.5±258, 40.1±15.7, 5.65±1.3, 4.12±1.1, 1.25±0.67 and 1.22±0.66 g kg^{-1} for sugarcane leaves burning, respectively. Total biomass burning emitted CO, NMHCs, NOx, $PM_{2.5}$, OC and EC in the PRD in the year 2008 were estimated to be 193.70, 18.34, 5.08, 15.31, 7.76, 2.71 ktons, respectively. Field burning of straws made a major contribution to $PM_{2.5}$ and OC emissions. Residential sector, including firewood and crop straw consumption, was the dominant source of EC, CO and NOx.

Meanwhile, the ambient VOCs were measured by a proton transfer reaction - mass spectrometer (PTR-MS) at a receptor site in the Pearl River Delta (PRD) in 2008. Biomass burning plumes are identified by using acetonitrile as tracer, and enhancement ratios (ERs) of nine VOCs species relative to acetonitrile are obtained from linear regression analysis and the source-tracer-ratio method. Biomass burning was estimated to contribute 9.5%-17.7% to mixing ratios of the nine VOCs. The estimated biomass burning contributions are compared with local emission inventories. Large discrepancies are observed between our results and the estimates in emission inventories. Though biomass burning emissions in TRACE-P inventory agree well with our results, the VOCs speciation for aromatic compounds may be not appropriate for Guangdong.

Keywords: biomass burning; emission inventory; acetonitrile, validation

[A7-081]

MASS AND ENERGY EXCHANGE OVER CENTRAL INDIAN DECIDUOUS FORESTS USING EDDY COVARIANCE FLUX MEASUREMENTS

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We report observations of 1 annual cycle (2012) of Carbon Dioxide (CO_2), Water Vapour (H_2O), and heat fluxes (sensible and latent heat flux) at the Betul Flux Research Site (BFT) located in teak mixed deciduous forests of Madhya Pradesh, central India. Continuous fast response measurements of CO_2, H_2O and heat fluxes above the canopy were carried out at 10 Hz and averaged for 30 minutes using closed path infra-red gas analyzers. Simultaneous slow response measurements (averaged for 10 minutes) of meteorological parameters are also being carried out. Furthermore, seasonal ground based measurements of leaf/plant level biophysical parameters viz., photosynthetic rate, stomatal conductivity, sap flow (heat ratio method) and leaf area index (LAI) have been carried out for dominant tree species. Diurnal and seasonal variations of CO_2, H_2O and heat fluxes were analysed in relation to meteorological variables. Attempts have also been made to study the environmental controls of fluxes in the study area.

Results showed strong influence of leaf "off" and "on" scenario on the CO_2, H_2O and energy fluxes due to prevalence of deciduous vegetation type in the study area. Maximum amount of CO_2 was sequestered for photosynthesis during green-up season (monthly mean of -31 µmol/m^2/s during July-2012) till winter months (monthly mean of -25 µmol/m^2/s during Nov-2012) compared to summer (monthly mean of -4 µmol/m^2/s during Mar-May, 2012). Energy flux analysis showed more energy being portioned into latent heat during leaf-on period and sensible heat during leaf-off period. Seasonal analysis on the biophysical parameters along with the fluxes suggested strong correlation of fluxes variability with vegetation greenness.

The present study is carried out as part of the 'Soil and Vegetation - Atmosphere Fluxes' sub-project of the National Carbon Project funded by Indian Space Research Organisation (ISRO) - Geosphere Biosphere Programme.

Keywords: Eddy Covariance, Sensible Heat Flux, Latent Heat Flux, leaf area index.

[A7-082]

EFFECTS OF DISTURBANCES ON THE BALANCES OF CARBON DIOXIDE AND WATER IN TROPICAL PEAT ECOSYSTEMS

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Tropical peatlands have accumulated huge soil carbon over millennia. However, the carbon pool is presently disturbed on a large scale by land development and management, and consequently has become vulnerable. Peat degradation occurs most rapidly and massively in Indonesia, because of fires, drainage and deforestation of swamp forests coexisting with tropical peat. Peat burning releases carbon dioxide (CO_2) intensively but occasionally, whereas drainage increases CO_2 emission steadily through the acceleration of aerobic peat decomposition. Therefore, tropical peatlands present the threat of switching from a carbon sink to a carbon source to the atmosphere. However, the ecosystem-scale carbon exchange is still unknown in tropical peatlands. A long-term field experiment in Central Kalimantan, Indonesia showed that tropical peat ecosystems, including a relatively intact peat swamp forest with little drainage (UF), a drained swamp forest (DF) and a drained burnt swamp forest (DB), functioned as net carbon sources. Mean annual NEE (± 1 standard deviation) for four years from July 2004 to July 2008 was 174±203, 328±204 and 499±72 gC m^{-2} y^{-1}, respectively, for the UF, DF and DB sites. The carbon emissions increased according to disturbance degrees. We found that the carbon balance of each ecosystem was chiefly controlled by groundwater level (GWL). The net ecosystem CO_2 exchange (NEE) showed a linear relationship with GWL on an annual basis. The relationships suggest that annual CO_2 emissions increase by 79−238 gC m^{-2} every 0.1 m of GWL lowering probably because of the enhancement of oxidative peat decomposition. In addition, CO_2 uptake by vegetation photosynthesis was reduced by shading due to dense smoke from peat fires ignited accidentally or for agricultural practices. Our results may indicate that tropical peatland ecosystems are no longer a carbon sink under the pressure of human activities. Evapotranspiration (ET) was also affected by such disturbances. Because of energy imbalance, ET was adjusted to close energy balance on a daily basis. Mean annual ET (± 1 standard deviation) for the four years was 1636±53, 1553±117 and 1374±75 mm y^{-1}, respectively, for the UF, DF and DB sites, which account for 67, 64 and 56% of mean annual precipitation of 2435 mm y^{-1}, respectively. Annual ET of the DB site was significantly smaller than those of the other sites, mainly owing to less transpiration due to few trees. This fact indicates that more water is lost by surface and groundwater runoff in the DB site. In addition, annual ET showed a positive linear relationship with annually mean GWL at each site. This significant linearity suggests that annually mean GWL is a robust indicator to assess the annual balances of carbon and water in tropical peat ecosystems.

[A7-083]

LAND-ATMOSPHERE FLUXES OF CARBON DIOXIDE AND METHANE FROM THREE ECOSYSTEMS IN TROPICAL PEATLAND OF SARAWAK, MALAYSIA

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Tropical peatlands constitute one of the largest reservoirs of terrestrial organic carbon, signifying their potential significance for the global carbon cycle and climate change. However, there remain great uncertainties in the magnitude and driving forces of carbon fluxes from tropical peatland at various temporal and spatial scales.

Being the last frontier of arable land available for agricultural development, it is also the least studied and least understood among the tropical soils. Unlike temperate and boreal regions, where peats are mainly derived from the remains of low growing plants such as sedges and sphagnum, tropical peats are formed from woody forest trees. Over the last several years, tropical peatlands of Southeast Asia have garnered considerable global attention. The increasing extent of oil palm cultivation on peat remains the major concern. It has been postulated that deforestation and drainage from land use change release huge carbon emission that contributed to the global climate change. However, the quantum still needs to be quantified.

The eddy covariance method is supremely suited for nonintrusive continuous flux measurements over a large footprint area. Thus, three eddy covariance towers equipped with instruments had been erected to monitor CO_2 and CH_4 fluxes at three ecosystems in tropical peatland of Sarawak, Malaysia. An observation site at an oil palm plantation is set up primarily to understand the carbon cycle of oil palm, and to elucidate the relationship between carbon emission and drainage depth of peat soil. Another observation site was established at a secondary peat swamp forest that had been selectively harvested before, and then left to regenerate naturally. The third study site located at the Maludam National Park is destined to obtain a thorough understanding on carbon dynamics and ecosystem production of a natural peat swamp forest. Hence, it is imperative to evaluate the carbon balance of different ecosystems in tropical peatland.

CH_4 emissions from open water bodies are likely to contribute considerably, since it has a global warming potential of 25 that of CO_2 over a 100-year time horizon. However, to date, only a few short-term studies on CH_4 emission based on closed-chamber method had been conducted in tropical peatland. To our knowledge, there is no study reporting on a continuous CH_4 measurement from tropical regions. Therefore, one of the goals of this study is to provide the first eddy covariance CH4 flux data from the tropical peat ecosystems. Together with eddy covariance CO_2 and CH_4 fluxes, which are measured concurrently with dynamic enclosure (or chamber) method, a clear and comprehensive picture of the carbon budget of tropical peatland will be captured.

[A7-084]

ENERGY AND CO_2 FLUXES AT THE FIRST VIETNAMESE EDDY COVARIANCE SITE IN TROPICAL SEASONAL FOREST

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According to local inventory data (FIPI, 1995) forests represent about 28% of Vietnam. Forest areas play important role in the reservation of biodiversity and in ecological sustainability of country. In present time natural tropical forest of Vietnam are under intensive researches of scientists from different fields. In 2009 year investigations of soil CO_2 fluxes were begun as planning works of joint Vietnam-Russian tropical research and test center. In November 2011 year the works were expanded and the first eddy covariance tower was erected in the southern of Vietnam in territory of Cat Tien national park (N 11°27', E 107°24', 134 m a.s.l.). Tower is located in semi evergreen tropical seasonal forest.

According to Keppen-Geiger climate classification Southern Vietnam is located in tropical monsoon climate with dry-warm...hot winter and rainy-warm summer. Three characteristic months (December, March, September) were chosen for comparing of heat fluxes in different meteorological conditions. December, the month of the first part of dry period, had lowest (24.0º) average canopy temperature, not so big precipitation rate (49.8 mm) and medium soil moisture content (25 %vol.). March was the hottest month (26.9º) in the end of dry period with both lowest precipitation (24.1 mm) and soil moisture content (15 %vol.). September was the peak of rainy season (607.6 mm of rain per month) with flooding of vast areas in Cat Tien and highest soil moisture content (38 %vol.).

Highest radiation sums were recorded in March (426.0 MJ m^{-2} mon^{-1}). December and September sums (336.7 and 342.1 MJ m^{-2} mon^{-1}) were not so high due to increased hade of sunlight in the first case and cloudiness in the second case. Sensible heat flux (H) rate rose sharply in the second half of dry season (from about 35 MJ m^{-2} mon^{-1} in December and September to 155.4 MJ m^{-2} mon^{-1} in March). Evapotranspiration (LE) dominated considerably in the heat expenditures during all the year (216.7...271.6 MJ m^{-2} mon^{-1}). Bowen ratio (H/LE) varied from 0.13 in September to 0.71 in March.

For the whole first year of observation, the tropical forest was a carbon sink CO_2 from the atmosphere. Highest rate of CO_2 absorption was observed in July. The hottest month of the year (March) with lowest precipitation caused forest to become a small carbon source for the atmosphere. Interesting is the fact the forest was not the most intensive carbon sink in the wettest month because of higher temperature in comparison with December and so higher ecosystem respiration, and probably because of high level of ground water.

[A7-085]

EFFCTS OF CLIMATIC FACTORS AND ECOSYSTEM RESPONSES ON THE INTER-ANNUAL VARIABILITY OF EVAPOTRANSPIRATION OF A CONIFEROUS PLANTATION IN SUBTROPICAL CHINA

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As evapotranspiration (ET) is the second largest component of water cycle and a critical process in terrestrial ecosystems, understanding the inter-annual variability (IAV) of ET is significant in the global climate change context. Eight years of continuous eddy covariance measurements (2003–2010) at a subtropical coniferous plantation were used to investigate the impacts of climatic factors and ecosystem responses on the IAV of ET. The mean and standard deviation of annual ET for 2003–2011 were 786.9 and 103.4 $kgH_2O\ m^{-2}\ yr^{-1}$ (CV=13.1%), respectively. The IAV of ET built up mainly in three periods: March, May and June, October, which were mainly the transition periods between seasons.

A set of look up tables (LUTs) approaches were used to separate the sources of IAV. Annual ET was calculated by assuming that (a) the climate and ecosystem responses among years are both variable ($V_{cli\text{-}eco}$), (b) the climate is variable and the ecosystem responses are constant (V_{cli}) and (c) the climate is constant and ecosystem responses are variable (V_{eco}). The analysis of ET calculated under the above assumptions suggested that the IAV of ET was dominated by ecosystem responses, and there was a negative interaction between effects of climatic factors and ecosystem responses. The study emphasized the importance to understand the mechanisms of ecosystem responses. Therefore, for long-term predictions of water and energy balances in global climate change projections, the ecosystem responses must be taken into serious accounts so as to restrain estimation uncertainties.

[J1-086]

LONG-TERM VARIATION AND SOURCE ANALYSIS OF RADIOACTIVE CESIUM IN THE OHORIGAWA RIVER

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Radioactive materials were released from the Tokyo Electric Power Company's Fukushima nuclear power plant after the Great East Japan Earthquake on 11 March 2011. They were diffused into the atmosphere, deposited with rainfall, and incorporated into surface waters and aquatic organisms. The Japanese government regulates food and drink to protect the health of the populace. Fishes in some areas are now regulated owing to high concentration of radioactive cesium. It is necessary to understand the sources, behavior and fate of radioactive cesium in waters. In the metropolitan area, high concentration of radioactive cesium has been detected from sediments in the Ohorigawa River and *Carassius auratus langsdorfii* harvested in the Teganuma Pond, which the Ohorigawa River enters, has been regulated. Therefore, in this study, we surveyed long-term variation of radioactive cesium in suspended solids (SS) in the Ohorigawa River and analyzed its sources using molecular makers, namely sterols and hydrophobic pharmaceutical and personal care products.

The sampling campaign has been done from May 2012. A SS sampler proposed by Phillips et al. (2000) was set at the Showabashi Bridge. This sampler is useful to collect time-integrated SS samples. Samples collected by the SS sampler and the river waters were collected every two to three weeks. Fifteen samples collected by the sampler, fifteen river water samples at dry weather and three river water samples at wet weather were collected. Sediments were collected at six sites in the Ohorigawa River in October, 2012. Street dust was collected in the catchment in October, 2012. Road runoff was collected three times in the catchment. The water samples (river water samples, samples collected by the SS sampler, and street runoff samples) were filtrated with GF/F glass fiber filters (Whatman, pore size 0.7 μm) . The filters and solid samples (sediment samples and street dust samples) were freeze-dried. Radioactive cesium (Cs-134 and Cs-137) in samples was measured by germanium semiconductor detector and multi channel analyzer. The radioactivity was decay-corrected based on the collection date.

Cs-137 concentrations in SS in the river samples during dry weather and wet weather, SS sampler and street runoff were in the range of 1380–9630 Bq/kg, 7580–15100 Bq/kg, 3460–15900 Bq/kg, and 7340–27300 Bq/kg, respectively. Radioactive cesium concentrations in both the river waters and the SS sampler showed a decrease trend.

Radioactive cesium concentrations in SS in the river water were much higher than those in sediments and lower than or comparable to those in street dust and SS in street runoff. Radioactive cesium concentrations in SS in the river water at wet weather were higher than those in the river water at dry weather. Radioactive cesium concentrations in SS in the SS sampler were significantly higher than those in the river water with the same sampling period. These results indicate that radioactive cesium concentrations in SS in the river water were higher at wet weather than at dry weather.

Use of molecular markers showed the major source of radioactive cesium in the river water was street dust, followed by river sediments and river waters at dry weather. Even after one and half year had passed since the accident, radioactive cesium was present in the catchment surface deposits such as street dust and gradually washed out to enter the river over time.

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[J1-087]

THE CHRONICLE OF THE ESTIMATING METHOD OF PROJECT DESIGN FLOOD IN JAPAN

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The purpose of this study is to present the chronicle of the estimating method and concept of Project Design Flood (PDF) in Japan . When a flood protection project is planned and managed, PDF is calculated and set for each river. In Japan, PDF is set by using the return period of annual maximum precipitation according to the economic and social importance of the river. For example, the PDF of the Tone River and the Yodo River, which are the most important rivers, are set to 200 years.

The estimating method and concept of PDF was imported by Dutch engineers in the early the Meiji-era (1868-). From the Meiji-era to WW2 (-1945), PDF was set by using the largest flood discharge in recorded history. Right after WW2, however, a large number of floods exceeding PDF occurred, leaving enormous damage: Makurazaki typhoon in 1945, Kathleen typhoon in 1947, Ione typhoon in 1948 and the record braking rainfall in Western Japan in 1953. The Japanese government needed to update PDF in many rivers. However, using those recorded flood discharge to set PDF would require a big budget for the flood protection projects in spite of limited national budget after WW2. Hence, Japanese government and researchers brought in an exceedance probability method, which was developed by American researchers [e.g. Fuller (1914), Foster (1924) and Hazen (1930)], to make PDF adjustable to the national budget scale at the time; the revised PDF of the Tone River and the Yodo River were 100 years. After the Rapid Economic Growth in Japan, the return period of PDF in each river increased along with the national budget and property. In recent years, the estimating method and concept of PDF have caused heated debates in both the public and academic field. The main reasons of this are: absence of completed flood protection projects, shrinking national budget along with population decline and increasing environmental movements. In addition, some recent floods exceeding PDF accelerates this debate. Thus, this chronicle shows that the calculation method and concept of PDF has been decided not only by the development of technology but also by the economic and social situation.

[J1-088]

COPING WITH FLOODING: THE CASE OF BARANGAY MALINTA, LOS BANOS, LAGUNA, PHILIPPINES

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The study probed two Puroks that had been recently flooded for three months. It sought to determine the history of flooding, its effect to the household and the community as well as the coping strategies that they have employed. Various participatory tools and techniques such as village walk, historical timeline, participatory mapping, Venn diagram, stakeholder analysis, livelihood analysis, SWOT, and institutional analysis were used to gather data. The participatory mapping revealed that the most recent flooding affected 472 households and has reached as high as 3 feet in some areas. The historical analysis describes that this was the longest and considered the worst flooding that affected the area for the past 26 years. Despite the inconvenience and health related problems resulting from flooding, the affected community members are thankful of the help that came their way from various organizations. As such, the timeline and key informant interviews supported how the community was able to cope with the challenges they faced during times of flooding. The Venn diagram shows how the community was deluged with relief goods which eased the difficulty among the evacuees but also created conflict among community members in the availment of goods. The institutional analysis revealed that village local officials bear the brunt of work and coordination due to lack of community involvement in the various Barangay level committees such as in disaster response and management. The experience has wizened the Barangay officials who have now invested in an early warning system device and several first aid equipment. Despite such attempts for preparedness, the institutional analysis reflects that much is needed to be done in order to develop a plan to address the issue of mitigating measures. A list of mitigating activities and of possible partners were identified to ensure improved preparedness for flooding which is expected to be more frequent in the coming years.

Keywords: participatory tools, participatory techniques, vulnerability, coping strategies

[J1-089]

SIMULATING THE IMPACTS OF FLOOD ON WHEAT-CASE STUDY IN CHINA

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Recent studies have demonstrated that higher and more intense precipitation is increasing in some parts of the world. More frequently occurring water-logging can cause crop losses and large economic costs. Crop yield can thus be significantly reduced under waterlogging conditions. Despite the risk of increased crop losses due to flooding and waterlogging under climate change, the impact of water logging is rarely included or is considered in a very simple way in dynamic crop models. The General Large Area Model for annual crops (GLAM), used in this study, is one such example, which does not presently account for such effects. The aim of this study therefore is to modify the infiltration process of GLAM and assess a number of simple methods for incorporating the negative impact of waterlogging into the GLAM crop model. In order to improve model ability to predict soil moisture, the default infiltration scheme in GLAM was modified. The first modified scheme uses the Soil Conservation Service Curve Number (SCS-CN) method to calculate the infiltration scheme. In the second modified infiltration scheme the infiltration rate of soil is assumed to be affected by the soil water content. While the soil water content is above the soil drainage limit and below the saturated soil water content, the infiltration rate linearly decreases with increase of soil water content. The effect of waterlogging on crop growth is parameterized by introducing a waterlogging stress factor. When the soil water content is greater than the lower limit of waterlogging stress, transpiration rate is reduced by the waterlogging stress factor. The results showed the original model with waterlogging stress is better than without waterlogging stress. The modified GLAM model was better than the original model, and when final infiltration rate was estimated from soil water content based equation, better results were obtained. The improvement in model ability is due to modified infiltration and including of waterlogging stress. This indicates that the crop model can capture the yield reduction duo to floods effect by including the waterlogging stress factor. Therefore it is critical to consider the yield loss due to excess soil moisture when crop model is used for crop forecasting and climate impacts studies in region with intensive precipitation.

[J1-090]

DETERMINANTS OF FARM-LEVEL ADAPTATION TO CYCLONE AND FLOOD: A SURVEY OF FARM HOUSEHOLDS IN ODISHA, INDIA

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Various studies report that farm households in Odisha are vulnerable to cyclone and flood, and they have to undertake adaptation measures to buffer impacts of extreme events in the foreseeable future. A better understanding of adaptation decision-making process is imperative to inform policies aimed at promoting successful adaptation strategies for farmers in rural Odisha. Using data from a survey of 285 farm households in cyclone and flood prone region of Odisha, this study analyses factors influencing farm-level adaptation decision. There are seven mostly practiced farm-level adaptation options e.g. salt and flood tolerant indigenous/ traditional paddy seeds, soil conservation, mixed paddy cropping, crop diversification, land holiday, more time seedling and re-planting, and pest and disease management. A multivariate probit model is used to examine factors influencing farm households' decision to undertake various farm-level adaptation options. This has conceptual similarities with the agriculture technology adoption literature. This study identifies cyclone and/ or flood sensitive adaptation mechanisms. Further, household size, income per member, formal extension, employment opportunity in NREGA, formal crop loss compensation, and informal credit are some of the important determinants. Designing policies that aim to improve these factors for rural farming communities have a significant potential to enhance capacity of the farmers to undertake adaptation measures.

Key words: Cyclone and Flood; Farm-Level Adaptation; Determinants; Odisha

[J2-091]

POLLUTANTS EMISSION BY AGRICULTURAL STRAWS BURNING IN CHINA

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Key words: Biomass burning, Agricultural Straw, Pollutants Emission, Chamber

Biomass burning is an important source of particulate pollutants and volatile organic compounds in the atmosphere and has a significant impact on global climate change and adverse effects on human health. Laboratory measurements were conducted to determine particle size distribution and polycyclic aromatic hydrocarbons (PAHs) emissions from the burning of rice, wheat, and corn straws, three major agricultural crop residues in China. Particle size distributions were determined by a wide-range particle spectrometer (WPS). PAHs in both the particulate and gaseous phases were simultaneously collected and analyzed by GC-MS.

We found burning of agricultural crop residues releases a large amount of pollutants into the atmosphere, including CO, CO2, NOx, particulate matter, hydrocarbons, and other matters, which could cause serious local and regional environmental impacts. Particle number size distributions showed a prominent accumulation mode with peaks at 0.10, 0.15 and 0.15 μm for rice, wheat, and corn-burned aerosols, respectively. PAHs emission factors of rice, wheat and corn straws were 5.26, 1.37 and 1.74 mg kg-1, respectively. It was suggested that the combustion with higher efficiency were characterized with smaller particle size and lower PAHs emission factors. The total PAHs emissions from the burning of three agricultural crop residues in China were estimated to be 1.09 Gg for the year of 2004. The PAH size distribution of the emitted particles is also important due to its impact on the environment and human health, more work is worth to be done in this field of research.

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[J2-092]

CONTRIBUTION OF BIOMASS BURNING TO AIR POLLUTANTS BY EMISSION INVENTORY AND AMBIENT MEASUREMENT: THE PEARL RIVER DELTA REGION, CHINA AS A CASE

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Biomass burning in the Pearl River Delta (PRD) region has been of increasing concerns due to its adverse effects on visibility, urban air quality, and human health. Emissions of major agricultural residues burning were studied by laboratory simulations using a self-designed combustion system and dilution chamber. Emission factors of CO_2, CO, PM_{10}, $PM_{2.5}$, OC and EC in $PM_{2.5}$ were measured to be 1105.2±189.3, 53.2±17.9, 14.0±5.1, 12.1±4.4, 10.53±4.87 and 0.49±0.22 g kg^{-1} for rice straw burning in flaming condition, 1024.0±207.9, 110.6±37.9, 20.6±14.2, 18.3±13.5, 8.77±4.81 and 0.37±0.11 g kg^{-1} for rice straw combustion in smoldering condition, and 1152.5±258, 40.1±15.7, 5.65±1.3, 4.12±1.1, 1.25±0.67 and 1.22±0.66 g kg^{-1} for sugarcane leaves burning, respectively. Total biomass burning emitted CO, NMHCs, NOx, $PM_{2.5}$, OC and EC in the PRD in the year 2008 were estimated to be 193.70, 18.34, 5.08, 15.31, 7.76, 2.71 ktons, respectively. Field burning of straws made a major contribution to $PM_{2.5}$ and OC emissions. Residential sector, including firewood and crop straw consumption, was the dominant source of EC, CO and NOx.

Meanwhile, the ambient VOCs were measured by a proton transfer reaction - mass spectrometer (PTR-MS) at a receptor site in the Pearl River Delta (PRD) in 2008. Biomass burning plumes are identified by using acetonitrile as tracer, and enhancement ratios (ERs) of nine VOCs species relative to acetonitrile are obtained from linear regression analysis and the source-tracer-ratio method. Biomass burning was estimated to contribute 9.5%-17.7% to mixing ratios of the nine VOCs. The estimated biomass burning contributions are compared with local emission inventories. Large discrepancies are observed between our results and the estimates in emission inventories. Though biomass burning emissions in TRACE-P inventory agree well with our results, the VOCs speciation for aromatic compounds may be not appropriate for Guangdong.

Keywords: biomass burning; emission inventory; acetonitrile, validation

[J2-093]

FOREST FIRE PREVENTION FOR MITIGATING GHG EMISSIONS IN INDONESIA

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Scientific evidence have shown that forest fire in Indonesia is not new, because it had been been occurred since 15510 BC and 1650 AD. Big forest fire for the first time occurred in East Kalimantan in the year 1982/1983 where 3.6 million ha of forest and land burnt, then every year fire blow up with different size and impact. An assessment of Indonesia's peat land GHG emissions from fire, peat oxidation and loss of AGB, completed according to IPCC Tier 2 standards, shows average annual net emissions of 903 Mt CO2 yr-1 between 2000 and 2006. This estimation is based emissions from oxidation of 220 Mt CO2/yr using land use and land cover data from 2000-2006 and previously published emissions factors; loss of AGB of 210 Mt CO2/yr based on past rates of deforestation and carbon stock in peat swamp forests and fire emissions estimate of 470 Mt CO2/yr which divided into controlled and uncontrolled burning. The majority of the peat emissions during this period are estimated to be a result of uncontrolled burning (defined as fires occurring outside of licensed areas and contributing 46% of total emissions), peat oxidation (25%) and biomass removal (24%) with the main source regions being Sumatra (44%) and Kalimantan (40%). Forest and land fires in Indonesia finally known also as one of the main contributor to deforestation and land conversion which responsible for mostly of greenhouse gas produced. These all directly or indirectly could increase the global greenhouse gas emission which finally will cause global climate change. To mitigate GHG emission then controlling forest fire and peat fire become the most important activities should be done. The government of Indonesia already declare to reduce 26 % GHG emission until the year 2020 by the own support and 41 % if it will be supported by international community. At the government level it had been agreed to reduce 20 % hotspot every year based on the 2005-2009 average hotspot baseline, land clearing without fire, community based fire management, increasing the capacity of local government and community in controlling forest fire hazard, law enforcement. It means that forest fire controlling especially fire prevention activities become important and significant.

Key words: Forest Fire, Prevention, GHG emission, Indonesia, mitigate

[J2-094]

HUMAN DIMENSIONS OF FIRE ON TROPICAL PEATLANDS: REFLECTIONS FROM THE EX MEGA RICE PROJECT AREA IN CENTRAL KALIMANTAN, INDONESIA

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Managing fire in degraded tropical peatlands is an integral part of conserving, rehabilitating and reducing the GHG emissions from this ecosystem. The issue of climate change has highlighted the importance of tropical peatlands: Carbon stored underground in tropical peatlands in Indonesia are estimated to be 55 +/- 10 Gt[1]. Per hectare, they contain 10 times the amount of carbon found on mineral soils[2]. Peat fires release huge quantities of greenhouse gasses (GHGs), and prevent plant regeneration. In Indonesia, a country currently populated by 230million people, 60% of total carbon emissions are caused by Peatland degradation[3].

We review the human dimensions of fires on degraded tropical peatlands, by asking: How do humans influence and perceive the causes, impacts and management of peat fire? We reflect on our research in parts of the Ex Mega Rice Project area in Central Kalimantan (Ex MRP), Indonesia. Also known as the Million Hectare Rice Project, this area went through large-scale land conversion induced by a government policy for rice self-sufficiency in the mid-late 1990s. It caused widespread degradation, leading a once fire-resistant ecosystem to become fire-prone. Fifteen years later, the area is still prone to annual fires during the dry season.

We highlight the implications of human dimensions on local strategies to reduce fire on these peatlands. For example, the abrupt EMRP-associated environmental changes that led to these fires had outpaced the local communities' ability to form (formal/informal) institutions to deal with fires. Fires in the vast, 'unused' degraded peatland are often left unchecked, since the most important sources of livelihoods (rubber and rice) are limited to areas with no/little peat. Fires on degraded peatlands can be beneficial; they clear vegetation, making it easier to reach pockets of wetland areas where fish is abundant, and remnant forests that are relatively resistant to fires. In this particular setting, the scope for strategies such as community-based fire management on degraded peatlands is limited, and conditional on continuous and significant technical and financial assistance from outside sources.

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[J2-095]

IMPACT OF FIRE EMISSIONS IN SOUTH ASIA ON AIR QUALITY IN THE REGION

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Open biomass burning yields large amount of trace gases and particulates to the atmosphere on a regional and global scale. Emissions of these trace gases strongly influences chemical environment, leads to formation of secondary pollutants, and significantly impacts local air quality. In this study, for the first time, the influence of spring (MAM) time biomass burning in South Asia on regional air quality have been evaluated using WRF-Chem regional chemical transport model and fire inventory (FINNv1) from NCAR. Model results are compared with tropospheric column retrievals of carbon monoxide (CO) from MOPITT and nitrogen dioxide (NO_2) from OMI. Model results capture reasonably well temporal variation when simulation includes daily varying biomass burning (index of agreement (*R*) for CO is 0.89 and 0.63 for NO_2) emissions indicating that it is well suited for simulating the overall fire impact on regional scale. A clear increase in CO, NO_2 and PM2.5 levels over whole Eastern region including Burma (35-60%), Central India (30-50%), Indo-Gangetic (15-25%) region and Bay of Bengal (15-40%) has been observed. The model results are also used to quantify the amount of ozone net production which shows significant ozone production up to 5 ppb h-1 over inland region and up to 0.2 ppb h-1 over marine region. Our modeled based analysis yield average $\Delta O_3/\Delta CO$ ratio of 0.13 ±.04 ppbv/ppbv and ozone production of 3.8 ± 1.2 Tg O_3 during spring season. The findings demonstrate that springtime fire emissions in South Asia have significant impact on air quality in this region.

[A7-096]

RESPONSES OF CO_2 FLUXES IN DRY DIPTEROCARP FOREST TO CLIMATE VARIABILITY

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Increase in frequency and intensity of extreme climatic events due to global warming has escalated the concerns for its adverse impacts on the environment. In Thailand, various records during the past 50 years indicate the increase in average surface temperatures, the increased intensity and duration of droughts and floods. The numbers of warm days/nights have also increased significantly. Precipitation trend analysis indicates that Thailand will be experiencing more intense rainfall while the numbers of raining days are decreasing. Thus, Thailand is increasingly facing the warming future, with high annual and decadal climate variability. It is therefore important to evaluate the impacts of these climate extremes and to improve our understanding of the response of various ecosystems to such climatic variability.

Using eddy covariance method for canopy and automatic chamber for soil surface fluxes, we have measured CO_2 exchange over the canopy of dry dipterocarp forest in Thailand since 2008. The dry dipterocarp forest ecosystem typically occupies the area where a clear dry period of 3-4 months and precipitation amount of 900-1200 mm per year is found. The study site is located within the 178 ha-dry dipterocarp forest inside the campus of King Mongkut's University of Technology Thonburi (KMUTT), Ratchaburi Province in western Thailand (13^o 35' 13.3'' N, 99^o 30' 3.9'' E). During four years of measurements, the dry period during 2009-2010 was considered hotter and longer than usual. Low precipitation, high soil temperature over 40˚C and low soil moisture below 5 %Vol were recorded for a prolonged period, while in other years this was not occurred. We found that the net NEP, RE, and soil respiration were not significantly different during these four years of measurements, despite the prolonged dry period during 2009-2010 as mentioned above. However, GPP and RE responded differently to the increase in soil moisture. During the transition period from dry to wet seasons, RE increased more rapidly than GPP. As a result, NEP significantly decreased due to the increasing contribution of RE. During the dry period when forest shades their leaves, the carbon exchange process was dominated by RE. Soil respiration usually accounted for >80%and below 50% of the total ecosystem respiration during the dry and wet period, respectively. Therefore, unusual long dry period of 2009-2010 do not have any significant effects on the annual NEP (which was approximately 12-13 ton C ha^{-1} y^{-1}). This was probably because the increase in RE during dry period is compensated by the high GPP during the late raining season. Our results implies that the dry dipterocarp forest is capable of effectively adapting to variations in climatic variables such as longer-than-usual dry period and high soil temperature.

[A7-097]

TEMPORAL AND SPECIAL VARIATION OF NPP IN GUANGDONG PROVINCE EVALUATED BY IMPROVED CASA MODEL

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Using data of MODIS NDVI, climate and land use, spatial and temporal dynamics of NPP produced by Guangdong's terrestrial ecosystem during 2001~2007 was estimate by improved CASA model. Light energy utilization status, relationship between NPP and climate factors and NPP in the future 100 years are analyzed in the paper. Main results are:

Mean NPP over 2001~2007 in Guangdong is 138.8TgC·yr^{-1}, where NPP of 2003 is the highest and 2005 the lowest. Decreasing trends of annual NPP over the period in Northern, Middle and Southern Guangdong was examined as -34.9±20.8gC·m^{-2}·yr^{-1}, -25.7±21.5 gC·m^{-2}·yr^{-1} and -20.5±22.9 gC·m^{-2}·yr^{-1} respectively, Which is more significant in northern area with better vegetation cover. NPP is produced mostly during May to October.

Mean NPP in northern Guangdong was estimated as 857.7±230.5 gC·m^{-2}·yr^{-1}, which is higher than that of the Pearl River Delta, 472.2±304.1 gC·m^{-2}·yr^{-1}, due to vegetation cover difference.

NPP varies with land use type, the top-down sequence is: woodland > grassland > cropland > urban and built-up > Barren or Sparsely Vegetated.

Mean APAR, ε, and LUE of 2001~2007 in Guangdong were estimated as 1371.4±353.4MJ·m^{-2}, 0.531±0.128gC·MJ^{-1} and 1.38±0.53% respectively, which are the highest in 2003 and the lowest in 2005.

There is positive correlation between NPP and temperature in spring and winter, while negative correlation in summer and autumn in some part. There is negative correlation between NPP and rain. Limiting factors of vegetation are different from location, water stress happens mainly in southeast Guangdong, while light stress and temperature are mainly in northern Guangdong.

Based on climate prediction scenarios and assumption of none vegetation change, NPP in 2100 of terrestrial ecosystem in the province was estimated as 10% lower than current. No significant spatial change was detected.

Keywords: Guangdong Province; improved CASA model; NPP; light energy utilization

[A7-098]

PREDICTING GEOGRAPHIC DISTRIBUTION AND HABITAT SUITABILITY DUE TO CLIMATE CHANGE OF SELECTED THREATENED FOREST TREE SPECIES IN THE PHILIPPINES

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Climate change is projected to alter the geographic distribution of forest ecosystems. This study aimed to evaluate the consequences of climate change on geographical distributions and habitat suitability of 14 threatened forest tree species in the Philippines. Based on the principle of maximum entropy, it utilized a machine algorithm called Maxent to estimate a target probability distribution and habitat suitability of the selected species.

Threatened forest tree species occurrence records and sets of biophysical and bioclimatic variables were inputted to Maxent program to predict current and future distribution of the species. The Maxent models of the threatened species were evaluated using Receiver Operating Characteristics Area Under Curve (ROC AUC) and True Skill Statistics (TSS) tests which revealed that the models generated were better than random. The Maxent models ROC AUC values of the 14 species range from 0.70 to 0.972 which is higher than 0.5 of a null model. Based on TSS criteria, Maxent models performed good in two species, very good in ten species, and excellent in two species.

Seven species (*Afzelia rhomboidea*; *Koordersiodendron pinnatum*; *Mangifera altissima*; *Shorea contorta*; *Shorea palosapis*; *Shorea polysperma*; *Vitex parviflora*) were found to likely benefit from future climate due to the potential increase in their suitable habitat while the other seven species (*Agathis philippinensis*; *Celtis luzonica*; *Dipterocarpus grandiflorus*; *Shorea guiso*; *Shorea negrosensis*; *Toona calantas*; *Vatica mangachapoi*) will likely experience decline in their suitable habitat.

This study provided an initial understanding on how the distribution of threatened forest trees will be affected by climate change in the Philippines. The generated species distribution models and habitat suitability maps could be used as basis in formulating appropriate science-based adaptation policies, strategies and measures that could enhance the resilience of those threatened forest tree species and their natural ecosystems to current and future climate. In addition, these could also contribute in developing a climate proof protected area management plan.

[A8-099]

CHARACTERIZING TEMPERATURE RESPONSES OF PHOTOSYNTHETIC PHYSIOLOGY IN FLAG AND THIRD LEAVES OF WHEAT

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Intensive land use in agriculture plays an important role globally in gas exchange between the land surface and the atmosphere. Quantifying and understanding the gas exchange of agriculture landscapes is important in order to assess the multiple dimensions of sustainable resource use and trade-offs in ecological-social scenarios related to planning. Development and application of photosynthesis-stomatal conductance coupled models for crop species not only provide insight with respect to possible changes in photosynthetic regulation under global change, but can also help us to better understand carbon and water exchange at larger scales and to evaluate crop yield under future climate conditions. To provide input for parameterization of crop leaf gas exchange models, gas exchange and chlorophyll fluorescence of winter wheat at panicle initiation was sampled. Data were compared to those at tillering stage of paddy rice and obtained over the seasonal courses of cotton crop development.

Our measurement results showed that: 1) Significant differences in the maximum photosynthetic rate (A_{max}) existed between flag and third leaves in wheat, mainly due to higher absolute values of the maximum carboxylation rate (V_{cmax}) and light and CO_2 saturating assimilation rate (P_{ml}) in flag leaves. Additionally, slight difference of initial quantum efficiency (α) in flag and third leaves was observed, but third leaves had higher assimilation rates than flag leaves by 6.3 to 9.7% under low light (less than 350 μmol m^{-2} s^{-1}) and leaf temperature 15 to 20 ^{o}C, respectively. 2) The activation energies (ΔH_a) for both V_{cmax} and P_{ml} in crop species were not always higher than those in tree species, in disagreement with the review of Medlyn *et al.*(2002). 3) At atmospheric CO_2 concentration, 21% O_2 inhibited photosynthesis increased with leaf temperature, by 47% and 27% at 25 ^{o}C in flag and third leaves of wheat, respectively. Stomatal limitation linearly increased with leaf temperature, with no significant difference in flag and third leaves, but flag leaves had higher instantaneous water use efficiency (WUE_i). Generally, between leaf suboptimal temperature (1-3 ^{o}C higher than optimal of photosynthesis), stomatal limitation (40-50%) together with rapid increasing photorespiration are the main factor responsible for decreases in assimilation rate.

The measured data were used to parameterize a physiologically-based leaf gas exchange model. The correspondence in flag leaves of wheat between measured and simulated gas exchange (modeling efficiency 0.88 and 0.90 for assimilation rate and transpiration rate, respectively) was striking, indicating robustness in the derived key photosynthetic parameters from temperature response curves. Observations in flag and third leaves of wheat suggest that the relative importance of shade leaves to primary production must be integrated into canopy gas exchange and yield coupled models in agriculture. The ongoing studies will further characterize and compare seasonal changes in wheat, paddy rice and cotton leaf gas exchange control, especially in relation to final agricultural yields and in response to applied fertilizer levels.

Key words: chlorophyll fluorescence; gas exchange; light acclimation; model parameters; optimal temperature; stomatal limitation.

[A8-100]

SEASONAL VARIATION OF STOMATAL COUNDUCTANCE AT CANOPY-SCALE IN RELATION TO CROP PHENOLOGY

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Introduction

Stomatal conductance (g_s) is an important factor that expresses the effect of stomatal movements on water and carbon transfer between the plant and atmosphere. However, stomatal conductance at the canopy scale cannot be measured directly and usually it has been estimated based on bottom-up approach from the measurement of g_s at leaf-scale. In this study, we aimed to determine g_S values at canopy-scale based on top-down approach from the measurements of sensible and latent flux above the canopy in irrigated rice. Additionally, we examined how g_s values at canopy-scale respond to environmental factors, such as solar radiation and humidity. From the result, we found a common relationship between phenological stage of rice plant and maximum stomatal conductance at canopy-scale. This finding makes it possible to connect the land surface processes in agro-ecosystems with crop phenology.

Materials and Methods

Observations were conducted in commercial rice paddies at three experimental sites with different cropping seasons, i.e. Miyazaki Plain (early-cropping), Saga Plain (late-cropping) and Aso Basin (middle-cropping), under a humid temperate climate in Japan. Sensible heat flux and latent heat flux were observed from transplanting to maturity of rice based on the Bowen ratio energy budget. The Bowen ratio was determined using the gradient of the regression line for the profiles of air temperature and humidity at three different heights above the canopy. Time variation in g_s at canopy-scale were calculated based on top-down approach from the flux data using double source model. Here, it is advantage for g_s calculation that the paddy soils in rice fields are saturated throughout the growing season, so that soil resistance to evaporation is negligible. From obtained data of g_s, we examined their response to solar radiation and vapor pressure deficit to determine seasonal variation in maximum value of g_s at canopy-scale.

Results and Discussion

In all site of three cropping seasons, i.e. early, late and middle cropping seasons, variations in heat fluxes differed for sensible heat and latent heat. Sensible heat flux was smaller and almost constant within the range –50 to 50 W/m^2, whereas latent heat flux showed large variations from 0 to 250 W/m^2 throughout the growth period. Diurnal variation in g_s showed a common trend in all growth periods with lower values in the morning and evening, and higher values during the midday. Correlation between g_s and environmental factors were most significant for solar radiation, but not significant for vapor pressure deficit. The relationship between absorbed solar radiation (S_{abs}) and g_s was determined using a Jarvis-type model for each growth period. Maximum values of g_s for saturated S_{abs} rapidly decreased from 60 to 20 mm/s between the active tillering and panicle formation stages, and moderately decreased from 20 to 10 mm/s during the ripening stage. Seasonal variation in g_s can be commonly expressed for all cropping seasons using a function of rice phenological stage (P_s). Using these functions, the g_s value can be obtained easily at a given solar radiation and phenological stage, which makes it possible to estimate water requirements and photosynthesis rate in agro-ecosystems more accurately at canopy scale in relation to crop phenology.

[A8-101]

CANOPY-SCALE RELATIONSHIPS AMONG LEAF NITROGEN CONTENT, PHOTOSYNTHESIS, AND STOMATAL CONDUCTANCE IN IRRIGATED RICE

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Modeling stomatal behavior is critical in research on land–atmosphere interactions and climate change. The most common model uses an existing relationship between photosynthesis and stomatal conductance. However, its parameters have been determined using infrequent and leaf-scale gas-exchange measurements and may not always be representative of the whole canopy in time and space. In the present study, we used a top-down approach based on a double-source canopy model and eddy flux measurements throughout the growing season. Using this approach, we quantified the canopy-scale relationship between gross photosynthesis and stomatal conductance for 3 years and their relationships with leaf nitrogen content throughout each growing season above a paddy rice canopy in Japan. The canopy-averaged stomatal conductance (g_{sc}) increased with increasing gross photosynthesis per unit green leaf area (A_g), as was the case with leaf-scale measurements, and 41 to 90% of its variation was explained by variations in A_g adjusted to account for the leaf-to-air vapor-pressure deficit and CO_2 concentration using the Leuning model. The slope (m) in this model (g_{sc} versus the adjusted A_g) was almost constant within a 15-day period but changed seasonally. The m values determined using an ensemble dataset for two mid-growing-season 15-day periods were 30.8 (SE = 0.5), 29.9 (SE = 0.7), and 29.9 (SE = 0.6) in 2004, 2005, and 2006, respectively; the overall mid-season value was 30.3 and did not greatly differ among the 3 years. However, m appeared to be higher during the early and late growing seasons. These findings suggest that the use of a constant m throughout the growing season could lead to miscalculating the canopy energy balance and plant water status in models that use the photosynthesis–conductance framework. Incorporating additional adjustments that account for such seasonal changes in m or explicitly varying m values based on crop development may be a possible strategy for improving those models in water-limited or high-temperature environments. In addition, we have discussed the agronomic impacts of the interactions between leaf nitrogen content and g_{sc}. The ontogenic changes in leaf nitrogen content strongly affected A_g and thus g_{sc}. Despite limitations in the observations and modeling, our canopy-scale results emphasize the importance of continuous, season-long estimates of stomatal model parameters for crops using top-down approaches.

[A8-102]

RESPONSE OF PHOTOSYNTHETIC PARAMETERS IN SUBTROPICAL FORESTS TO DROUGHT

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Drought, which is expected to increase in frequency, extent and severity with climate change, affecting the structure, function, process of forest ecosystems. Based on the throughfall manipulation experiment in the Qianyanzhou station in China, we used gas exchange techiniques to measure the CO_2 response curve of photosynthesis in subtropical forest, examing the response of photosynthetic parameters (V_{cmax} [maximum rate of Rubisco carboxylation], J_{max} [RuBP regeneration capacity mediated by maximum rate of photosynthetic electron transport], g_s [stomatal conductance], *TPU* [the rate of triose phosphate utilization]) to different drought level. Soil moisture was significantly different among two treatments (Control and dry plots), but none-significant results can be found for leaf chemistry chacterestic. The net photosynthesis rate (A_n) was significantly lower in dry plots than in control plot, while there was not significantly different for photosynthetic parameters among treatments except g_s. This suggested that the drought regulated the stomatal conductance, and then slowed the photosynthesis rate. Photosynthetic capacity was greater in Masson pine than in Schima. Meanwhile, it also indicated that Masson pine is more resilence to drought than Schima. Furthermore, the relationships of photosynthetic parameters with leaf nitrogen content were also limited by drought.

Keywords: Photosynthesis; Drought; Stomatal conductance; Subtropical forests

[A8-103]

INCORPORATING SEASONALLY VARYING SURFACE ORGANIC LAYER INTO VERSION 4 OF THE COMMUNITY LAND MODEL

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Organic material plays an important role in surface energy partitioning due to its distinct thermal and hydraulic properties compared to mineral soil. Although most of soil in a temperate deciduous forest and deciduous grass is covered by a shallow litter layer during dormant period, it is not considered properly in land surface models. CLM4 considers the effect of seasonally varying litter indirectly using radiative effect of dead standing grass (SAI) which increases after litterfall and decreases linearly during dormant period. In this study, we removed radiative effect of dead standing grass and incorporated a seasonally varying shallow litter layer above the mineral soil in CLM4 and scrutinized the simulated surface fluxes and soil temperature and moisture against the *in-situ* observation data over a Tibetan grassland. The litter depth is parameterized to vary depending on litter mass and litter density. To consider decrease of litter depth during dormant period, we used low litter density for new-fallen litter and increased litter density with rain and snowfall amount over the litter layer during dormant period. The moisture of litter layer is parameterized to increase with intercepting rainfall and to decrease with evaporation. Preliminary results show that incorporation of the shallow organic layer shows improvement of underestimation of soil temperature and sensible heat flux during winter. However, it prevents rapid warming of soil during spring. Other problems and difficulties in the parameterization are also discussed.

[J3-104]

ELK-TESTING LANDSURFACE MODELS BY INTEGRATION OF LOCAL AND GLOBAL OBSERVATIONS

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Process-oriented biogeochemical models are a primary tool that has been used to project future states of climate and ecosystems in the earth system in response to anthropogenic and other forcing, and receive tremendous attention also in the context us the planned assessment report AR5 by the IPCC. However, model intercomparison and data-model comparison studies indicate large uncertainties regarding predictions of global interactions between atmosphere and biosphere. Rigorous scientific testing of these models is essential but very challenging, largely because neither it is technically and ethically possible to perform global earth-scale experiments, nor do we have replicate Earths for hypothesis testing. Hence, model evaluations have to rely on monitoring data such as ecological observation networks, global remote sensing or short-term and small-scale experiments. Here, we critically examine strategies of how model evaluations have been performed with a particular emphasis on terrestrial ecosystems. Often weak 'validations' are being presented which do not take advantage of all the relevant information in the observed data, but also apparent falsifications are made, that are hampered by a confusion of system processes with system behavior. We propose that a stronger integration of recent advances in pattern-oriented and system-oriented methodologies will lead to more satisfying earth system model evaluation and development, and show a few enlightening examples from terrestrial biogeochemical modeling and other disciplines. Moreover it is crucial to take advantage of the multidimensional nature of arising earth observation data sets which should be matched by models simultaneously, instead of relying on univariate simple comparisons. A new critical model evaluation is needed to improve future IPCC assessments in order to reduce uncertainties by distinguishing plausible simulation trajectories from fairy tales.

[J3-105]

RECONCILING TOP-DOWN AND BOTTOM-UP CARBON FLUXES OF SOUTH ASIA

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The source and sinks of carbon dioxide (CO_2) and methane (CH_4) due to anthropogenic and natural biospheric activities were estimated for the South Asia region (Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka), using the top-down and bottom-up methods. Based on atmospheric CO_2 inversions (top-down), the net biospheric CO_2 flux in South Asia (equivalent to the Net Biome Productivity, NBP) was a sink, estimated at -104±150 TgC yr^{-1} during 2007-2008. Based on the bottom-up approach, the net biospheric CO_2 flux is estimated to be -191±193 TgC yr^{-1} during the period of 2000-2009. The bottom-up estimate includes: (1) the Net Ecosystem Productivity from the terrestrial ecosystem models, (2) the annual net carbon flux from land-use change, (3) the riverine export flux from terrestrial ecosystems to the coastal oceans; and (4) the net CO_2 emission due to biomass burning. The emissions from the combustion of fossil fuels is estimated as 444 TgC yr^{-1} for the decades of 2000s. Based on bottom-up and top-down estimates, and chemistry-transport modeling, we estimate that 37±3.7 TgC-CH_4 yr^{-1} (radiative forcing weighted CO_2-equivalent emission = 37x23 TgC) were released to atmosphere from South Asia during the 2000s.

Although the region-aggregated total fluxes from top-down and bottom-up estimations agree well, large uncertainty (similar as the values or greater) still remains at process level understanding of the carbon flows between pools as well as the values assigned to individual pools. Further cooperation is needed between the carbon cycle research communities for making policy-relevant carbon budgets for the Asian regions. Organizational efforts are being continued by an Asia-Pacific Network (APN) and the REgional Carbon Cycle Assessment and Processes (RECCAP) projects over the past few years.

[J3-106]

ESTIMATION OF TERRESTRIAL WATER STORAGE FROM HYDROLOGIC MODELING, GRACE, AND LAND-ATMOSPHERE WATER BALANCE ANALYSIS

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Among the global water cycle components, Terrestrial Water Storage (TWS) is perhaps the one most difficult to estimate. At least three approaches are currently available to estimate TWS variations over the large scale: (1) the column-integrated atmospheric vapor convergence provides a global distribution of precipitation minus evapotranspiration. The combined land-atmosphere water balance computation using the atmospheric and river discharge data can be used to estimate the temporal change of spatially averaged TWS over large areas; (2) Satellite observations of Earth's time-variable gravity field from the Gravity Recovery and Climate Experiment (GRACE) mission launched in 2002 have provided a unique opportunity of monitoring monthly or longer TWS variations from space. (3) Land Surface Models (LSMs) used for climatic studies is the only tool at present to estimate the variations of TWS and its components (soil moisture, groundwater, snow, etc.) at any temporal and spatial scales, provided that LSMs are well constrained by accurate meteorological forcing and satellite- and ground-based observational data for calibration and validation. In this study, large-scale TWS variations are estimated over selected global largest river basins by using a LSM hydrologic modeling. Model simulations of TWS are validated against the GRACE TWS data, and also compared with the estimates derived from the combined atmospheric-land water balance computation at daily, monthly, seasonal and interannual timescales. Also, various TWS estimates from the above three approaches are compared to the direct observations in Illinois where a comprehensive long-term hydrologic datasets, including groundwater level and soil moisture, are available. The ultimate goal of this study is to provide a quantitative assessment on the TWS dynamics controlling the propagation of hydro-climatic anomalies across the atmospheric and terrestrial branches of regional hydrology from daily to inter-annual timescales.

[J3-107]

DEVELOPMENT OF A NEW MODEL OF PAN EVAPORATION

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Traditionally, evaporation pans are used as physical means for measuring the evaporative demand of the atmosphere with applications in agricultural water use and water resources management. In the context of global warming, analysis of long-term pan evaporation data has shown a general trend of decline across many regions worldwide. This global phenomenon has gained widespread interest (e.g., Peterson et al. (1995), Brutsaert and Parlange (1998), Roderick and Farquhar (2002), Ohmura and Wild (2002)) because it involves the question of changing water cycle that is both of scientific and socio-economic concern in a changing environment. Driven by the potential of using long-term pan evaporation data for evaluating Global Circulation Models, Rotstayn et al. (2006) have developed the PenPan model. However, more detailed assessment of the PenPan model is needed before we could confidently do some calculations. To that end, we monitored an instrumented US Class A pan that replicated an operational pan at Canberra Airport in Australia. By a combination of the experimental programme (2007-2010) and theoretical formulations, we studied the heat and mass transfer of pan evaporation under non-steady state conditions. In this presentation, we will describe the development of a new Penman-type pan evaporation model and its evaluation.

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[J4-108]

GLOBAL DATASET OF HISTORICAL YIELDS: TOWARD LINKING YEAR-TO-YEAR VARIATIONS OF CROP YIELDS WITH RECENT CLIMATE EXTREMES

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Crop production per unit area (i.e., yield) is a fundamental parameter in agricultural and environmental research as well as land-use change research. Recent changes in crop yields have implications for global food security and land-use change in near future, which will likely be affected by climate change as well. We developed a spatially explicit global dataset of historical yields for maize, soybean, rice, and wheat in order to explore the historical changes in time-mean, year-to-year variation, and annual rate of change in yields for the period 1982–2006. The historical and spatial patterns of yields at a grid size of 1.125° were modeled by combining global agricultural datasets related to crop calendar and harvested area in 2000, country yield statistics, and NOAA/AVHRR satellite-based net primary production. The modeled yields were compared with other global datasets of yields in 2000 (M3-Crops and MapSPAM) and subnational yield statistics for 23 major crop-producing countries. We examined the spatially patterns of historical changes in time-mean, coefficient of variation, and annual rate of change in yields in the 2000s relative to the 1980s. Southern hemispheric low and mid-latitudes (0–40°S) experienced significantly increased year-to-year variations in maize, rice, and wheat yields in the 2000s. In these regions, increases in time-mean yields of these crops are limited compared to those in other areas, despite the higher annual rates of increase in yields. By examining the new global dataset of historical yields, increased year-to-year variations in crop yields were evident in a broad region of the southern hemisphere where many developing countries are located. Such changes may be related to reported recent yield stagnation and collapses. Although our understanding of the impacts of recent climate change, particularly incidences of climate extremes, on crop yields remains limited, our dataset offers opportunities to close parts of this knowledge gap.

[J4-109]

ECOSYSTEM PROCESSES AND FUNCTIONS OF CHANGING LAND SYSTEM AND CLIMATE EXTREME

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Ecosystem behavior is coupled with the interaction of biological components and surrounding environments with various spatial and temporal scales. Recent anthropogenic activities such as vast land-use changes, exploitation of natural resources and excess consumption of energy and food widely disturb and alter the natural processes and functions of the land system locally, regionally and globally. The Global Land Project (GLP), a joint core-program of International Geosphere-Biosphere Program (IGBP) and International Human Dimension Program (IHDP), is designed to promote the land system science focusing on the coupled social and ecological system in land under the multiple global and regional issues, and to develop the management option toward the sustainable society in future. In this presentation, I introduce the conceptual and analytical framework of the GLP with interdisciplinary aspects and approaches and then review the current progress and findings of the GLP related studies.

Nitrogen cycle is one of the key ecosystem process relating the various ecosystem functions and services such as carbon sequestration, water purification, air quality control, productions of timber, fiber and food, and so on. Current on-going environment changes including air pollution, climate changes and land-cover/land-use changes increased the pools and fluxes of reactive nitrogen in many ecosystem components with various magnitudes and mechanisms. However the interrelation between climate changes and nitrogen cycle in the system has not been fully understood yet. I introduce a couple of case studies and field experiments trying to clarify the impact of winter climate changes (decrease of snowpack and increase of freeze/thaw cycle in soil) on nitrogen dynamics in natural forest ecosystem. I also highlight the current on-going program to synthesize the cascading interaction of nitrogen biogeochemistry in ecosystem by analyzing the long-term and cross-site analysis of anthropogenic and natural behavior of nitrogen as a useful indicator of various social and environmental problems.

[J4-110]

BIOGENIC VOCS EMISSIONS AND THEIR IMPACTS ON SURFACE OZONE IN THE PEARL RIVER DELTA REGION, CHINA

Wang Xuemei[1], Situ Shuping[1], Guenther Alex[2], Turnipseed Andrew[2], Jiang Xiaoyan[2], Wu Zhiyong[1], Zhou Guoyi[3], Bai Jianhui[4], Wang Xinmin[5]

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Combining Thematic Mapper images and local-survey data to characterize plant functional types (PFTs) and using observed emission potential of BVOCs from local plant species and high-resolution meteorological outputs from mesoscale atmospheric model, MEGAN was constrained to estimate the biogenic VOCs (BVOCs) emissions. The MEGAN output was used to drive the Weather Research and Forecasting model with chemistry (WRF-Chem) to study the impacts of BVOCs on surface ozone in the Pearl River Delta (PRD) region, China. The results show strong variabilities of BVOCs emissions spanning diurnal and seasonal time scales, which are mainly distributed in the remote areas (with more vegetation and less economic development) in the PRD. ~3 ppb of the daytime ozone peak is related to the BVOCs emissions on monthly average in fall, and surface ozone in the urban area and in the downwind area are most sensitive to the BVOCs emissions. The max hourly impacts vary between 10 and 24 ppb in the urban and downwind areas. Additional experiments concerning the sensitivity of BVOCs emissions and surface ozone to MEGAN input parameters. Using MODIS PFTs data, BVOCs emissions decrease 27%, and isoprene emissions decrease most, ~49%. Using MEGAN model default emission factors lead to 24% increase in BVOCs emissions. Increasing (Decreasing) temperature and downward shortwave radiation produces more (less) BVOCs emissions, and the isoprene is the most sensitive species to the changes of meteorological forcing, varying between -39.6 and 50.7%. Impacts on surface ozone change by a factor of 1.5 if the BVOCs emissions change by a factor of 3, and surface ozone is more sensitive to landcover change, followed by emission factors and meteorology.

Key word: BVOCs emissions, MEGAN, surface ozone, PRD

[J4-111]

IMPACTS OF LULCC ON REGIONAL CLIMATE IN CHINA

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My talk will introduce the up to date advances of a National Key Basic Research Project in China, "Impacts of Large Scale Land Use and Cover Change on Regional Climate".

It is well known that the impact of human activities on global climate and environment is one of the frontiers in global change researches, especially the large-scale land use/cover changes (LUCC). LUCC can significantly alter the surface physical characteristics and the land surface-atmosphere exchanges of energy, water and materials and thus have significant impacts on climate and environment. However, LUCC on regional climate research has not yet been given systematic and quantitative assessments. The main reasons include: the lack of long-term observations of the exchanges between land surface and atmosphere in terms of momentum, heat and water vapor under different land cover types; the limited understanding of the impacts of LUCC on climate, especially on key processes of energy and water cycles; uncertainties in numerical modeling owing to the differences in involved models, land surface parameterization schemes and employed land cover maps.

Asia, especially China is one of the regions with most intense human activities, and is also one of the most representative regions with large scale LUCC. Based on outfield observation experiments, satellite remote sensing, reconstruction of historical data and ensemble regional simulations, this project intends to reconstruct China's temporal and spatial evolution of LUCC over the past 300 years, and its impacts on the energy and water vapor cycles of Asian monsoon system. Reveal its possible linkage with the regional climate change, and evaluate LUCC's potential impacts on future climate change in this region. This project reveals the facts and mechanisms of large-scale human-induced LUCC impacting on regional climate, gives the scientific basis for prediction on the regional climate in the future, and provides the scientific advice on orderly human activities and rational use of land resources. The topic of my talk is related to the following issues: (1) The spatial-temporal evolutions of China's land use/cover in the past 300 years and future changes; (2) The analysis on the characteristics of surface-atmosphere exchange of material, energy and water vapor under different land use/cover and the atmospheric boundary layer structure; (3) The impacts of the large-scale LUCC on the energy and water cycle processes of monsoon systems and regional climate; (4) The assessments on large-scale LUCC in regional climate and the ensemble predictions on future climate.

POSTER
SESSION

[PO-112]

APPLICATION OF THE CHARACTERISTICS OF FRACTIONAL UNCERTAINITY ON EDDY COVARIANCE MEASUREMENT TO DATA QUALITY CONTROL

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Micrometeorological heat, water, and CO_2 fluxes have been widely monitored with eddy covariance (EC) method. Its uncertainty information should be as important as the flux measurement itself and indispensable to studies addressing site intercomparison, model validation, and model-data synthesis. Therefore, we estimated the fractional uncertainty (φ) using EC data collected over various types of land cover and at different instrumental heights, and also investigated φ characteristics according to spatiotemporal scale and flux averaging interval (τ).

As results, we demonstrate that the least median of squares method should be applied to estimate φ because the frequency distribution of φ has more significant kurtosis and skewness than Gaussian. Furthermore, we suggest that if φ is estimated under the EC measurement condition satisfying stationarity, it is stable and uniform regardless of land cover, spatiotemporal scale, and kind of flux. Based on the constancy of φ, we determined the baseline as a function of τ for a stationarity or a heterogeneity index of EC measurement.

In addition, these results suggest that φ and τ can be a general threshold to support data quality control and assurance (QCQA), φ analysis is adequate to estimate not only uncertainty magnitude but also whose sources, and τ analysis is helpful to explore ecosystem intercomparison, model development, and model-data synthesis with EC measurement.

Keywords: Eddy covariance measurement, Error analysis, Fractional uncertainty, Quality control and quality assurance

[PO-113]

A STUDY OF CO_2 FLUX IN AFFORESTED CROPLANDS PLANTED WITH THREE TREE SPECIES IN TAIWAN

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In recent years, several flux towers were established in old-aged native forest in Taiwan, such as Chilan, Peitungyen and Xitou stations, to investigate the carbon exchange between land surface and the atmosphere. In this study, we used Eddy covariance method to observe the CO_2 fluxes over the afforestation area, which planted with different species (e.g. Melia azedarach, Pterocarpus indicus and Sapindus). Therefore, the characteristic of carbon sequestration in afforestation could be identified. The study periods were from 24th November to 11th December in 2009 and 4th May to 10th May in 2010. The observed CO_2 flux ranges between -1.5 and 0.3 $\mu g\ m^{-2}\ s^{-1}$. The forest stands was the source of CO_2 attribute to plant respiration during the nighttime. In contrast, it was considered to be the carbon sink due to photosynthesis in the daytime. The CO_2 flux is proportional to vapor pressure deficit (VPD) when VPD < 2.0, but inversely proportional when VPD > 2.3. It can be depicted well by a function of solar radiation, air temperature with a nonlinear regression analysis.

[PO-114]

FOREST EVAPOTRANSPIRATION AND CO_2 FLUX OVER LARCH FORESTS WITH DIFFERENT CANPY STRUCTURE AT EASTERN SIBERIA

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This study investigated evapotranspiration and CO_2 exchange, observed by the eddy covariance method, over two larch-dominated forests mixed with birch and willow, in the southern and middle parts of the Lena basin, eastern Siberia. One is the Spasskaya Pad station (SP) at Yakutsk (62° 15´N, 129° 14´E). The other station named Elgeeii station (EG) (60° 0´N, 133° 49´E) is located at 300 km southeast of Yakutsk. Average of annual precipitation during 1986-2004 is 290mm and 230mm at Ust-Maya, which is the nearest station at a distance of 60km from Elgeeii, and Yakutsk, respectively, while difference of the other meteorological values such as air temperature and humidity is small (Suzuki et al., 2007). The dominant species in the forest is larch (*Larix cajanderi*), mixed with birch (*Betula pendula*), willow (*Salix bebbiana*) and pine (*Pinus sylvesrtis*). The stand density of larch trees is 720 and 1040 trees ha^{-1} (1800 and 2600 trees ha^{-1} including birch, salix and pine) at SP and EG, respectively. The mean stand height of upper canopy, which is comprised of larch trees, is around 20m at SP and 25m at EG, and plant area index measured in August 2011 is 1.4 at SP and 2.1 at EG.

Observations in three growing seasons showed similarities in the seasonal variation of meteorological conditions and evapotranspiration, while the two sites varied in gross CO_2 uptake and ecosystem respiration during the growing season. The total ET during the growing season was almost identical at the two sites, whereas the gross uptake of CO_2 differed between two sites following difference in above ground biomass. It is likely that the level of forest transpiration is commonly optimized to the similar meteorological conditions through a difference in contribution of evapotranspiration from the floor vegetation and the soil water availability. For example, when facing drought conditions during the mid-summer, when CO_2 uptake and ET reached their seasonal peaks, photosynthetic CO_2 uptake increased at both sites due to favourable conditions for photosynthetic activity. Evapotranspiration was increased during this period at EG, but decreased at SP, probably because of the decline in floor ET due to the surface water deficit, which did not affect the canopy-scale CO_2 uptake by trees. Water use efficiency, defined as the rate of net CO_2 uptake to evapotranspiration and of gross (photosynthesis) CO_2 uptake to evapotranspiration, exhibited different behaviours, reflecting the seasonal variations in each flux.

[PO-115]

RADIAL DISTRIBUTION OF SAPFLUX DENSITY TO UPSCALE STAND WATER USE

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Sap flux measurements are widely used for the estimation of tree and stand water use because they are relatively easy to apply, cheap, and reliable. However, there are also limitations or sources of uncertainty when up-scaling from point measurement to whole sapwood area. One of the most important sources of uncertainty is the radial variation of sap flux density, and this radial variation shows high interspecies differences as well. Thus, understanding the radial variation of tree species is essential for estimating stand water use. To figure out the characteristics of radial distribution of sap flux density, we installed Granier type's thermal dissipation sensors on two coniferous species (*Pinus Koraiensis* and *Abies holophylla*) and three deciduous species with different xylem anatomy (ring-porous species: *Quercus serrata, Quercus aliena* and diffuse porous species: *Carpinus laxiflora*) during summer. Based on diameter and sapwood depth, sensors were installed at two or three depths on each tree species. Mean sapflux density of outer sapwood was 12.26 g m^{-2} s^{-1} for *Quercus serrata*, 12.47 g m^{-2} s^{-1} for *Carpinus laxiflora*, 5.49 g m^{-2} s^{-1} for *Abies holophylla*, 7.99 g m^{-2} s^{-1} for *Quercus aliena* and 13.52 g m^{-2} s^{-1} for *Pinus koraiensis*. Sapflux density decreased with sapwood depth in all species, but the magnitude of reduction varied with species. The reduction is highest on *Pinus koraiensis* (93.5%), followed by *Quercus serrata* (69.6%), *Quercus aliena* (58.9%) and *Abies holophylla* (43.4%), and lowest on *Carpinus laxiflora* (3%). Interestingly, except *Carpinus laxiflora*, the magnitude of reduction increased with sap flux density of outer sapwood. Even though there are interspecies differences in radial distribution of sapflux density, unexpectedly this study shows a convergent patterns within deciduous ring-porous and coniferous species.

[PO-116]

REAL-WORLD ERROR AND UNCERTAINTIES ACROSS THE AMERIFLUX NETWORK: SYNTHESIS OF 10 YEARS OF SITE INTERCOMPARISONS

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Data from flux networks are now being used in an ever-increasing number of data synthesis studies. It is essential to identify, quantify, and correct measurement errors to insure consistency of data products. The AmeriFlux network conducts independent site comparisons with a high quality, portable eddy covariance system (PECS) to reduce uncertainty across sites in the network. We present theoretical and empirical error and uncertainty estimates for the eddy covariance technique based on direct comparison of side-by-side measurements. The accumulated record of site comparisons spanning 10 years and over 80 sites provides a rare opportunity to assess the real-world error of network data. Relative instrumental errors, including random and systematic instrumental errors, are described for meteorological variables (< 2.5%), radiation (< 4%), gas concentrations, and turbulent fluxes (< 10%).

[PO-117]

THE EFFECT OF CLIMATE CHANGE ON ECONOMY OF FISHERY INDUSTRY ON CASPIAN LITTORAL STATES

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Sudden changes in the marine environment are more likely to occur near the surface and in shallow coastal waters, often in response to weather events. The Caspian Sea is the water important fishery water body in the country. Russia, Azerbaijan, Kazakhstan, Turkmenistan and Iran are the littoral states of The Caspian Sea .The Caspian Sea is home to 1345 plants and animals and more than 122 fish species .The bulk of the remaining stocks of the world sturgeon resources is located here and provides another unique feature of the Caspian sea where 80-90% of the world Caviar is produced. Transgression of the Caspian Sea level, started in 1978, radically changed the condition of bio resources formation and exploitation and determined the need for assessment of changes. Disturbance of the common system of reproduction, protection and utilization of bio resources connected with establishment of new climate change and independent littoral states. Decreased from 25.8 thousand tones in 1985 to 1345 tones in 2005, in its turn the definition of the most effective measures is possible only if bases on an analysis of conditions formed during a period of time, assessment of priorities in change of ecological situation and productivity of the water body. Based on this paper, analysis of the influences of various factors on bio resources formation, asseseement of impact on the basin environment and climate change of measures proposed , Although the fishing industry in the Caspian Sea has been through hard times during its development as a result of changes in seal level, followed by increase areas for fishing and increases productivity.

Key Words: Climate change, Caspian Sea, Fishery

[PO-118]

SATELLITE-BASED ANALYSIS ON ECOSYSTEM RESPONSE TO EXTREME CLIMATE EVENTS USING IMAGERY IN MONGOLIA

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Recent climatic variations in Mongolia showed distinct trends in temperature warming and precipitation reduction since late 1990s, which can exert negative effects on primary productivity and water resources. In this study, we investigated ecosystem responses to extreme climate events derived from satellite observations in Mongolia over the last 10 years. Our specific purposes are to examine spatial and temporal patterns of extreme climate events; and to investigate the responses of normalized difference vegetation index (NDVI) to extreme climate events. Various satellite datasets were prepared, including NDVI, albedo, LST, air temperature from Moderate Resolution Imaging Spectroradiometer (MODIS), and Tropical Rainfall Measuring Mission (TRMM) precipitation data for a period of 2002-2011 (partially from 1998 to 2011). We collected monthly temperature and precipitation data from 72 weather stations in Mongolia. Especially, temperature and precipitation data have potentials to examine the relations between drought or summer stress and vegetation productivity across dryland ecosystem. MODIS-derived monthly mean air temperature and TRMM monthly precipitation showed good agreements with weather station data, which were applied to estimate summer-time aridity index for determining years and regions with hot and dry condition. Scaled anomaly maps were prepared for all of spectral, biophysical, and climatic variables to investigate relations among the variables. In temporal variation, year 2002 was the hottest and driest year but year 2003 showed the coolest and wettest condition in Mongolia during our study period of 2002-2011. The scaled anomaly analysis indicates that similar interannual and spatial variations of NDVI and precipitation, which implicate strong dependence of NDVI on the spatio-temporal variations of precipitation. Whereas, temperature effect was unclear. Drier year (i.e. low aridity index with high temperature and low precipitation) showed lower NDVI and higher LST and albedo. In spatial variation, extreme climate events were frequently occurred in central and eastern parts of Mongolia. NDVI temporal variations were significantly associated with the temporal variations of aridity index ($r = 0.48$, $p < 0.01$). In this presentation, we will discuss the relations of climatic variables with NDVI and biophysical variables in the regions where extreme climate events have frequently occurred.

[PO-119]

ESTIMATING CHANGE OF INTER-ANNUAL GREEN-UP VARIABILITY IN MONGOLIA

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The objective of this study is to estimate and examine vegetation green-up and its response to the recent climatic variation in Mongolia. The annual green-up onset date was estimated by the time series data of 250m MODIS (Moderate Resolution Imaging Spectroradiometer) 16-day composite NDVI products from 2000 to 2011. The observation data include several phenological dates such as beginning, flowering and senescence. In this study, we used the observed onset date when 50% of plant cover is green-up. Particularly, we selected the measurement of Stipa in the 118 sites of agro-climate and weather stations between 2000 and 2011. The data were collected by the Institute of Meteorology and Hydrology of Mongolia. The sites in forest steppe and northern part of steppe zones are 25x25m^2 (625sm^2), but southern part of steppe and desert steppe zones are 50x50m^2 (2500 sm^2) plot area. The onset DOY of Stipa is generally, observed from 106 to 146 DOY during the middle of April to end of May. We extracted NDVI from MODIS time series data at all observation sites from 2000 to 2011. The onset threshold NDVI was using the observed onset DOY of Stipa. The threshold NDVI showed a good liner relation with maximum NDVI. We made pixel based onset threshold map in Mongolia by applying the regression model. The onset DOY maps were produced from 2000 to 2011. Our study indicates of MODIS NDVI products can provide information on the past 12 years changes in onset phenology. This would be useful to understand long-term vegetation response to climate change in Mongolia.

Keywords: MODIS NDVI datasets, Observed onset DOY, onset Threshold NDVI and Climatic Variability.

[PO-120]

RESPONSES OF ECOSYSTEM CARBON CYCLE TO BIOTIC DISTURBANCE FROM LEAF TO ECOSYSTEM LEVELS: A META-ANALYSIS

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Global warming is believed to cause more frequent and extreme events in many parts of the world, which may increase the frequency of insect or pathogen outbreaks (referred to biotic disturbance). Biotic disturbance considerably affected plant eco-physiological processes and then significantly impact ecosystem carbon (C) cycle. However, little is known about how biotic disturbance quantitatively affect C processes at different scales (e.g., leaf, plant, ecosystem). Here, we conducted a meta-analysis to quantify the responses of C processes to biotic disturbance at leaf, individual and mixed plants (pot experiment) and ecosystem levels (field experiment). Our results show that biotic disturbance decreased net photosynthesis rate but increased dark respiration at a leaf level. From individual plant to ecosystem scales, shoot, root, total biomass, litter mass, and soil organic carbon (SOC) all significantly reduced in response to biotic disturbance but root biomass and SOC had lower magnitudes at ecosystem than other scales compared to shoot biomass. Plant types and disturbance agents (i.e., pathogen or insect) also affected the responses of the C cycle to biotic disturbance to some degree. The diverse responses of the C processes to biotic disturbance at different scales indicate that caution should be considered in scaling up the effects of biotic disturbance on ecosystem C cycle from leaf to ecosystem scales.

Key words: insect; pathogen; soil organic carbon (SOC); respiration; photosynthesis; different scale

[PO-121]

ECOSYSTEM FLUX MEASUREMENT OF YOUNG RUBBER PLANTATION IN NORTH-EASTERN REGION OF THAILAND

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Rubber tree (*Hevea brasiliensis* Müll. Arg.) is a major commercial source of natural rubber which represent one of the main forest ecosystem in Southern Thailand. Now rubber plantation is extended to North and North east part of Thailand due to government policy. The new area is mainly in non-traditional area such as the Northern and North-eastern part, where it has extreme climatic condition including long and dry season. This project not only aims to understanding an ecosystem's response to environmental perturbation and also to understanding the impact of extreme drought on carbon and water balance of young rubber plantation. The validate CO_2 and H_2O flux will be used to model carbon and water balance of young rubber plantation ecosystem according to climate. The new eddy covariance tower was estribished in 4 year old rubber tree located in Pak Khat district, BuengKan province (18°13' N, 103°18' E). The installation finished in October 2012. The tower height was 15 m. The eddy flux measurement was setup at 12 m. for an objective to continuously measure net ecosystem exchange (NEE) of carbon and water vapor, net ecosystem production (NEP), gross primary production (GPP), and total ecosystem respiration (TER) along with additional air and soil meteorological measurements.

[PO-122]

ESTIMATING NET ECOSYSTEM EXCHANGE AT A TROPICAL ESTUARINE WETLAND ECOSYSTEM BY COMBINING REMOTE SENSING AND FIELD DATA

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Concerns over global climate change have stimulated much interest in investigating the processes and controlling mechanisms of carbon exchange between atmosphere and terrestrial ecosystems, identifying present and potential carbon sinks or sources, and evaluating the trends of carbon budgets in the future. Compared with other types of ecosystem, the organic carbon storage in wetland ecosystems is estimated to contribute about 15% of the terrestrial organic carbon storage in the earth. In recent years, though there were some studies on carbon budget for wetland ecosystems, most of them were conducted over northern peatlands, and very few attentions were given to tropical estuarine wetland ecosystems. These are more productive than areas of open sea due to the regular input of nutrient, and estuaries are believed to be large sources of carbon dioxide (CO_2) to the atmosphere that collectively balance atmospheric CO_2 uptake on continental shelves. However, this estimate of estuarine CO_2 exchange with the atmosphere is based on very limited spatial data. To date, regions where estuarine air–water CO_2 flux studies exist are mostly along the European and eastern North American coasts.

In this study, we estimate the carbon exchange over a tropical estuarine wetland at Guandu in Taipei, Taiwan based on a continuous eddy covariance measurement covering two years of carbon flux. The eddy covariance technique can provide direct measurement of net ecosystem exchange of CO_2 (NEE) over the ecosystems, but spatial scope of the investigation were limited. As rapid advancement of remote sensing technology, the ecosystem scale of estuarine wetland carbon sequestration predicted from satellite and in-field remote sensing can be integrated with field ground eddy-covariance surveys to better capture the dynamics of carbon exchange. In this study, the eddy covariance NEE data is partitioned into gross photosynthetic production(GPP) and ecosystem respiration by taking difference between day-time NEE and night-time NEE. A rectangular hyperbolic function was tried to fit between PPFD and daytime NEE for all measured data. Otherwise, the relationship between ecosystem respiration and temperature could be estimated based on the Van't Hoff equation. We can use it to compare the MODIS GPP product by using in situ measurements of meteorology and eddy covariance GPP for Guandu site and discover the roles and uncertainties of the variables used in the algorithm.

[PO-123]

THE EFFECT OF PLUM RAIN EVENTS ON NEE OF SEASONAL EVERGREEN FOREST

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Temporal rainfall variations at the Lien-Hua-Chih (LHC) site with seasonal evergreen forest in Taiwan are quite significant. Wet season (May to September) rainfall is contributed by typhoons and southwesterly summer monsoon and totally accounts for 72% of annual rainfall having an averaged amount of 2300 mm. Unlike most typhoon event may invade the island with intensive rainfall for 1 to 2 days, prolonged and stationary front induced by summer monsoon gradually brings significant rainfall from mid-May and may intermittently continue to June, which is often called as plum rain season. The objective of this study is to investigate the effect of the onset of intermittent plum rain events on NEE of the LHC site. Eddy covariance measurements are conducted at the LHC in association with comprehensive hydrometeorological measurements, including soil moisture, soil temperature, soil respiration, canopy CO_2, temperature, and moisture profiles. Principle component analysis is used to reveal dominating factors responsible for NEE variations before and during plum rain events. Preliminary results show a great reduction of NEE in an amount of 20% caused by the first plume rain event in 2011. Increase of soil moisture stimulates the enhancement of ecosystem respiration which may further aggravate such NEE reduction at the LHC site.

[PO-124]

APPLICATION OF AN INTEGRATED FLUX DATABASE FOR ASIA: EMPIRICAL UPSCALING AND MODEL EVALUATION

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The newly established integrated flux database in Asia (Ueyama et al. 2013; this workshop) have more spatial and temporal coverage (44 sites EC data with 163 site-years from five eddy-covariance database covering Asia: AsiaFlux, CarboEastAsia, Forestry and Forest Products Research Institute (FFPRI) in Japan, European Flux Database Cluster, and Arctic Observatory Network (AON)) than existing data (e.g. CarboEastAsia dataset; Saigusa et al., 2013). Therefore, the dataset have a potential to improve our understandings on terrestrial carbon and water cycles in Asia.

Here, we present two applications of the new flux database in Asia to understand terrestrial carbon and water cycles at continental scales. First, results of an empirical upscaling with a machine-learning algorithm (support vector regression) will be presented to estimate terrestrial carbon and water fluxes at continental scale. Second, carbon and water fluxes simulated by multiple terrestrial ecosystem models (e.g. BEAMS, Biome-BGC, LPJ, and VISIT) will be tested with available observation sites as a further analysis of Ichii et al. (2013) at both sub-daily and monthly time scales. The initial results of these two applications, advantages of the new DB, and potential further applications will be discussed in the workshop.

References:
Ichii et al. (2013) J. For. Res. (CarboEastAsia Special Issue), 18, 13-20.
Saigusa et al. (2013) J. For. Res. (CarboEastAsia Special Issue), 18, 41-48.

[PO-125]

EFFECTS OF RESIDUAL BIOMASS BURNING ON THE CO_2 FLUX FROM A PADDY FIELD

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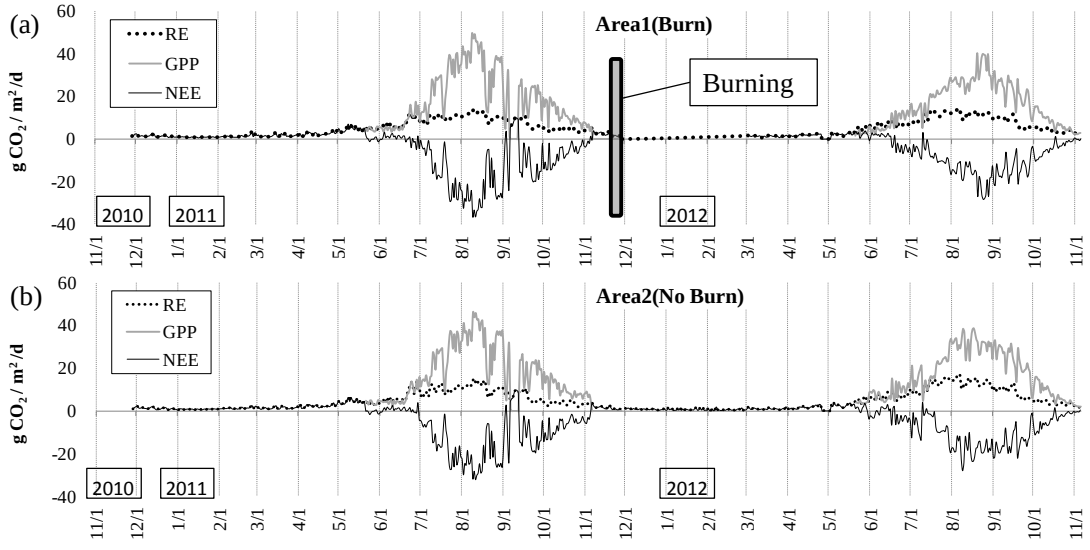
Paddy field is one of the most important eco-system in monsoon Asia, and takes a great important role in CO_2 uptake. Carbon budget in agricultural field is influenced by some artificial management. After the harvest, residual biomass is burned on fields, brought out from fields, or remained and harrowed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

In this study, quantity of lost carbon according to burning of residual biomass were investigated at a single rice cropping field in western Japan, in which long-term continuous CO_2 flux (NEE) measurement by the eddy-covariance technique and aerodynamic gradient technique was conducted. In addition, an experimental paddy field was divided into two areas to investigate what impact is brought on the annual CO_2 flux by the difference of disposal management of residual biomass after the harvest. Residual biomass was burned and plowed into soil at the one area on Nov. 29th, 2011, and Nov. 21st, 2012, and residue was not burned and directly plowed into soil at the other area as usual.



2011年						
(gCO2/m²)	Area1			Area2		
	Rice	Fallow	Total	Rice	Fallow	Total
GPP	2947.2	0.0	2947.2	2767.8	0.0	2767.8
Re	1341.1	389.2	1730.2	1236.4	329.3	1565.7
NEE	-1606.2	389.2	-1217.0	-1531.4	329.3	-1202.1

2012年						
(gCO2/m²)	Area1			Area2		
	Rice	Fallow	Total	Rice	Fallow	Total
GPP	2726.4	0.0	2726.4	2876.1	0.0	2876.1
Re	1371.2	277.6	1648.8	1474.0	296.6	1770.7
NEE	-1355.2	277.6	-1077.6	-1402.1	296.6	-1105.5

Fig.1 Seasonal variations of CO_2 GPP, RE, and NEE by in 2011 and 2012 at the Burned area (upper panel) and No-Burned area (lower panes)
Table.2 Integration value of RE, GPP and NEE.

[PO-126]

AN INTEGRATED FLUX DATABASE FOR ASIA

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Eddy covariance (EC) database is an essential tool to study terrestrial energy, water, and carbon dioxide (CO_2) cycles in Asia. Currently, there are five available EC database covering Asia: AsiaFlux, CarboEastAsia, Forestry and Forest Products Research Institute (FFPRI) in Japan, European Flux Database Cluster, and Arctic Observatory Network (AON). Data processing, such as flux-partitioning and gap-filling, are often different in each database. Since different processing may bias individual database, integrated EC database with standardized processing is essential to promote availability of the database for multi-site synthesis, model validation, and upscaling EC data.

We collected 44-site EC data, which consisted 163 site-years, from the four EC database for Asia, and applied consistent processing of 1) quality control by the robust method, 2) u_*-filtering correction, 3) gap-filling, and 4) flux-partitioning of CO_2 fluxes. The method of the data processing was based on our previous works (Saigusa et al., 2013; Ueyama et al., 2012). The integrated database will be helpful for users who have synthesized the EC data in Asia. We will incorporate new EC data into our database, when additional data will be available; we are welcome people who contributed this database.

References:

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[PO-127]

EFFECT OF RESIDUAL BIOMASS BURNING ON THE METHANE EMISSION FROM A SINGLE-RICE CROP FIELD

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Paddy field is one of the most important eco-system in monsoon Asia. Methane (CH_4) is generated by organic matter decomposition in the anaerobic soil. It is said that about 20% of CH_4 sources is paddy fields. In some rice-crop fields, residual biomass left after the harvest is burned and plowed into soil, meanwhile in other fields, unburned residual biomass is directly plowed into soil. In this study, long-term continuous measurements of CH_4 flux by the aerodynamic gradient technique were conducted at a single-rice crop field in order to estimate annual CH_4 budget between atmosphere and paddy field. We also investigated what impact is brought on the annual CH_4 flux by the difference of disposal management of residual biomass after the harvest. An experimental single rice-crop field was divided into two areas. Biomass residue was burned and plowed in one area, and no-burned residue was directly plowed in the other area. The loss of biomass carbon by burning was about 140gC m^{-2}, and equivalent to 18% of annual GPP. The ratio of annual emission of CH_4 was about 0.4-1.0% to annual GPP. No clear difference was seen in the CH_4 flux between two areas.

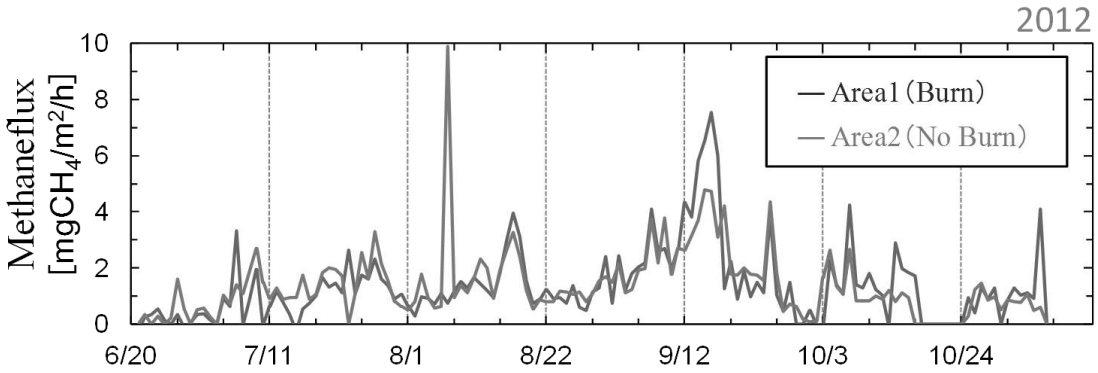

Fig1. Seasonal variation of CH_4 flux in 2012

Annual emission of methane

Area1: 2.9gC/m^2

Area2: 3.0gC/m^2

[PO-128]

AN INFRA-RED LASER HIGH RESOLUTION SPECTROMETER TO MEASURE FLUXES OF CH_4, N_2O, AND CO_2 AND $\delta^{13}C/^{12}C$ OF CO_2 ENCOUNTERED IN VARIOUS ECOSYSTEMS (PEATLANDS AND HYDROCARBON CONTAMINATED SOILS)

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SPIRIT (SPectrometer Infra-Red In Situ Tropospheric), is a portable wheel infra-red spectrometer (~100 kg; 120×80×50 cm^3) developed by the LPC2E to measure gas phase mixing ratios of CH_4, N_2O and CO_2, as well as isotopic ratios $^{13}C/^{12}C$ and $^{18}O/^{16}O$ of CO_2. The instrument description and method for CH_4 and N_2O concentration retrieval are reported in Guimbaud *et al.* (2011). A multiple-reflection cell invented by the LPC2E (French and international patents) allows for an easy length path modulation (14 to 84 m) to switch from CH_4/N_2O to CO_2 ambient air analysis. New type of lasers, i.e. DFB-CW-RT-QCL, are used. They emit a more considerable light power with a better spectral quality than the classical lead-salt diode lasers and operate in near ambient temperature. Thanks to the home-made QCL emission controller, three lasers can work sequentially, triggered and synchronized by the data acquisition system within a periodicity of 1.5 s. At present, two lasers are installed: the first one uses the N_2O and CH_4 ro-vibrational lines positioned at the central wavenumbers 1261.9874 and 1262.2285 cm^{-1}, with line intensities of 1.044×10^{-19} and 2.723×10^{-20} cm $molecule^{-1}$ at 296 K, respectively (Rothman *et al.*, 2009). SPIRIT has been recently modified to hold an accurate temperature regulated optical cell (<0.02°C, 1 m long, 8 cm diameter) in order to reach high precision on isotopic ratio measurements. Then, a second laser has been set and uses the $^{12}C^{16}O$, $^{12}C^{18}O$, $^{13}C^{16}C$, ro-vibrational lines positioned at the central wavenumbers 2310,0025, 2310,2056 and 2310,3470 cm^{-1}, with line intensities of $4{,}664\times10^{-21}$, $4{,}637\times10^{-21}$ and $6{,}447\times10^{-21}$ cm $molecule^{-1}$, respectively.

SPIRIT has demonstrated accurate results for CH_4 and N_2O mixing ratios measurement in ambient air (0.2% for 15 s integration time) as well as for flux emission measurements above peatlands, lakes, and cultivated fields, using the closed chamber method (Guimbaud *et al.*, 2011; Gogo *et al.*, 2011). Fluxes are derived from the closed chamber method; the optical cell of SPIRIT is directly connected to a chamber set on a permanent PVC cylinder collar (internal diameter of 30 cm) sunk into the soil. In addition, Allan variance plots demonstrated an isotopic deviation precision better than 0.05 ‰ for a 20 s integration time for $\delta^{13}C/^{12}C$ with an accuracy better than 0.1 ‰ given by a certified CO_2 gas cylinder (391 ppm ; $\delta^{13}C$=-40,5‰ versus Pee Dee Belemnite (PDB) regularly used for online calibration (typically a 30 s integration time is performed for calibration each 15 min). Keeling plots derived from CO_2 accumulation in the closed chamber (started at ambient air CO_2 concentrations) show accurate determination of the $\delta^{13}C/^{12}C$ for the emitted CO_2 (<1 ‰). This value is given by the intercept derived from the linear regression of $\delta^{13}C/^{12}C$ of CO_2 versus CO_2 mixing ratio measured inside the chamber.

Description of SPIRIT performances and its applications for flux measurements of CH_4, CO_2 and $\delta^{13}C/^{12}C$ of CO_2 from various ecosystems to atmosphere will be presented and discussed. It will mainly concern emissions from ecosystems under extreme climates or events such as: i) CH_4 strong emissions during spring snow thaw from river surrounded by natural sphagnum arctic peatlands (Esrange, Sweden), ii) Effect of an artificial drought on CO_2 and CH_4 exchanges from *ex situ* peatcores (La Guette temperate peatland, Sologne, France) and, iii) practical methods based on $\delta^{13}C/^{12}C$ of CO_2 emissions for monitoring the remediation by bio-stimulation of hydrocarbon contaminated soils.

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[PO-129]

QUANTITATIVE RELATIONSHIP BETWEEN GREENHOUSE GAS EMISSIONS AND ASSOCIATED MICROBIAL POPULATIONS UNDER AEROBIC AND ANAEROBIC CONDITION

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Organic farming techniques in crop production are largely dependent on decomposition of the soil-amended organic matter (OM), which is naturally accompanied with release of greenhouse gases like as CO_2, CH_4, and N_2O. In the present study, for soils amended with various OM (including compost, liquid organic fertilizer, and green manure), we have investigated emission fluxes of greenhouse gases and the concurrent changes in soil chemical properties and in soil microbial population. We also examined quantitative relationships between emission strengths and microbial populations. Generally, liquid biofiltrate and green manure including barley and hairy vetch showed highest emission strengths in both aerobic and anaerobic conditions. On the other hand, compost and inorganic fertilizers were considered to be relatively weak sources of GHGs. However, the integrated CO_2 emission load for providing unit available N decreased in the order of barley, hairy vetch, compost, liquid biofiltrate, and inorganic fertilizer. Liquid biofiltrate and inorganic fertilizer were most efficient in providing available N, whereas compost was considered to be most appropriate for providing P with less emission of GHGs. We also observed a marked difference in microbial biomass among OM-amended treatments, which was well correlated with CO_2 emission differences. In addition, through phospholipid fatty acid analyses, we found that distinct microbial populations were involved in decomposition of each OM. Especially, fungi played an important role in degrading large-size OM (e.g., green manure). The relative proportions of G(+)/G(-) bacteria and archear were associated with the relative easiness in degradation. On the other hand, CH_4 emission fluxes were quantitatively correlated with the population size of methanogens for both incubation and field soils.

[PO-130]

SOIL CO_2 EFFLUX IN A TEMPERATE DECIDUOUS FOREST IN KOREA

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It is important to understand the environmental controls on soil CO_2 efflux, in order to evaluate potential responses of ecosystems to climate change. This study investigated the relationship between total soil CO_2 efflux and soil temperature, soil moisture on an inter-annual basis for a plot of temperate deciduous forest in Korea. In order to understand the effects of soil temperature and soil water contents on soil CO_2 efflux, we measured soil CO_2 efflux using a closed dynamic chamber method with an Auto Opening and Closing Chamber system since 2004. Soil CO_2 efflux exhibited pronounced seasonal variations that clearly followed the seasonal changes in soil temperature and soil water contents. Soil CO_2 efflux varied markedly during the study year with high rates in summer and low rates in winter. The mean annual soil CO_2 efflux was 345 mg $CO_2m^{-2}h^{-1}$, ranging from 10 to 1,210 mg $CO_2m^{-2}h^{-1}$. Soil CO_2 efflux was highly correlated with temperature during spring and autumn, soil temperature is the main parameter controlling soil CO_2 efflux. On the other hand, soil CO_2 efflux strongly limited by soil water contents (>25%) during the summer, very high soil CO_2 efflux was observed during the summer and immediately after rainfall events. These suggest that random rainfall events may play important role in determining the annual net ecosystem exchange of carbon. The relationship proposed for soil CO_2 efflux with soil temperature and soil water contents is useful for understanding and predicting potential changes in temperate deciduous forest ecosystem in response to forest management and climate change.

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[PO-131]

SOIL RESPIRATION IN RICE AND BARLEY DOUBLE CROPPING PADDY-FIELD IN KOREA

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Agricultural systems are major sources and sinks for global carbon cycle. To quantify and understand the net effect of these systems on atmospheric CO_2 concentration, the amounts and characteristics of carbon fixed in primary production and that respired by the soil must be known. To monitor soil respiration in rice-barley double cropping paddy-field during the growing season (the rice paddy had been consistently cultivated with double cropping of rice and barley (June 2011 ~ 2012), we newly designed "floating" automatic opening/closing chamber (AOCC) system based on closed dynamic method and conducted on field plots measuring with planted to rice. The newly "floating" AOCC system was designed to minimize disturbances to cultivate environmental factors, and also allowed for real-time monitoring of soil respiration. During monitoring (from June to August in 2011), maximum, minimum, daily mean soil respiration was 228, 3, 58 mg $CO_2\,m^{-2}\,h^{-1}$, respectively. The diurnal variations were not closely related to soil temperatures. At day time (temperature increase), soil respiration was decreased, and at night time (temperature decrease), it was increased. As a result, soil respiration in rice paddy field was basically controlled by ecological condition, greatly influenced by cultivation practices and field management (e.g. stable manure amendment, seeding or transplanting of rice, water management, harvest, treatment of harvest residuals and plowing). We will continuously monitor soil respiration and find characteristics of soil respiration in double cropping rice and barley paddy-field for next 3 years.

Acknowledgement. This research was supported by "Cooperative Research Program for Agricultural Science & Technology Development", Rural Development Administration, Republic of Korea (Project No: PJ 90722803).

[PO-132]

EFFECTS OF "OPEN BURNING" ON THE GREENHOUSE GAS EXCHANGE FROM A SINGLE-RICE PADDY FIELD IN JAPAN

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Paddy field is artificially maintained wetland and is one of the large sources of CH_4. Besides, a large quantity of N_2O is emitted from the soil surface due to the decomposition of inorganic fertilizer. A long term continuous measurement of GHG fluxes between atmosphere and paddy ecosystem is effective method to clarify the contribution of paddy fields to recent rapid increase of GHG concentration.

In this study, three techniques for flux measurement (eddy covariance, aerodynamic gradient, and chamber techniques) were applied to investigate the annual variation of three GHG (CO_2, CH_4 and N_2O) exchanges at a single-rice paddy field for two years and a half. An observational site is located on reclaimed land in the southern part of Okayama Prefecture, Japan. Single rice cropping cultivation has continued in a similar way every year. An experimental paddy field was divided into two areas to investigate what impact is brought on the annual GHG fluxes by the difference of disposal management of residual biomass after the harvest. Residual biomass was burned and plowed into soil at the one area on Nov. 29th, 2011, and on Nov. 21th, 2012, and residue was not burned and directly plowed into soil at the other area as usual. We illustrate some results for the control-term before the burning experiment, and for the comparison-term after the experiment.

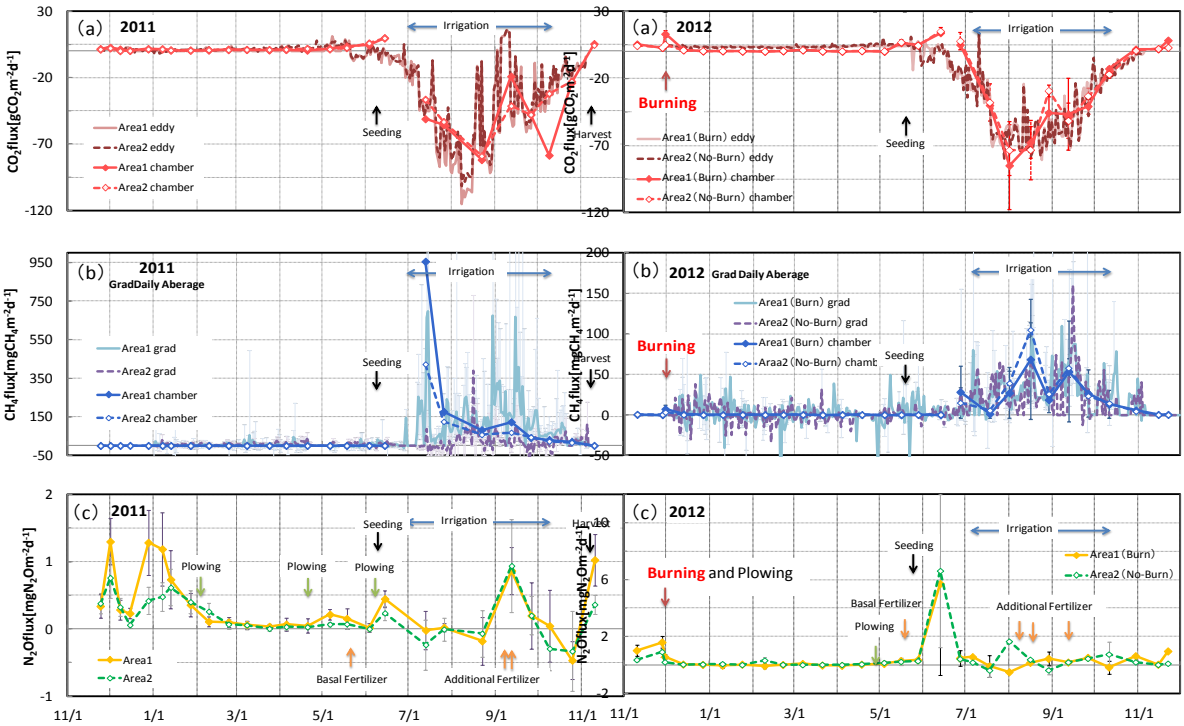

Fig.1 Seasonal variation of GHGs fluxes in 2011 and 2012.
(a) CO_2 flux by the eddy covariance and the chamber techniques,
(b) CH_4 flux by the gradient and the chamber techniques, and
(c) N_2O flux by the chamber techniques.

[PO-133]

SEASONAL VARIATIONS OF CARBON DIOXIDE AND ENVIRONMENTAL FACTORS ON A TIDAL FLAT IN SUNCHEON BAY, KOREA

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In this study, observation was carried out on a tidal flat in Suncheon Bay, Korea. The purpose of this study is to analyze the seasonal variations of carbon dioxide and environmental factors on a tidal flat.

Observation was performed total 10 times from May 2010 to July 2012. Soil carbon dioxide observation was spatially made on the surface of mud flat during low tide and soil samples were collected. Soil carbon dioxide observation is to measure carbon dioxide flux, carbon dioxide concentration and soil temperature using soil carbon dioxide measurement system. Soil samples from mud flat were preprocessed in laboratory and were used to analyze water content, pH, Eh, and soil organic carbon (SOC). In addition, in order to investigate the characteristics of the micrometeorological environment in observation site, automatic weather system (AWS) was installed on a tidal flat in Suncheon Bay. AWS observation was carried out total five times from April 2011 to July 2012. Air temperature, relative humidity, wind speed, net radiation and ground heat flux were measured using AWS.

Carbon dioxide fluxes were ranged from –224 to 235 mg/m^2/hr for spring, –33 to 179 mg/m^2/hr for summer, -26 to 154 mg/m^2/hr for autumn and -177 to 66 mg/m^2/hr for winter, and the average carbon dioxide fluxes were 21 mg/m^2/hr, 45 mg/m^2/hr, 72 mg/m^2/hr and -45 mg m^{-2} hr^{-1} for spring, summer, autumn and winter. Carbon dioxide concentrations were ranged from 378 to 437 ppm for spring, 372 to 400 ppm for summer, 371 to 451 ppm for autumn and 389 to 459 ppm for winter, and the average carbon dioxide concentrations were 405 ppm, 381 ppm, 403 ppm and 420 ppm for spring, summer, autumn and winter. Soil temperature was ranged from 11.9 to 23.5 ℃ for spring, 25.3 to 30.3 ℃ for summer, 7.4 to 26.0 ℃ for autumn and 0.0 to 9.2 ℃ for winter, and the average soil temperature was 18.3 ℃, 27.7 ℃, 17.0 ℃ and 5.4 ℃ for spring, summer, autumn and winter. Air temperature was ranged from 23.1 to 28.0 ℃ for summer and -4.3 to 3.8 ℃ for winter, and the average air temperature was 25.6 ℃ and -0.9 ℃ for summer and winter. Net radiation was ranged from –61.4 to 636.2 W/m^2 for summer and -99.6 to 501.4 W/m^2 for winter, and the average net radiation was 163.1 W/m^2 and 43.1 W/m^2 for summer and winter. Ground heat flux was ranged from –93.4 to 202.8 W/m^2 for summer and -28.2 to 60.3 W/m^2 for winter, and the average ground heat flux was 4.2 W/m^2 and 9.4 W/m^2 for summer and winter.

Carbon dioxide from soil to air was emitted for spring, summer and autumn, and it was uptake for winter. The variation of carbon dioxide concentration was smallest in the summer, and greatest in the autumn.

[PO-134]

BIOMASS BURNING DETECTION BY AIRCRAFT MEASUREMENTS OVER MALAYSIA

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During the SHIVA (*Stratospheric Ozone: Halogen Impacts in a Varying Atmosphere*) campaign in Nov. and Dec. 2011 a number of polluted air masses were observed in the marine and terrestrial boundary layer (0 – 2 km) and in the free troposphere (2 – 12 km) over Borneo/Malaysia. The measurements include isoprene, CO, CO_2, CH_4, N_2O, NO_2, SO_2 as primary pollutants, O_3 and HCHO as secondary pollutants, and meteorological parameters. This set of trace gases combined with a nested-grid regional scale chemical and meteorological model and lagrangian particle dispersion model (e.g., CCATT-BRAMS and FLEXPART) can be used to fingerprint different sources of local and regional air pollution. The study focuses on biomass burning emissions in Malaysia region by aircraft measurements. The aircraft landing and take-off of several flights are directly impacted by biomass burning near Miri (Borneo Island). It is reflected by an increase of the concentration of several tracers as CO, CH_4 and CO_2. The emission ratios and emission factors of these tracers are calculated for the young biomass burning plume. These ratios can be used as a measure of combustion efficiency to help place the type of biomass burning particular to this region within the wider context of fire types found globally. Simultaneously of the CO, CH_4 and CO_2, a sharp ozone increase is observed in the young fires plume. By using the CCATT- BRAMS model, simulations of photochemical processes in the nascent plume are presented. The ozone production and $\Delta O_3/\Delta CO$ ratio with the plume age are studied. Except the biomass burning near Miri, several flights are also influenced by more or less old biomass burning plumes from more or less distant regions depending on the meteorological conditions. For instance, savannas fires from Australia or forest and rice fires from Vietnam are detected in the aircraft measurements.

[PO-135]

MONITORING PADDY RICE INFORMATION THROUGH AN UNMANNED AERIAL VEHICLE SYSTEM

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Unmanned Aerial Vehicle (UAV) remote sensing systems can monitor terrestrial vegetation information more efficiently and widely than any other ground-based observation systems and can get higher resolution spatial imageries than satellite or manned aircraft imageries. Mini-helicopters, especially, can be easily and flexibly used for monitoring study areas of interest as they are easy to carry. In this study, we have built up an UAV system using a mini-Oktocopter and compared the imagery data of spectral reflectance and vegetation indices with the measured CROSCAN data from the paddy rice field at Chunnam National University. The mini-Oktocopter has been fitted with a Mini-Multiple Camera Array (Mini-MCA) multi spectral camera (made by Tetracam Inc.) that consists of 6 spectral lenses, band pass filters and image sensors, ranging from 550 to 880 nm. To correct atmospheric and radiometric effects of the spectral imagery, we used the linear regression method using 3 calibration tarps made by 3 color (black, gray and black) plastic foam materials showing similarly standard reflectance values for each color. In our preliminary results, the errors of the camera-based reflectance for red and near-infrared wavebands ranged from -4.5 to +5.6. The time series pattern of the camera-based Normalized Difference Vegetation Index (NDVI) was similar to the measured data. We will continually process data calibration to improve the reliability. Our mini-Oktocopter data can be used to acquire high resolution spatial information on the ground vegetation as well as to study land cover heterogeneity caused by the difference of spatial resolution or atmospheric scattering effects between the ground observation and the aircraft/satellite imagery.

[PO-136]

SOILS IN THE SOYANG LAKE WATERSHED: SOIL SAMPLING DESIGN AND EARLY SOIL DESCRIPTION

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Soil in the complex mountain areas is one of the most important factors to provide ecosystem services, such as carbon storage, water purification and as the basis for plant and soil live development. The knowledge about spatial distribution of soils and the soil forming processes is limited. We need to extend the information about soils in the complex mountain areas. For that purpose, a soil sampling design has been developed to get representative impressions of the spatial distribution of physical and chemical soil properties in Soyang lake watershed.

Conditioned Latin Hypercube Sampling (cLHS) is one of the stratified random sampling methods offering an optimal coverage of the variability of environmental variables' covariates in feature space. Because of the variety of soil forming processes, several of environmental variables are included in the soil sampling design, e. g. geology, elevation, incoming solar radiation, surface curvature, upslope contributing area, NDVI and landuse. Due to the limited accessibility (e. g. landmines, steep slopes and time), 300m-bufferzones along the roads and footpaths are also considered in the sampling design.

In addition to the soil description in the field physical soil parameters are measured like shear ratio and soil humidity. We further take disturbed and undisturbed soil samples to analyze physical and chemical soil properties in the laboratory related to ecological functions, e. g. soil organic carbon, nitrogen and water retention.

The collected soil properties will provide us with the required data to describe spatial distribution of soil types and will give us additional hints on soil development in the study area.
Digital soil mapping (DSM) will be used to identify statistical relationships between soil properties and environmental variables. The resulting functional maps will provide us with information on ecological land potentials and soil related environmental risks in Soyang lake watershed.

Key words: *chemical and physical soil properties, digital soil mapping, Soil Sampling design, environmental variables, soil ecological functions*

[PO-137]

INFLUENCE OF PLANT COMPETITION ON BIOCHEMICAL AND AGRONOMIC ATTRIBUTES OF SOYBEAN

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Increasing demand of world food has created a pressure to produce more food from the per unit area which may disturbing the food quality due to plant competition for nutrients. A greenhouse experiment was conducted in order to examine the effect of plant competition (3 plants (PC_1), 4 plants (PC_2), 5 plants (PC_3) per pot) on the biochemical and agronomic attributes of soybean at the North Central Soil laboratory, USDA-ARS, Morris, MN USA. The experiment was carried out in complete randomized block design with three replications. The results showed that by increasing soybean plant population, the number of pods per plant, total seed number per plant, total seed weight per plant and leaf dry weight was decreased. The higher oil and protein contents were recorded in PC_1 compared with PC_2 and PC_3 In addition to, higher Iron, Zinc, Aluminum and Calcium contents were recorded in PC_1 than of PC_2 and PC_3 whereas the highest and lowest %C, %N and C:N were noted in PC_1 and PC_3 treatments, respectively. Higher plant dry matter and leaf area index was recorded in those treatments where more plants per pot (PC_3) were planted. In conclusion, the increasing plant population may increase the plant biological yield but significantly decrease the soybean qualitative attributes.

Keywords: Plant competition, quality attributes, biological yield, soybean.

[PO-138]

WATERSHED MANAGEMENT AND NATURAL RRESOURCE CONSERVATION: SHIVALIK FOOTHILLS OF NORTHERN INDIA

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Watershed development has gained tremendous importance and relevance in India over the past few years. This has been due to the increasing use of the alarming state of India's natural resources-land, water and forests. Conservation and management of natural resources employing the modern concept of watershed management holds the key for holistic approach for sustainable restoration of ecosystem of an area (Rao et al., 1999). Himalayan foot-hills (Shivalik) sandwiched between the alluvial plains and the rocky mountains cover an area of about eight million hectares in five northern states i.e. Haryana, Himachal Pradesh, Jammu and Kashmir and Punjab (GOI, 1998). The holistic approach of Integrated Watershed Management in Shivalik is an effort with the goal of soil conservation linked with farm and forest land production with people's participation. The objective of this article is to discuss the various strategies of natural resource conservation with successful watershed development programs in Shivalik region. Furthermore, we will make the database of the strategies of different components of watershed management.

Integral part for hills: The Sukhna Lake was planned as an integral part of watershed management, which is located on the foothills of the Shivalik hills in the union territory of Chandigarh, located at $32^0$42' N latitude and $76^0$54' E longitudes. The lake has catchment area of 42.07 km^2 in Chandigarh.

Catchment treatment: Most of the rainwater ended in runoff carrying with it huge amount of sediments and detritus. The catchment area required intensive soil conservation measures to reduce the meanace of soil erosion to save the reservoir from siltation and also improve ecology of watershed.

Rainwater harvesting: Water harvesting is largely depends on rainfall. Besides rainfall, it also depends on several factors including soil types, vegetative cover and catchment area. The catchment area required intensive soil conservation measures to reduce the meanace of soil erosion to save the reservoir from siltation and improve ecology of the watershed (Singh, 2002). The efficiency of rainwater harvesting depends upon the prudent utilization of surface water resource.

Vegetative measures: The vegetative measures including planting of tree species like Accacia catechu, Dilbergia sissoo in the pits and slips of Eulaliopsis bianata on the mounds of trenches and hill slopes. All of these are aimed at containing surplus rain water and sediment in-situ.

Public participation: The public participation plays an important role for success of watershed development. People of the project area derived the multiple benefits and have positive impact on the employment generation following by availability of grasses from forests and increase in milk yield, reduction in soil erosion and yield of crops, appreciation of land value and improvement of socio-economic status of the society.

It has been suggested that the conventional approach for watershed management should be providing social and economic basis for natural resource conservation. With the productive component "harvested rainwater" will indeed conserve the hilly watershed as well as natural resource conservation to the best of their ability.

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[PO-139]

AN APPLICATION OF INVERSE LAGRANGIAN DISPERSION ANALYSIS METHOD ON THE CALCULATION OF LATENT AND SENSIBLE HEAT FLUX

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The inverse Lagrangian dispersion analysis method was used with the aim of calculating the latent heat flux (LE_t) and sensible heat flux (H) over broadleaved Koreanpine forest, using only gradient measurement of microclimate parameters as the input of the model from 1 May to 30 Sep 2003. The results were compared to the values observed by an open-path eddy covariance measurement system to evaluate the method. It showed that the inverse Lagrangian dispersion analysis method overestimated the latent heat flux about 15%, and overestimated the sensible heat flux about 30%, from the comparison. In order to evaluate both inverse Lagrangian dispersion analysis method and eddy covariance method, the summations of latent and sensible heat flux estimated and observed are compared to the difference of measured net radiation (R_n) and heat flux into the soil surface (G). It can be concluded from the comparison that LE_t+H estimated by the inverse Lagrangian dispersion analysis method was larger about 5% than R_n-G, and LE_t+H observed by the eddy covariance method was lower about 25% than R_n-G. But the statistical calculations showed that LE_t+H observed by the eddy covariance method had better agreement than that estimated by the inverse Lagrangian dispersion analysis method with R_n-G, because the linear correlation coefficients of the eddy covariance method was 0.8553, larger than 0.6462 of the inverse Lagrangian dispersion analysis method.

Key words: Lagrangian dispersion, Latent heat flux, Sensible heat flux, Atmospheric stability, Energy balance.

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[PO-140]

SIMULATIONS OF FREE AIR CO_2 ENRICHED SORGHUM GROWTH AND INTERACTIONS WITH WATER

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Crop modeling is one of the most relevant approaches to study crop growth in various environmental conditions. In this study, the CERES-Sorghum module of DSSAT v4.5 was calibrated and validated for simulating grain sorghum (*Sorghum bicolor* cv. Dekalb DK54) grown under elevated CO_2 conditions in the free air CO_2 enrichment (FACE) experiments conducted at Maricopa, Arizona, USA in 1998 and 1999. Biomass and LAI were in reasonable agreement between simulation and measurement with root mean square difference (RMSD) of 331.7 g m^{-2} and 1.72 cm^2 cm^{-2} in 1998 and of 427.9 g m^{-2} and 2.89 cm^2 cm^{-2} in 1999, respectively. Simulated grain yield, crop growth and soil moisture also matched well with the measured values in both parameterization and validation. We found that the model is capable of reproducing the different regimes of CO_2 and irrigation for sorghum. The validated model will be a helpful tool to study the crop responses to various environmental impacts.

[PO-141]

LAND AND SEA BREEZE ASSOCIATED TEMPERATURE GRADIENT BETWEEN ISHIKARI AREA AND YUHUTSU AREA HOKKAIDO IN JAPAN

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Variation of water resource and vulnerability of flood control and water utilization have been pointed out in northernmost Japanese island Hokkaido. It is urgent to plan climate change adaptations, and detailed simulation of regional climate is mandatory. Especially, Sapporo is the largest city of Hokkaido and populations of Sapporo are about 2.0 millions. Sapporo city is covered between Ishikari area and Yuhutsu area and there are no large mountains over these areas, therefore it can be regarded as huge plain. Additionally, target areas have unique topography which is caught between different seas. It means there is a potential that Japan sea and Pacific ocean can affect climate of target areas. From agriculture and dairy point of view, understanding climates are connected to people living.

This poster discussed the land and sea breeze circulation (LSBC)between Ishikari and Yuhutsu areas in Hokkaido in Japan . The diurnal variation of LSBC during boreal summer(July and August) of 1985-2009 was mainly investigated by using various data which are Automated Meteorological Data Acquisition System (AMeDAS), Sapporo City Multisensor(MULTI), analysis data of Sea Surface Temperature(SST) and data of author's original observation point.

LSBC was observed between Ishikari and Sapporo up to 13km from coastal zones of the Japan Sea. Tomakomai to Atsuma area also showed LSBC around16km from coastal zones of the Pacific Ocean. For inland region that area from Chitose to Naganuma, southerly wind was observed all day long. The reason is related to a fact that this inland region has strong southerly wind associated with the meridional temperature gradient between Ishikari and Yuhutsu area. Thermal balance between SST and temperature of land could be important to control the horizontal scale of LSBC. In the La-Nina years, SST over the Japan Sea at the vicinity of Sapporo area was higher than the climatology, and LSBC was enhanced and expanded its spatial scale. These results suggest that the climate characteristics over Hokkaido region may change if global warming continues.

[PO-142]

PROJECTING HYDROLOGICAL IMPACTS OF CLIMATE CHANGE - HOW CAN WE PREPARE FOR THE CHANGE? -

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Climate change would impact the hydrological cycles. Previous researches have showed that the warming climate would cause more extreme conditions for both low flow and high flow in river discharge[1]. These impact assessments were conducted by directly analyzing the output of hydrological variables projected by atmosphere-ocean general circulation models (AOGCMs) or future land surface or hydrological models forced by the projected future atmospheric variables by AOGCMs. Here, we report two relevant hydrological changes, flooding and volume change in glaciers derived from our latest hydrological projections using the latest AOGCMs participating in the fifth phase of the Coupled Model Intercomparison Project (CMIP5).

Future global flood risk was obtained from runoff projection of CMIP5-AOGCMs and a state-of-the-art global river routing model with an inundation scheme. Result showed that frequency of extreme discharge, having a 100 year return period in the historical period, will increase in Southeast Asia, South China, Peninsular India, East Africa and the northern half of the Andes, with small uncertainty in the direction of change (high agreement among AOGCMs). In certain areas, however, frequency of flooding will decrease. It is also notable that reduced snowfall will reduce spring flood peaks in many snow-dominant river basins. Estimation of the exposure to flooding (population in under potential inundation areas) for four new concentration scenarios (RCP8.5, 6.0, 4.5 and 2.6) reveals that much more people will be exposed to floods in future, depending on the degree of warming[2].

Besides the increase of fluvial flood in warm and humid flatland regions, impact of the warming climate would also appear in cold mountainous regions. Future changes in volume of glaciers, estimated by using a global glacier model HYOGA2 forced by precipitation and temperature projections of CMIP5-AOGCMs, showed that many glaciers in the world would lose its volume under the warming climate, while some glaciers would gain mass due to the increase of precipitation[3]. The total global volume loss from glaciers for 1948-2005 was $9.4 \pm 0.5 \times 10^3 km^3$ in the retrospective HYOGA2 simulation, corresponding to a 25.9 ± 1.4 mm sea level equivalent (SLE). According to the future HYOGA2 simulation, under the most severe warming scenario (RCP8.5), the cumulative volume loss from global glaciers would become $21.8 \pm 2.9 \times 10^3 km^3$ (corresponding to 60.3 ± 7.9 mm SLE) by 2060 and 35.8 ± 5.4 $10^3 km^3$ (60.3 ± 14.9 mm SLE) by 2099.

Such "future projection" could be used for our preparedness against potential effects of global warming, such as resilient design of water-related infrastructure in anticipation of future change. Even though the mean change is projected to be small in next several decades, large interannual variability, of the flood exposure and the melt water, implies the necessity of adaptation even before a significant warming occurs.

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[PO-143]

USE OF STOCHASTIC TYHOON MODEL FOR ESTIMATING FUTURE CHANGE OF POPULATION EXPOSED BY TYPOON WINDS IN THE WESTERN NORTH PACIFIC REGION

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Tropical Cyclones (TCs) have caused large impacts on human societies. Possible intensification of TCs in the future might magnify the impacts of TCs. Thus, it would be important to take adequate countermeasures for TC impacts so that we are able to reduce/prevent TC impacts in the future. In order to perform adequate/efficient countermeasures for TC impacts, reliable projection of TCs is crucial. Physical model to simulate TCs have been developed in previous study and is used for future projection of TCs. Nevertheless physical model is useful in projecting TCs in the future, physical model requires large computational cost and thereby it is not easy to simulate large number of TC samples, which are necessary to quantify possible range of TC impacts. On the other hand, stochastic model of TCs (Hashimoto et al., 2001; Rumpf et al., 2007) simulates large number of TCs with low computational cost. The Stochastic Typhoon Model (STM) stochastically simulates important properties of TCs such as number of TC genesis, track and intensity.

This study employed STM to simulate future change of TC properties in the Western North Pacific (WNP) region and also estimated future change of populations exposed by TC wind. Using the STM, we performed future simulation up to target year of 2100. In our STM, future change of TC properties was considered by incorpolating output from GCM (General Circulation Model) into the STM. We also modified the TC wind distribution calculation model suggested by Peduzzi et al (2012), and combined the model to our STM.

As the first step of this study, we validated performance of our STM, and then we applied the STM to estimate future change of population exposure from TC winds in WNP region. We estimated population exposure to TC winds, with and without considering future change of TC intensity (i.e. defined as central pressure in this study) or population. The result indicated future change of TC track might not largely change population exposure in large scale (e.g. country scale) but spatial distribution of exposure within the area/country might change due to track change. By employing temporal population change scenario of three high exposure locations (i.e. China, Philippines, Japan), the result also exhibited the temporal variation of TC exposure for those locations, with showing the highest exposure of each location might appear around which year in the future.

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[PO-144]

ESTIMATION OF EVAPOTRANSPIRATION BASED ON SATELLITE REMOTE SENSING DATA OVER THE CONTINENTAL US FOR ALL SKY CONDITIONS

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Evapotranspiration (ET) is not only the second largest component in water cycle, but is also one of important components for understanding the land surface water cycle and the land-atmosphere energy balance. For this reason, the quantification of ET at the regional scale is a fundamental task to improve our knowledge such as the terrestrial water budget. In this study, we present the method for the satellite data-based ET estimates over the Continental US region for all sky conditions. Moderate Resolution Imaging Spectroradiometer (MODIS) atmosphere and land products were used to obtain the input variables for ET calculation. The ET algorithm was used the improved RS-PM ET algorithm proposed by Mu et al. (2011), which is the operational MODIS ET algorithm. MODIS observations over the land surface are hampered by cloud presence. For this reason, the gap-filling processes were conducted for temperature variables (including air, dew, and land surface temperature) and radiation components (including downward and upward radiation fluxes of shortwave and longwave) under cloudy sky conditions. The brightness temperature at 37 GHz frequency from the Advanced Microwave Scanning Radiometer-Earth Observing System (AMSR-E) was used to fill the gaps for MODIS temperature variables. MODIS06 Cloud Properties product is utilized to estimate radiation components under cloudy sky conditions. Flux tower measurements at 40 sites over study domain were used to evaluate the ET estimates and its input variables. Both of MODIS ET and inputs showed good agreement in comparison with flux tower observations. The mean error (ME) and root mean square error (RMSE) for the estimated daily ET were varied from -1.22 to +1.71 mm day-1 and 0.53 to 2.17 mm day-1, respectively. The ET result produced from this study was compared with the operational MODIS16 ET product over the study domain in 2006. In general, the annual ET from this study showed higher than MODIS16 ET except for the southeastern and northeastern part of US, which are dominated by the deciduous broadleaf forest. The results generated by this study indicated that MODIS products provide the potentials to estimate ET and radiation components for all sky conditions, and offer a good chance to improve our knowledge on the land surface energy balance.

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[PO-145]

THE EFFECTS OF CHANGES IN NET RADIATION AND VAPOR PRESSURE DEFICIT ON INTERANNUAL VARIATION OF GROSS PRIMARY PRODUCTIVITY AND EVAPOTRANSPIRATION IN KOREAN PENINSULA.

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As climate change has been accelerated, frequency of abnormal climate events has been increased. Korean Peninsula has experienced increasing rain fall but the number of rainy days has been decreased. This rainfall patterns are expected to increase total summer net radiation absorbed by biosphere and vapor pressure deficit (VPD). Increasing total summer net radiation reaching the surface of the earth plays critical roles as catalysis which stimulates gross primary productivity (GPP) and evapotranspiration (ET). However, increased VPD has the opposite effects on GPP and ET. Here, we use MODIS-based biophysical model, the Breathing Earth Simulating System and generate 1 km resolution maps of GPP and ET between 2002 and 2012. Finally, we investigate the effects of increasing net radiation and vapor pressure in summer on GPP and ET.

[PO-146]

MESOSCALE WEATHER PATTERNS LEADING TO EXTREME SNOWFALL INTENSITY EVENTS IN SAPPORO CITY OF NORTHERN JAPAN

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Sapporo is the largest city of northernmost Japanese island Hokkaido with 1.9 million population and extreme annual snowfall of around 630 cm. Extreme snowfall plays a vital role by not only affecting daily life but also through its importance as an enormous water resource. We analyzed daily based extreme 100 snowfall intensity (SFI) events in Sapporo for the period of November to March over 20 years from 1992 to 2011 using Sapporo City Multi-sensor (MULTI) network data. Daily weather maps and radiosonde data were used to supplement MULTI data in this study. Among the classified 5 dominant weather patterns, the 'northeast-east low' could affect extreme SFI events in the north of Sapporo. The strongest weather pattern was 'southeast low' that could affect extreme SFI events in the east of Sapporo, and corresponded with topmost 7 cases out of most extreme 10 SFI events. The 'southwest low' was another strong weather pattern and could lead extreme SFI events in the south of Sapporo. Higher amount of precipitable water (≥ 5 mm) and 850 hPa relative humidity (≥ 90%) could intensify most extreme SFI events (average SFI > 25 mm/h) in Sapporo.

[PO-147]

THE INTERACTION BETWEEN VELOCITY AND DENSITY PROFILES IN THE ATMOSPHERIC BOUNDARY LAYER

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The response of atmosphere to the point disturbance is studied. Gravity waves are present in the stably stratified atmospheric boundary layer. In this study we analyze these phenomena by using a linear stability analysis of the piecewise linear boundary layer having density interface (see Figure 1(a)). The above results have been compared to the other cases without density profile and velocity profile (see Figure 1(b), (c)). Schmid and Henningson (2000) discussed the shear flow by using the theory of wave packets using the method of stationary phase. We discuss the interaction between the density profile and the shear flow using the study by Schmid and Henningson for analyzing the shear flow profile.

We wish to begin this theory by deriving the stability equations for infinitesimal disturbances. First we assume that the fluid is inviscid and incompressible, density being convected but not diffused. The stability equation can be derived by considering basic variables $(\mathbf{U},\ P,\ \bar{\rho})$ and perturbation state $(\mathbf{U}+\mathbf{u},\ P+p,\ \bar{\rho}+\rho)$. We suppose that the base flow have velocity only in x-direction which varies in the z-direction. From the above assumption, the equations of motion, incompressibility and continuity give

$$\bar{\rho}\left(\frac{\partial u}{\partial t}+U\frac{\partial u}{\partial x}+w\frac{\partial U}{\partial z}\right)=-\frac{\partial p}{\partial x},\quad \bar{\rho}\left(\frac{\partial v}{\partial t}+U\frac{\partial v}{\partial x}\right)=-\frac{\partial p}{\partial y},\quad \bar{\rho}\left(\frac{\partial w}{\partial t}+U\frac{\partial w}{\partial x}\right)=-\frac{\partial p}{\partial z}-g\rho, \tag{1}$$
$$\frac{\partial \rho}{\partial t}+U\frac{\partial \rho}{\partial x}+w\frac{\partial \bar{\rho}}{\partial z}=0,\quad \frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}+\frac{\partial w}{\partial z}=0$$

here we omit the nonlinear and viscous terms. We also take normal modes of the form

$$u=\hat{u}(z)e^{i(\alpha x+\beta y-\omega t)},\quad v=\hat{v}(z)e^{i(\alpha x+\beta y-\omega t)},\quad w=\hat{w}(z)e^{i(\alpha x+\beta y-\omega t)}, \tag{2}$$
$$p=\hat{p}(z)e^{i(\alpha x+\beta y-\omega t)},\quad \rho=\hat{\rho}(z)e^{i(\alpha x+\beta y-\omega t)}$$

where ω is a complex frequency and α,β are the wave number of x-direction and y-direction, respectively. Suitably, we use another wave number $k=\sqrt{\alpha^2+\beta^2}$ and wave direction θ instead of α, β. Eliminating $\hat{u}$, $\hat{v}$, $\hat{p}$ and $\hat{\rho}$ from Eq. (1), we obtain an equation known as the Taylor-Goldstein equation

$$gk^2\bar{\rho}'\frac{\hat{w}}{\omega-\alpha U}=\alpha\hat{w}[\bar{\rho}U']'+(\omega-\alpha U)[\bar{\rho}\hat{w}']'-\bar{\rho}\hat{w}k^2(\omega-\alpha U). \tag{3}$$

A prime (‘) denotes a z-derivative. Here we take the basic flow by approximating parallel boundary layer flow by piecewise linear velocity segments, as shown in Figure 1(a) and the boundary conditions

$$\begin{cases} Layer\ II;\quad U=U_{II},\quad \rho=\rho_{II} & at\ h<z \\ Layer\ I;\quad U=\dfrac{U_{II}}{h}z,\quad \rho=\rho_I & at\ 0\le z\le h \end{cases},\qquad \hat{w}=0\quad at\ z=0,\infty \tag{4}$$

here we take a semi-infinite domain. The solution of (3) satisfying the base flow and conditions (4) is found to be

$$\hat{w}_{II}=Ae^{-kz},\quad \hat{w}_I=Be^{-kz}-Be^{kz} \tag{5}$$

where A and B are constants. Appliying the matching conditions across the points $z=h$, we get the dispersion relation.

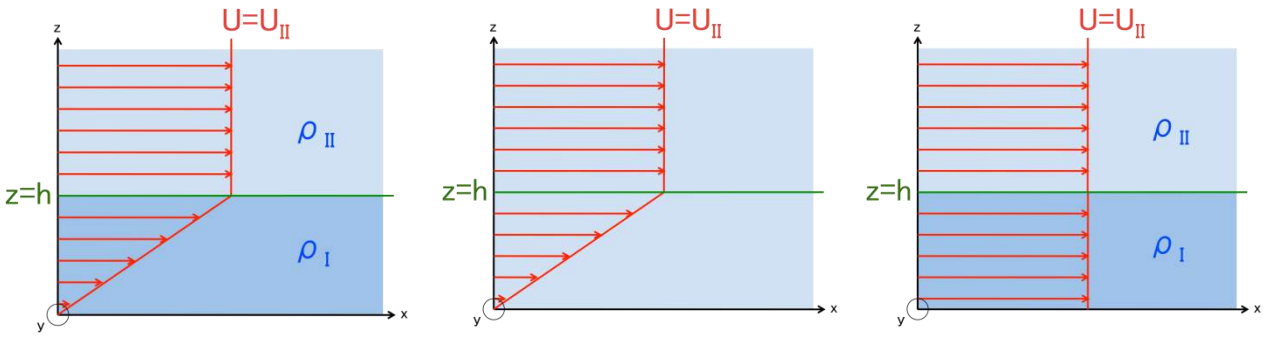
$$\omega^*=k^*\cos\theta-\frac{k^*\cos\theta}{2k^*(R+\coth k^*)}\pm k^*\cos\theta\sqrt{\frac{1}{4k^{*2}(R+\coth k^*)^2}-\frac{1}{Fi^2k^*\cos^2\theta(R+\coth k^*)}} \tag{6}$$

here a superscript * means dimensionless number by U_{II} and h. $Fi = U_{II} / \sqrt{hg(\rho_I - \rho_{II})/\rho_I}$ and $R = \rho_{II} / \rho_I$.Then group velocities of the disturbance are

$$c_{gx} = \frac{x}{t} = \frac{\partial \omega}{\partial \alpha}, \quad c_{gy} = \frac{y}{t} = \frac{\partial \omega}{\partial \beta}. \tag{7}$$

By plotting group velocities Eq. (7), we obtain Figure 2(a). We can consider this figure as the location of wave-like solutions in the (x/t)-(y/t)-plane for the basic flow (4). From the above, we propose the equations for the velocity profile which has the density interface effects and discuss the profile of wave areas.

Keywords: Linear stability theory; Small amplitude waves theory; stationary phase method

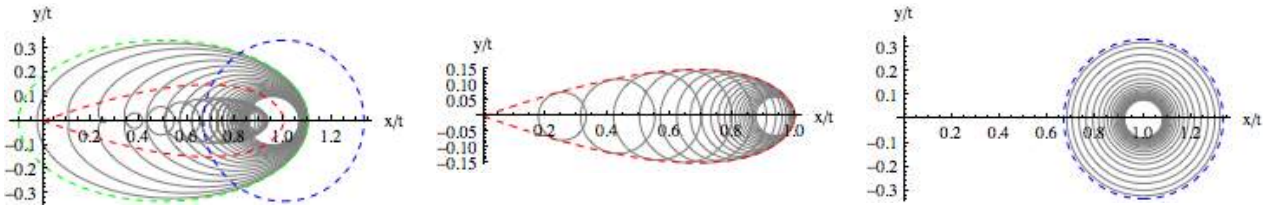


(a) Sketch of the profile having the shear effects and density differences. In this study, we discuss this profile mainly.

(b) Sketch of the profile having the shear effects. Schmid and Henningson discuss this profile.

(c) Sketch of the profile having density differences. We introduce this profile to compare with the profile of Figure 1(a).

Figure 1. Piecewise linear boundary layer profiles.



(a) Location of wave-like solution in the piecewise linear boundary layer profile having the shear effects and density differences (see Figure 1(a)).

(b) Location of wave-like solution in the piecewise linear boundary layer profile having the shear effects (see Figure 1(b)).

(c) Location of wave-like solution in the density interface (see Figure 1(c)).

Figure 2. Location of wave-like solution in the (x/t)-(y/t)-plane for Fi=3, R=0.1

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[PO-148]

SEASONAL VARIATION OF LEAF TRAITS IN WOODY PLANTS OF AN URBAN PARK

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There has been a lot of research conducted recently about measuring leaf traits for different species at a certain time or, in some cases, over the seasons. Foliar N content is also highlighted because of its relation to the maximum carboxylation rate. However, most studies related to leaf traits have been conducted in natural ecosystems. Urban areas cover a small fraction of the Earth, but they are one of the major emitters of greenhouse gases and their area is quickly expanding. Seoul Forest Park is one of the major parks in Seoul, Korea (3rd in area). Through a study of the park over the seasons, leaf traits that include leaf photosynthetic parameters (Maximum rate of carboxylation, maximum rate of electron transport), leaf mass per area and leaf C:N:P are measured here to understand the biochemical and ecophysiological characteristics of woody plants. This study could improve our understanding of carbon cycles in urban parks.

[PO-149]

INTERANNUAL VARIATIONS OF PRECIPITATION AMOUNT IN NORTHERN MONGOLIA AND ITS ASSOCIATION WITH THE SOURCE REGIONS

Withdraw

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Knowledge of regional water cycle and its variability is important for prediction and understanding mechanisms of the extreme events such as draught. The focus of this study is possible relationship between the interannual variations of precipitation and the change of water vapor sources.

In order to investigate sources of the precipitation in northern Mongolia and their interannual variations, a back-trajectory model of atmospheric water vapor was developed and applied to rainfall during the warm season from 2003 to 2009 in northern Mongolia.

The results show that the major precipitation sources of rainwater in northern Mongolia are the local regions of Mongolia and the central and the western Asia.

Water vapor evaporated from the local Mongolia is approximately 20% of the summer precipitation. This ratio is tends to be constant over the years, and investigated particularly higher in Mongolia in compared with the other area on the globe [Dirmeyer and Brubaker, 2009].

Then, water vapor supplied from the central and the western Asia is approximately 30-40% of the total summer precipitation, and has larger interannual variations in compared with that of the local regions of Mongolia. As these variations has the higher correlation with that of the total summer precipitation, the land surface condition in the central and the western Asia may explain the major portion of the interannual variations in the summer precipitation in northern Mongolia.

In addition, the total autumn precipitation is anomalously larger in 2003, and the supply of water vapor from the local Mongolia is anomalously large in 2004. It is hypothesized that the precipitation in the autumn of 2003 was preserved in the frozen soil during winter till the next spring, when it melts and evaporates, and become precipitation in the early summer of 2004.

[PO-150]

THE ESTIMATION OF CO_2 UPTAKE AT PADDY FIELD USING SATELLITE DATA

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Paddy fields in monsoon Asia have a great important role in the global budget of GHGs. Recently long-term fluxes are continuously observed at forest, grassland, and cropland ecosystems. In this study, the exchange of CO_2 at a paddy field was estimated by a satellite-based empirical model with the Terra/MODIS data, and the results were compared with the ground-based observation of exchange of CO_2. This result will be used to estimate the regional carbon balance of paddy fields in East Asia. We developed a satellite-based empirical model for paddy field by applying 1-day and 8-day products of Terra/MODIS. The model empirically infers gross primary productivity (GPP) from normalized difference vegetation index (NDVI) and respiration of ecosystem (RE) from the land surface temperature obtained from Terra/MODIS at 8-day time scale. Net ecosystem CO_2 exchange (NEE) was calculated the difference between GPP and RE. The ground observation data at paddy field acquired in the southern part of Okayama Prefecture, Japan (34°32N, 133°56E). The data of ground-based observation was used for the model calibration and validation, respectively. The data of two years between 2011 and 2012 were used. Seasonal variations of GPP, RE and NEE by the model and the observation were compared in Fig.1. The model reasonably reproduced the seasonal variation of the observed NEE. Though the difference is seen between GPP by the model and the observation at the middle of the growth period, the result in this study has enough accuracy. The differences between the cumulative NEE estimated by the model and the ground-based observation were 5% and 10% in 2011 and 2012, respectively.

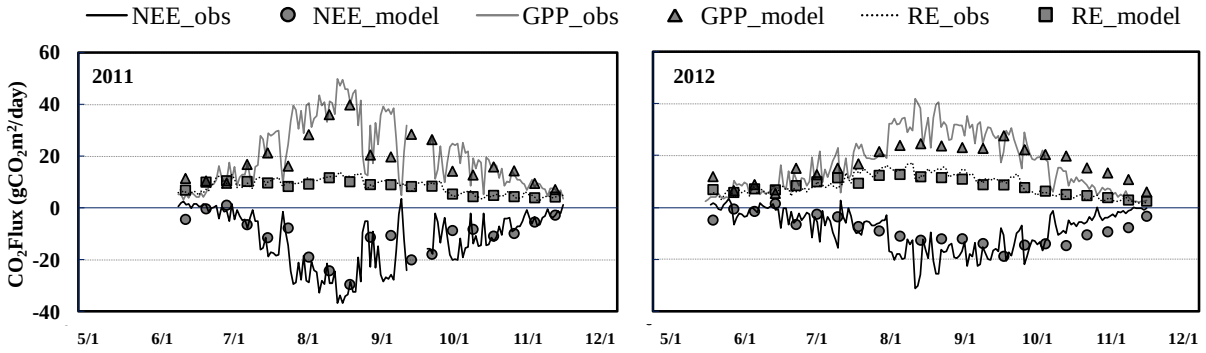

Fig.1 Seasonal variation of GPP, RE and NEE in 2011(left) and 2012(right)

Table.1 Cumulated GPP, RE and NEE (gCO_2/m^2/year)

	GPP		RE		NEE	
year	obs	model	obs	model	obs	model
2011	2940	2616	1249	1176	-1691	-1440
2012	2881	2880	1449	1381	-1432	-1499

[PO-151]

ESTIMATION OF CHANGES OF CARBON BALANCE AFTER THINNING OF 50-YEAR-OLD *PINUS KORAIENSIS* STANDS WITH SAP FLUX MEASUREMENTS

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Understanding the response of a forest ecosystem's productivity to artificial or natural environmental changes is essential to predict future carbon uptake capacity of a forest ecosystem. Atmospheric carbon is assimilated into tree biomass through photosynthesis, but direct measurement of photosynthesis is still difficult because of hard accessibility to tree canopy and its heterogeneity within canopy. Eddy covariance method is relatively hard to apply in complex terrain with various species composition. On the other hand, sap flux measurement can provide integrated information of canopy photosynthetic response to environmental changes. It is easy to upscale to stand or catchment level and also gives inter- or intra-species variations of water use and related carbon gain pattern. In this study, we installed Granier's type thermal dissipation sensors on a 50-year-old *Pinus koraiensis* stand to understand the response of sap flux and photosynthesis to artificial thinning. Thinning was conducted at two intensities (20%-thinned and 40%-thinned based on tree density) on March, 2012. Net photosynthesis is estimated by a 4C-A (Canopy Conductance Constrained Carbon Assimilation) model and validated with net primary production estimated by diameter increment and allometric equations. Mean sap flux density was highest in the 20%-thinned stand, and lowest in the control stand. However, this sap flux increment by thinning does not fully compensate the reduction of total leaf area, and stand transpiration was highest in the control stand and lowest in the 40%-thinned stand. Estimated total stand carbon assimilation was also highest in the control stand (1417.3 g m^{-2} yr^{-1}), and followed by 20%-thinned (1320.0 g m^{-2} yr^{-1}) and 40%-thinned stand (1253.3 g m^{-2} yr^{-1}), but trees in thinned stands showed higher carbon gain (ca. 28 kg $tree^{-1}$ yr^{-1}) than trees in control stand (ca. 23 kg $tree^{-1}$ yr^{-1}). Tree diameter increment, which indicates the net primary production of stands, was also higher in thinned stands (3.48 mm yr^{-1}) than control stand (3.03 mm yr^{-1}). This study shows that sap flux measurement can be used to monitor the responses of a forest ecosystem's water use patterns and productivity to environmental changes.

[PO-152]

CLIMATE CHANGE IMPACT ON WATER RESOURCES IN CHAOPHRAYA RIVER BASIN WITH AN INDEX OF POTENTIAL FOOD PRODUCTION

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The 21st century is often called "the century of water". The general concerns are increasingly focused on the change in the precipitation pattern owing to global warming, the global water problems such as floods or droughts, stable supply of water for agricultural and domestic use, and so on. As regards agricultural water use, it is estimated that agriculture receives 66% of total water withdrawal and 85 % of consumption in the world. Thus, the understanding of the spatial and temporal distribution of agricultural water demand and its response to climate variability is fundamental for stable supply of water for agriculture and sustainable water management.

It is important to assess crop growth state because agricultural water use is dominant to total water consumption whole the world. One of author and his colleague simulated river discharge change of whole Chaophraya river basin using river-routing model with GCM (MRI-AGCM3.1S) output provided from MRI-JMA. From their analysis, it was found that water resources in Pasak river basin decrease under the climate change projection. Therefore, in this study, water resources vulnerability was analyzed in Southeast Asia with an index of potential food production.

To access water resources variability from the view point of food production, application crop growth model is one of the essential ways. In this study, crop growth model based on land surface process is introduced. Particularly, the crop growth scheme in SWIM (Soil and Water Integrated Model) is utilized for crop growth model and the SiBUC (Simple Biosphere including Urban Canopy) model is utilized for considering land surface process.

Preliminary application result using original crop growth parameter for estimating LAI isn't reasonable. So, crop growth parameters are optimized and modified in this study. As a result, coupled model simulation using modified parameters shows good performance. Furthermore, it is assumed that inter-annual variation of estimated biomass can be comparable with one of crop production amount statistics. And then, this coupled model is applied to south-east Asia and accessing water resources variability from an index of food productivity.

Using observed meteoro-hydrological data which was derived by originally installed devices at Rama VI dam office, coupled model was tuned as well-reproducing rice crop state in Pasak river basin. After that, rice crop production changes were estimated by coupled model with GCM output data. As a result, it was assumed that rice crop production decrease about 5% under near future climate projection and it also decrease about 13% under future climate projection.

[PO-153]

CHARACTERISTICS OF LONG-TERM VARIATION FOR THE HEAT-STRESS AND THE HEAT-RELATED DEATHS RATE IN KOREA

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Using the perceived temperature (PT) estimated by the human heat budget model, the summer heat-stress in Korea (28 stations) from 1983 to 2012 was quantified. And then, the spatial distributions of climatical averages of PT and temperature were compared. It was found that the heat stress (PT) changed more sensitively by regional characters than the temperature. The observed mean increase rate of the heat stress was 7.9℃/century, so that summer mean PT is expected to rise up to 56℃ in on hundred years. The heat-related death rate due to the heat-stress has a positive correlation (R = 0.5674) with the PT at 99% confidence level. And a statistical model of heat-related death rate was constructed using these variables. The result of substituting the expected PT in this model showed that the death rate will become 84 people/10million in 1 century. Therefore, if we do not control the current population growth and environmental changes, it is anticipated that the severe risk by heat-wave will arrive.

[PO-154]

MONITORING FOREST STAND STRUCTURE AT LANDSCAPE LEVEL OF BLACK PINE(*PINUS THUNBERGII*) FORESTS IN SOUTHERN REGION, REPUBLIC OF KOREA

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This study has attempted to identify the change in spatial-temporal distribution of secondary forest succession and generate measurements for monitoring the changes in structural species diversity in Black pine forests resulting mainly from a wide variety disturbances occurred between 1980 to 2010 in southern region(Gyeongsangnam-do, Gyeongsangbuk-do, Jeollanam-do, Jeollabuk-do), Republic of Korea. The successional stages were mapped using the combination of GIS (Geographic Information System), GPS (Global Positioning System), color aerial images and high resolution satellite images (IKONOS). Forest stand structure and its relationship with structural species diversity along with its changes over time were characterized using FRAGSTATS software (Spatial Pattern Analysis Program Categorical Maps). In terms of spatial configuration of seral stages, the total number of fragments increased from 572 to 735, and mean size of patch (MPS) increased from 132.9ha to 182.2ha over 30 years. As an overall change in study area, there was a net decrease of 823.3ha forest during the period with a mean annual damage rate of 115.2ha year-1 (0.8% per year). In conclusion, this study showed that stand type maps for forest management plans in southern region provide a great chance to monitor the changes in structural species diversity over time. This study further contributes to the development of a framework for effective integration of biodiversity conservation into multiple use forest management plans using the successional stages as a critical mechanism. Secondary forest succession has been altered dramatically due mainly to natural disturbances, resulting in a potential cause of habitat loss and degradation. With the immense forest damages and management activities since 1980, however, fragmented forest patches have been combined and thus forest areas have been decreased in southern region. The conclusions have been supported by the proxy landscape metrics used in this study. Thus, monitoring as well as reevaluating the efficiency of forest management plan implementations is critical to the effective conservation of biodiversity at a larger landscape level, specifically in southern region black pine forests in Republic of Korea.

Keywords : Forest management, GIS, Landscape metrics, Pinus thunbergii forests, Plant succession,

[PO-155]

CARBON STORAGE BY STAND AGE SEQUENCES OF RED PINE (*PINUS DENSIFLORA*) AND CORK OAK(*QUERCUS VARIABILIS*) STANDS IN SOUTHERN KOREA

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This study was carried out to evaluate carbon storage by stand age sequences (20-40; 40-60; 60-80 year-old stands) from natural red pine and cork oak stands in southern Korea. The study sites were chosen from various stand age classes of red pine and cork oak stands located in six regions (Gosung, Hadong, Jinju, Sancheong, Uiryoung and Sacheon) in southern Korea. Carbon storage of tree biomass in red pine stand was higher in 60-80 year-old stand stands (87.8 Mg C/ha) than in 40-60 (73.5 Mg C/ha) or 20-40 year-old stands (56.1 Mg C/ha). Cork oak stands was higher in 60-80 year-old stand stands (115.5 Mg C/ha) than in 40-60 (54.81 Mg C/ha) or 20-40 year-old stands (48.77 Mg C/ha). However, carbon storage of forest floor in red pine stands was lower in 60-80 year-old stand stands (5.71 Mg C/ha) or 20-40 year-old stands (5.54 Mg C/ha) than in 40-60 (7.86 Mg C/ha) stands. Cork oak stands was not affected by stand age sequences (20-40: 5.77 Mg C/ha; 40-60: 5.53 Mg C/ha; 60-80: 5.19 Mg C/ha). Carbon storage in soil layers of red pine stands was affected by stand age sequences (20-40: 82.2 Mg C/ha; 40-60: 88.73 Mg C/ha; 60-80: 97.84 Mg C/ha). However, cork oak stands was not affected by stand age sequences (20-40: 62.31 Mg C/ha; 40-60: 54.91 Mg C/ha; 60-80: 87.6 Mg C/ha). The carbon storage of red pine and cork oak stands showed a similar proportion to each component (Red pine stands Tree biomass: 42-48%, Forest floor: 3-4%, Soil: 48-53%; Cork oak stands Tree biomass: 42-56%, Forest floor: 3-5%, Soil: 42-53%) regardless of age sequences. The results indicate that the dynamics of carbon storage in red pine and cork oak stands could be attributed to increase of tree biomass carbon during stand age development processes.

Keywords: Biomass, Carbon stock, Forest inventory, Pinus densiflora, Quercus variabilis

[PO-156]

SITE QUALITY EVALUATION OF SAWTOOTH OAK [*QUERCUS ACUTISSIMA* CARRUTH.] FOR PRACTICAL APPLICATIONS AT UNSTOCKED LAND IN KOREA

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The objective of this study was to investigate the relationships between *Quercus acutissima* site index and physical and chemical soil variables in stocked forest land and to create a site index model based on all original variables composed of soil properties, instead of the combination of selected soil variables, by applying and comparing various statistical steps to eliminate multicollinearity and to examine the signs and magnitudes of regression coefficients from the examined model. A total of 147 sample plots with the size of 40 m x 40 m were selected for determining the relationships between site index and soil-site features. Data on the physical and chemical soil nutrients were used to predict site index using both multiple linear and principal component regression methods. In PCR, we applied principal component analysis (PCA) based on the correlation matrix to the independent variables, then we selected PCs and took a regression on the PCs. Finally all of the original independent variables by considering both multicollinearity and coefficients sign. Highly effective variables that related to soil properties for *Q. acutissima* stands were total nitrogen (T.N.), exch. K+, exch. Na+, organic matter (O.M.), and pH in descending order of their contribution to the estimated SI model. The results of this study were reliable in accordance with the sign of most independent variables throughout whole statistical procedures with PCR, while the square of the correlation coefficient (R^2) in the estimated final model by the PCR method was about 0.3900. The results can be beneficial as preliminary data and can be used for establishing suitable plantations of this species, especially in unstocked land for the purpose of extending forest land.

Keywords : PCA(principal component analysis), Site index, Quercus acutissima

[PO-157]

VEGETATION STRUCTURE CHANGE OF OAK FOREST BY THINNING

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This study was performed to see how composition and location of a stand of oak trees, located in Bongjeon-ri, Seoha-myeon, Hamyang-gun, after thinning on its vegetation structure change. For that, thinned and unthinned sample areas were studied, and sample trees were collected. Compositions of the sample areas were used to understand competitive species in the stand and dominance value, and tree ring growth of core sample was studied to analyze the difference between thinned area and unthinned area.
Dominant trees of the tree layer of the thinned area were *Quercus mongolica*, *Quercus serrata* and *Quercus variabilis*; the sub tree layer were *Cornus controversa*, *Alnus hirsuta*, *Fraxinus rhynchophylla* and *Quercus variabilis*; *Sasa borealis* was predominant in the shrub layer. DBH and crown length, crown width by tree layer and sub tree layer was better thinned area than unthinned arean. But tree hieght was better unthinned area than thinned area.

According to the analysis on number of species and individuals and species diversity, tree layer and sub tree layer and shrub layer were increased due to thinning and plant species which appear at an earlier stage of succession varied as time went by since the thinning began.

Keywords : Species diversity, Thinning effect, Vegetation structure

[PO-158]

THE ANATOMICAL PROPERTIES OF DAMAGED *PINUS THUNBERGII* BY *MATSUCOCCUS THUNBERGIANAE*

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The density of *Matstucoccus thunbergianae*, anatomical properties and quantity of 1% NaOH extractions were investigated to *Pinus thunbergii*, Gohung in Junnam Province, which has been damaged from 1963 to 2012 by *Matstucoccus thunbergianae* on the based of its appearance.

As a lot of vermin was found in all samples of damaged trees and few of vermin was not found on the survey of vermin density. It can be concluded that selection of sound and damaged sample trees has been properly done. The width of annual ring in damaged trees was narrower than sound trees and the ratio of late wood had not much difference between damaged and sound trees.

Cell size and cell wall thickness also had not much difference between damaged and sound trees. Cell count per annual ring in damaged trees had less cell count than that in sound trees. Therefore, the diameter of damaged trees was very smaller than that of sound trees. There were almost no difference in longitudinal resin canal count per *area* between damaged and sound trees. but longitudinal resin canal count per *annual ring* had almost twice counts in sound trees. The quantity of 1% NaOH extraction was almost the same between damaged and sound trees.

Keywords : Anatomical Properties, Matsucoccus thunbergianae, Pinus thunbergii

[PO-159]

THE PHYSICAL AND MECHANICAL PROPERTIES OF DAMAGED PINE WOOD(*PINUS THUNBERGII)* BY *MATSUCOCCUS THUNBERGIANAE*

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This study investigated the physical and mechanical properties of damaged and sound wood of *Pinus thunbergii by Matstucoccus thunbergianae* in order to develop damaged tree's use. The swelling ratio in damaged pine wood trees was higher than that in sound. The width of annual ring in damaged trees was denser than that in sound trees, but ratio of late wood had not much difference between damaged and sound trees. There were almost no difference for the three types (bending, compression, and shearing methods) of mechanical properties between damaged and sound trees. It can be concluded that use of damaged *Matstucoccus thunbergianae* is uneconomic due to low growth increment in spite of having its sufficient mechanical properties.

Keywords : Matsucoccus thunbergianae, Pinus thunbergii

[PO-160]

STUDY ON MORPHOLOGICAL VARIATION AND GENETIC DIVERSITY OF NATIVE ZOYSIAGRASSES IN SOUTH KOREA

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In this study, two hundred and seventy-seven zoysiagrasses(*Zoysia* spp.) naturally in Korea were collected from costal, island and inland regions to identify their morphological characteristics, and were morphologically classified based on the results of a principal component analysis and extraction of principal variables. As a result, the different types of native zoysiagrasses, which were collected based on leaf width, stolon internode thickness, number of stolon internode, anther width, filament length, number of seed per spikelet, seed length, seed length/seed width ratio, were classified into four groups. In order for a more definitive classification, amplified fragment length polymorphism (AFLP) markers were used to analyze the genetic diversity of native zoysiagrasses to use the results as basic data to enhance of its genetic variation. Bayesian clustering analysis was conducted to obtain the probability of reassignment into the five clusters with morphological classification being a precondition, and the results showed representative species of four clusters. As such, the analysis of the morphological variation and genetic diversity of native zoysiagrasses resulted in the classification into four major groups. The major morphological traits observed in the each individual groups were compared to the morphological characteristics of native zoysiagrasses described in the reference, and three of the groups were assumed to be *Zoysia japonica*, *Z. sinica* and *Z. matrella*. One of the groups was assumed to be a hybrid and/or mutant with intermediate characteristics. These results a better understanding of the levels of genetic diversity present in native zoysiagrasses could aid in the utilization of these materials in future breeding.

Keywords : AFLP, Morphological variation, Zoysiagrasses

[PO-161]

ANNUAL VARIATIONS OF SOIL CO_2 EFFLUX IN A BROADLEAVED DECIDUOUS FOREST AT THE MT. KEUMSAN LTER SITE

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Soil respiration rates in forest ecosystems play an important role in global carbon cycle. This study was carried out to determine the annual variations of soil CO_2 efflux in a broadleaved deciduous forest for 4 years (2007-2010) at the Mt. Keumsan Long Term Ecological Research (KLTER) site, Southern Korea. The soil CO_2 efflux rates in KLTER showed annual variations with the fluctuation of mean soil temperature. The annual mean soil CO_2 efflux rates and temperature were significantly lower ($P < 0.05$) in the 2008 than in the other years. The annual soil CO_2 efflux rates were 0.32 g m^{-2} h^{-1} for 2008, followed by 0.40 g m^{-2} h^{-1} for 2009, 0.41 g m^{-2} h^{-1} for 2009, and 0.54 g m^{-2} h^{-1} for 2010. The lowest soil CO_2 efflux rates in 2008 were associated with the lowest soil temperature (12.0℃) compared with other years (13.03-13.52℃). The exponential relationships between monthly soil CO_2 efflux rates and the corresponding soil temperature at a depth of 20 cm were highly significant (R^2= 0.31 - 0.74, $P < 0.01$). However, soil water content showed no discernible effect in annual soil CO_2 efflux rates. The results indicate that soil temperature explains the major portion of the annual variances in soil CO_2 efflux rates in KLTER sites.

[PO-162]

INTEGRATED RESEARCH OF BIOGEOCHEMICAL CYCLES INTERACTIONS IN 50-YEAR-OLD *PINUS KORAIENSIS* STANDS OF MT. TAEHWA

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Integrative and multi-scale approaches are necessary to understand how atmosphere, biosphere and earth transport and transform energy and matters through physical, chemical and biological processes. In Mt. Taehwa which is located on temperate region of Korean peninsula, the collaborative efforts of multi-universities and research institutes are organized to understand a 50-year-old *Pinus koraensis* forest ecosystem's biogeochemical cycles. Key ecological and atmospheric processes are monitored at different scales, and the integrative and collaborative analyses are followed. For instance, water and carbon balance of the forest are performed at tree, species and stand level using portable gas analyser, sap flux and eddy-covariance method by National Institute of Environmental Research (NIER) and Seoul National University. In addition, biogenic volatile organic compounds (BVOCs) are main focus due to their role in the formation of ozone and secondary organic aerosol (SOA), which affect air quality and climate. For this, NIER, Korea University, UCI, and NCAR join forces to measure reactive gases including BVOCs, ozone, NOx, and other photochemical byproducts, vertical flux of BVOCs, and physical and chemical properties of aerosol. Nitrogen oxides emission from soil is being measured by Kunsan National University and soil respiration is continuously measured by Konkuk University. In addition, forest inventory is monitored by Seoul National University. This initiative collaboration among universities and institute in Mt. Taehwa would be a bridge for many innovative opportunities to understand forest biogeochemical and ecohydrological cycles and forest ecosystem's responses against changing climate.

[PO-163]

APPLYING THREE DIFFERENT LITTER DECOMPOSITION FUNTIONS FOR ALDER LEAF UNDER DIFFERENT SOIL MOISTURE CONDITIONS

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We investigated leaf litter decomposition in a temperate forested wetland dominated by Japanese alder in central Korea. One upland site (US) and three wetland sites, named drained site (DS), poorly drained site (PDS) and surface saturated site (SSS) were selected based on the different soil moisture conditions. The total 200 litter bags were placed in February 2009. Five bags in each site were retrieved after 3, 6, 10, 12, 15, 26, and 50 months, and litter mass and chemical properties were determined. The change of litter mass remaining was applied into the three different litter decomposition functions as follows; Olson's simple exponential function ($X_t = X_0 e^{-kt}$), Berg's asymptotic function ($X_t = 1 - m\left(1 - e^{-kt/m}\right)$), and rational function by Rovira and Rovira (2010) ($X_t = X_0 e^{-a^3 t^4 / 4b(t^2+b)^2}$).

After 50 months, the mass remaining of leaf litter was the lowest in DS (9.6%) followed by PDS (19.3%), SSS (27.6%), and US (31.9%) (Fig. 1). In PDS and SSS, most of the mass loss occurred during the first 18 months and the mass loss has been restricted since that time. However, the mass loss continuously occurred during the entire study period in US and DS. First, the Olson's simple exponential function estimated the decomposition constant *k* as 0.528 for US, 0.911 for DS, 1.181 for PDS, and 0.950 for SSS (Table 1). The constant *k* from the Olson's simple exponential function can be easily obtained and was comparable to other studies, however, it was not appropriate to explain the inhibited mass loss in the late decomposition stage. Second, the Berg's asymptotic function was applied for estimating the limit value of the litter mass loss. The limit value may represent the stabilized residues of litter decomposition and humus accumulation. The limit value of the litter mass loss was estimated as 70.5% for US, 91.7% for DS, 89.0% for PDS, and 76.9% for SSS (Table 1). Determining the limit value could be an appropriate approach for revealing the contribution of litter decomposition process to soil organic matter. Third, the rational function from Rovira and Rovira (2010) can simulate the assumption of decomposition rate change due to litter quality and environment change through decomposition stages. This function (R^2=0.97–0.99) presented the best fit for litter mass among the other functions (R^2=0.94–0.99) (Table 1). Therefore, these functions may have strength for realistic estimation of mass loss pattern, especially at the late decomposition stage. The current results could support that all these litter decomposition functions may have respective advantages to explain the characteristics of mass loss pattern.

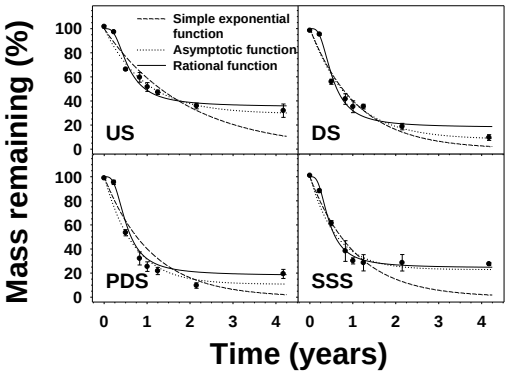

Fig. 1. The litter mass remaining of Japanese alder leaf under different soil moisture conditions.

Table 1. The parameters determined by three different litter decomposition functions shown in Fig. 1.

		US	DS	PDS	SSS
Simple exponential function	*k*	0.528	0.911	1.181	0.950
	R^2	0.971	0.980	0.956	0.938
Asymptotic function	*k*	0.751	0.988	1.316	1.269
	m	0.705	0.917	0.890	0.769
	R^2	0.987	0.982	0.964	0.965
Rational function	*a*	0.955	1.161	1.175	0.948
	b	0.208	0.227	0.205	0.151
	R^2	0.988	0.986	0.984	0.974

[PO-164]

BASE TEMPERATURE FOR THE APPLICATION OF THE GROWING DEGREE DAY MODEL TO ESTIMATE FLOWERING OF SEVERAL LANDSCAPE WOODY PLANTS

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This study used the data of full blooming date and temperature of landscape woody plants to estimate the base temperature and Growing Degree Day (GDD) according to biotic season. The full blooming date of landscape woody plants from 2011 to 2012 was investigated, and the GDD was calculated by deducting the base temperature from daily mean temperature using the temperature data of Suwon Regional Meteorological Office. To set up the reference temperature, the GDD is calculated in the unit of 0.1℃, setting the temperature with low standard deviation of GDD from 2011 to 2012 as the base temperature. As a result, the base temperature of plants is 1.9℃ for *Rhododendron mucronulatum Turcz.*, *Cercis chinensis Bunge.* and *Daphne odora Thunb.*, 0℃ for *Spiraea cantoniensis Lour.*, and 1.2℃ for *Grewia parviflora Bunge.*. The GDD of the full bloom stage is 324.10±96.32℃ for *R. mucronulatum Turcz.*, 506.90±84.99℃ for *C. chinensis Bunge.* and *D. odora Thunb.*, 853.65±59.61℃ for *S. cantoniensis Lour.*, and 2112.70±11.74℃ for *G. parviflora Bunge.* The comparison of predicted full bloom date and actual full bloom date in Hongreung Arboretum using the calculated GDD showed that 45% of the predicted full bloom date for *R. mucronulatum Turcz.* matched the actual full bloom date, 35% for *Cercis chinensis Bunge.*, and 0% for *S. cantoniensis Lour. D. odora Thunb.* has similar full bloom date with *C. chinensis Bunge.*, and thus may show similar prediction accuracy. The prediction date and actual date did not match for *S. cantoniensis Lour.*, which may be due to interspecies difference or error in data and enumeration district.

Key words: Plant phenology, average GDD method, base temperature, cardinal temperature

[PO-165]

REVISING THE DSSAT/CERES-RICE MODEL TO SIMULATE THE EFFECTS OF ELEVATED CO_2 ON GROWTH, DEVELOPMENT AND YIELD OF PADDY RICE

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A comprehensive process-based model, the DSSAT/CERES-Rice, has been in use for more than 20 years by researchers worldwide. However, the model was not originally developed with the intention to model the effects of elevated CO_2 under climate change conditions. The model contain many empirical equations, model parameters have little plant physiological meaning and have to be determined under specific conditions. These empirical equations do not incorporate the latest knowledge about how plant responds to changing climates and management practices. For example, photosynthesis, a basic process that drives plant growth and development, is calculated by converting daily canopy intercepted radiation into plant dry matter using an empirical, crop-specific radiation use efficiency parameter; and the effects of elevated CO_2 are simulated by multiplying the net assimilation by a factor on CO_2 effects. Evidence showed that the empirical equations can result in a wrong direction of interaction among involved factors. In this study, the DSSAT/CERES-Rice model was revised to simulate growth, development and yield more explicitly and improve its ability to estimate the effects of elevated CO_2 under climate change from rice paddy fields under a wide range of climatic and agronomic conditions. The revised model used the FvCB biochemical photosynthesis equations coupled with stomatal conductance model, integrating with local air temperature, to develop a new approach to improve the performance of DSSAT/CERES-Rice models. To capture non-linear responses elevated CO_2 under changing climate conditions, the processes photosynthesis, transpiration and stomatal conductance are calculated in an hourly time-stem. Hourly model results are aggregated to daily value. The new approach can be used for improving rice yield gap analyses to find the solution to improving the farmers' yield; rice yield trend analyses to help in managing the yield-limiting or yield reducing factors; rice management, planting date, cultivar choice, irrigation and fertilizer management; policy making and strategic planning by predicting national food production, effects of climate change.

[PO-166]

COMPARATIVE ASSESSMENT OF CARBON DIOXIDE FLUXES OF FLOODED AND DRAINED MANAGEMENT CONDITIONS AT RICE PADDY FIELD IN KOREA

Kyomoon Shim, Sunghyun Min, Yongseok Kim, Myungpyo Jung, Seokcheal Kim, Kyuho So

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The seasonal fluxes of heat, moisture and carbon dioxide were investigated under rice cropping paddy field, located at the Gimje paddy flux site in the southwestern coast of Korea, during the 2012 growing season. Net ecosystem carbon dioxide exchange (NEE), gross primary production (GPP) and ecosystem respiration (RE) were analyzed by employing the open path eddy covariance technique. Environmental parameters (net radiation, air temperature, *etc.*) and plant biomass (LAI, plant height, *etc.*) were also collected and measured. During the growing season, radiation and air temperature were the main environmental controls of NEE and GPP, and soil temperature was the main environmental impact of RE. The drained condition of rice paddy field had higher sensible heat flux (H) and lower latent heat flux (LE) compared to flooded condition. The H in drained condition of rice paddy field was about five times higher than in flooded condition while the LE in flooded condition was 1.1 times higher than in drained condition. The drained condition of rice paddy had significantly higher Bowen ratio (1.5) than the flooded condition (0.3). The NEE in flooded condition of rice paddy field was about 1.2 times higher than in drained condition. However, the GPP and RE in drained condition of rice paddy field were about 1.1 and 1.3 times higher than in flooded condition, respectively. The ratio of GPP to RE in flooded condition of rice paddy field was 1.5, and it was 1.3 in drained condition of rice paddy field. During the rice cropping period, the NEE, GPP and RE in flooded condition were -124.8, 346.7 and 221.9 g C m^{-2}, and they were -104.1, 395.8 and 291.7 g C m^{-2} in drained condition, respectively. So, the ratio of RE to GPP in flooded condition of rice paddy field was 0.64 while it was 0.75 in drained condition. This short-term data showed differences in C budget and heat exchange between the flooded and drained condition of rice paddy field. Further investigation is needed to clarify seasonal and inter-annual variations in microclimate, carbon and water budget of different condition of rice paddy field.

[PO-167]

INFLUENCE OF FERTILIZER COMBINATION ON TOTAL AND HETEROTROPHIC SOIL RESPIRATION IN RED PINE STANDS

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This study was conducted to evaluate effect of fertilizer combination on soil respiration (total and heterotrophic soil respiration) in red pine forests, Korea. Different combinations of fertilizer (N:P:K=113:150:37 kg/ha; P:K=150:37 kg/ha) were applied in April 2011, and total and heterotrophic soil respiration rates were monitored from April 2011 to March 2012. Monthly variation of total soil and heterotrophic respiration was similar between the different combination of fertilizer and the control treatments. Annual mean total soil respiration during the study period was not significantly different between the different combination of fertilizer (NPK: 0.504 g $CO_2\,m^{-2}\,h^{-1}$; PK: 0.475 g $CO_2\,m^{-2}\,h^{-1}$) and the control (0.501 g $CO_2\,m^{-2}\,h^{-1}$) treatments. However, heterotrophic soil respiration was generally higher in the different combination of fertilizer (NPK: 0.392 g $CO_2\,m^{-2}\,h^{-1}$; PK: 0.353 g $CO_2\,m^{-2}\,h^{-1}$) than in the control (0.315 g $CO_2\,m^{-2}\,h^{-1}$) treatments. The proportion of heterotrophic soil respiration was 78% for the NPK, 74% for the PK, and 62% of total soil respiration for the control treatments. These results suggest that total soil respiration was not affected by the different combination of fertilizer, although the fertilizer induced increased heterotrophic soil respiration.

[PO-168]

THE INFLUENCE OF PLANT GROWING ON THE DAILY TEMPERATURE CHANGES OF GREEN ROOF IN SUMMER

Ha-Kyung Jang*, Seung-Won Han, Jae-Soon Kim, Myung-Il Jeong

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The purpose of this study was to analyze the effect of plants on daily temperature changes of green roof surface. Seven perennial green roof plants such as *Dianthus chinensis, Chrysanthemum zawadskii, Sedum takesimense* etc. were selected and the measurements were undertaken by thermal imaging technology during August 2012. The results of this study were as follows; the experimental plants were average 11.4-16.3℃ lower than the green roof surface. There was the greatest temperature difference as much 17℃ between *Dianthus chinensis* and the roof surface at 2pm. *Rhododendron indicum* and *Sedum takesimense* showed about 1℃ lower difference than other species. The temperature difference between plants and roof surface were greater at 1-2pm than other time.

[PO-169]

THERMAL EFFECT MEASUREMENTS FOR LANDSCAPE PLANTS ON HIGH TEMPERATURE STATUS

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By reducing thermal fluctuation on the outer surface of the roof and by increasing their thermal capacity, they contribute, to the cooling of the spaces below the roof during the summer. This paper refers to the investigation were implemented that the investigation of the landscape plants's thermal performance of an experimental single-species in south Korea, a southern city with a temperate climate. Field measurements during a warm period(01-June-2012–31-August-2012) at from 25℃to 37℃. Every species of landscape plants were different amount of thermal capacity. The experimental species were *Lysimachia* spp., *Sedum* spp., *Hosta* spp., *Joysia* spp., *Parthenocissus* spp., *Saxifraga* spp., *Pachysandra* spp., *Liriope* spp. that was the major landscape plants on urban spaces. On the ambient Temperature at 25℃, *Parthenocissus* spp. was higher than other species as much as 2℃. Moreover on the 35℃, *Sedum* spp. was higher than other species as much as 3℃.

[PO-170]

IN-DEPTH EXAMINATION OF SCS CURVE NUMBER METHOD ON STEEP FORESTED WATERSHEDS

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** Corresponding Author*

A common feature of the forest floor is the presence of litter layer. The litter layer play an important role in preventing soil erosion by intercepting rainfall and keeping infiltration rate high. Also litter-mycelium may contribute to retard water movement into the soil. For estimating infiltration capacity of floor litter, fungi species in deciduous and coniferous forest were selected and incubated for rainfall simulator experiments.

In this study, we used a small standard rainfall simulator in laboratory(Eijkelkamp). With 49 capillary tubes and raindrops of 5.9 mm of diameter this simulator generated a standardized rain shower on a surface area of 25 x 25 cm. To all plots a rainfall simulation with an intensity of 100 mm/hr and duration of 20 min was applied. During the rainfall simulation, we could measure interception capacity by difference in weight between initial litter layer and after 35 min increased litter layer weight. Litter-layer weight was measured by scale every two second.

The results of deciduous infiltration capacity were as follows. Total rainfall is 2000 ml. If there are litter-mycelium layer infiltration capacity is 3.3%. While control layer infiltration capacity is 2.7%. And results of coniferous infiltration capacity were as follows. If there are litter- mycelium layer infiltration capacity is 3.4%. Control layer infiltration capacity is 2.5%.

In this study, it was found more detail mechanism of rainfall interception and infiltration rate by litter mycelium layer. The contribution of decomposition fungi to infiltration capacity was quantitatively evaluated. A great difference between the mycelium in the litter can affect infiltration rate and water storage capacity of floor litter. Litter mycelium reduced the infiltration rate by storing the rainfall and making water repellent layer. Variation of infiltrated water showed that the effect of fungi on infiltration was predominant at the beginning of rainfall.

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[PO-171]

VULNERABILITY ASSESSMENT OF AN APPLE ORCHARD ACCORDING TO ABNORMAL CLIMATE

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Vulnerability assessment of agriculture towards abnormal climate is a scale for understanding how easily the system is affected by climate exposure or stress. It is an important footing for establishing a measure for climate change and it is used as an important basis for establishing a direction for adaptation policy in a nation or a local government (UNDP, 2005). For the last 10 years (1995 ~ 2004), total damage from various climatic disasters amounts to 17 trillion 250 billion KRW and among this, damage from agricultural products amounts to 5 trillion 250 billion KRW which takes up more than 30% of total damage. This research is on a vulnerability assessment by the effect of climate that focused on apple orchards which is highly affected by the abnormal climate. The map for vulnerability assessment is made based on the climate expose and sensitivity, but the adaptation ability is excluded. In climate expose assessment by the RCP scenario and SRES A1B Scenario, proxy variable for climate expose is selected based on the maximum value of daily maximum temperature, number of days with daily maximum wind speed of 14m/s, number of days with daily amount of precipitation of 160mm and amount of solar radiation. Proxy variable for sensitivity is selected based on the area of apple orchard, numbers of orchard farm, production per cultivation area, total damage from a typhoon, a strong wind and a heavy rain. Adaptation ability is measured based on level of financial independence and local gross production per capita. Gyeongsangbuk-do showed higher vulnerability of an apple by abnormal climate based on past RCP (2000s). As the data moves towards RCP 8.5 2050s, Gyeongsangbuk-do, Jeollabuk-do and east Gyeonggi-do showed progressively growing vulnerability. Comparing A1B 2050s and RCP 8.5 2050s, RCP scenario showed higher vulnerability.

Key words : Abnormal climate, Climate expose, Sensitivity, Adaptation ability, Vulnerability assessment

[PO-172]

VERTICAL AND HORIZONTAL VARIATIONS OF THE SEASONAL CHANGES IN CANOPY STRUCTURE AND THE LEAF TRAITS

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To understand the photosynthetic and structural characteristics in Gwangneung intensive monitoring site (37º45'25"N, 127º09'11"E), we conducted the periodic measurements of leaf area index (LAI), maximum rate of carboxylation (V_{cmax}), and leaf spectra; as a measure of canopy structure, photosynthetic capacity, and the leaf traits, respectively. Also, leaf mass per area (LMA) and carbon-nitrogen ratio (C:N ratio) were measured from the leaves of dominated species in every field survey, which were additionally used to describe the seasonal changes in leaf characteristics. This study showed the preliminary result of the observations at deciduous-forest study area (GDK), focusing on spatial and temporal variations in the measurements.

We attempted to observe vertical change in seasonal LAI-s, not only by the weekly measurement of LAI-2200 Plant Canopy Analyzer (Li-Cor Biosciences Co.), but also the daily records acquired from the self-produced LED sensors (Ryu et al., 2010), at different heights of the Eco-tower in GDK site. Horizontal LAI variations around the tower were monitored by the upward digital cameras (Ryu et al., 2012) on ground, which was based on the periodical random observations along a line, as well as the daily shots at three pivot positions. Five to ten leaf-samples of dominant species (i.e., *Quercus Serrata*, *Carpinus laxiflora*, *Carpinus cordata*) were taken at different canopy layers for measuring the spectral properties, LMA and C:N ratio. The full range of high spectral-resolution information from visible to near-infrared region (350~2500 nm) was acquired for each sample using Fieldspec 4 (ASD Inc.), and then characterized by the published vegetation indices. The results of all these time-series measurements were analyzed and discussed.

As a result, we successfully observed 1) clear trends showing the increase of LAI and V_{cmax} during spring season of sprouts and the stabling phase at early summer, and 2) the developing stages of leaves as shown in the changes of C:N ratio, LMA, and the values of spectral vegetation indices. It was believed to be explainable in terms of the ecological implications of all measurement items.

By extending this campaign throughout the year, future study is expected to understand more clearly the seasonality of photosynthetic and structural indicators in deciduous forests, and contribute to the improvement of previous upscaling model (Ryu et al., 2011).

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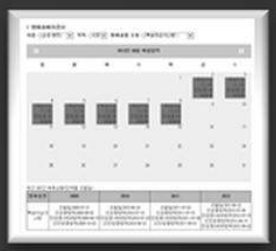

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NCAM's mission is to develop and deliver information to KMA, RDA and KFS on the options and trade-offs for a sustainable future of agricultural and forest ecosystems under a changing environment.

Vision

NCAM's vision is to support individuals and organizations to be prepared to engage wisely in sustainability challenges from local to global scales by envisioning and implementing sustainable solutions to the current and future agricultural, forest and environmental problems in ecological-societal systems. To accomplish this vision, NCAM will provide key information, synthesized understanding, options & trade-offs, and education & workshops on sustainability of agricultural and forest ecosystems in the context of climate change.

Strategy

NCAM consists of diverse groups of experts in various disciplines in both 'hard' (natural science & technology) and 'soft' sciences (social science & humanities) and works with diverse communities to bring better understanding of ecological-societal systems and to facilitate resilience-based systems thinking, which will ensure sustainable resources from agricultural and forest ecosystems. Currently, the core services and research & development of NCAM are:

(1) Satellite- and model-based high-resolution, digital climatology mapping of structure and function of agricultural and forest ecosystems,
(2) Synthesized analysis of measurement and modeling of plant and animal production, outbreak and risk of diseases and insect pests,
(3) Monitoring of energy, water and carbon cycles through multi-purpose tower-based networks (e.g., KoFlux, AsiaFlux),
(4) Transdisciplinary education in 'Agricultural & Forest Meteorology' in collaboration with Seoul National University (http://agfm.snu.ac.kr), and
(5) Workshops, training courses, and internships.

Through the synergy of adaptive monitoring, adaptive management, and adaptive governance, NCAM will play a critical role in enhancing ecosystem services, mitigating disasters, and adapting to climate and environmental changes to ensure sustainable water and food security in Asia.

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