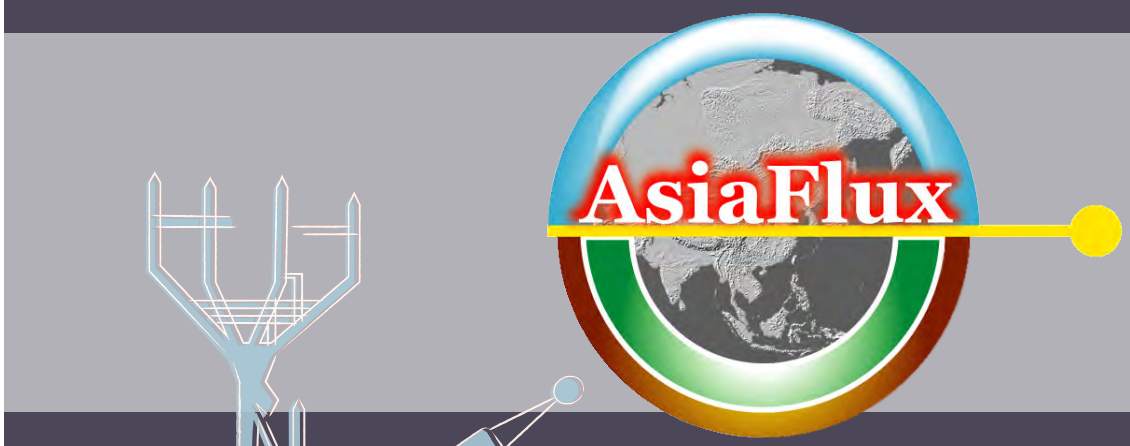
2021

PROCEEDINGS



AsiaFlux Online Conference

December 20-21, 2021

AsiaFlux Conference 2021 Organizing Committee

Kazuhito Ichii (Chiba University, Japan) (Chair)
Shuli Niu (Chinese Academy of Science, China)
Minseok Kang (National Center for Agro-Meteorology, Korea)
Hiroki Ikawa (Institute for Agro-Environmental Sciences, NARO, Japan)
Jehn-Yih Juang (National Taiwan University, Taiwan)
Yuji Kominami (Forestry and Forest Products Research Institute, Japan)
Youngryel Ryu (Seoul National University, Korea)
Yoshiyuki Takahashi (National Institute for Environmental Studies, Japan)

Secretary
Yukimi Nakata (National Institute for Environmental Studies, Japan)

Design
Ayane Kosugo (Chiba University, Japan)

Support
Chihaya Miyamoto (Chiba University, Japan)

Acknowledgement
This conference is partially supported by a joint research program of Center for Environmental Remote Sensing (CEReS), Chiba University.

AsiaFlux Conference 2021 Program (V3, Dec. 15, 2021)

Day 1: Dec 20, 2021 (TimeZone: Tokyo (JST) GMT+9)

	Session 1: Invited Talk/Lecture (Chair: Shuli Niu)		
S1-01	12:30-13:00	Sara Knox (invited)	FLUXNET-CH4 – a global database of eddy covariance methane flux measurements
S1-02	13:00-13:30	Joe Berry (invited)	SiF and GPP

Break

	Session 2: Climate Change, IPCC, Political Applications (Chair: Minseok Kang)		
	13:45-13:55	Kazuhito Ichii	Greetings
S2-01	13:55-14:25	Prabir K. Patra (invited)	Global and regional carbon budgets – lessons from IPCC AR6 and MIROC4-ACTM inversions
S2-02	14:25-14:40	Chandra S. Deshmukh	Tropical Peatland Conservation as a Natural Climate Solution Provides Significant Avoided Emissions
S2-03	14:40-14:55	Erik Velasco	Carbon sequestration potential of urban greenery

Break

	Session 3: Site Measuments and Applications (Chair: Hiroki Ikawa)		
S3-01	15:05-15:20	Olga Kuricheva	Dry-season precipitation controls interannual variations in evapotranspiration in a monsoon tropical forest in Vietnam
S3-02	15:20-15:35	Arnon Setsungnern	Effect of strong El Nino on net ecosystem CO2 exchange and grain yield from Thai rainfed rice field
S3-03	15:35-15:50	Madan Subedi	Investigating the influence of extreme climatic events on net ecosystem carbon dioxide exchange (NEE) in a commercial oil palm plantation, Indonesia.

Break

	Session 4: Reagional Network Reports (Chair: Yoshiyuki Takahashi) (Program TBD)		
	16:00-17:00	Zhi Chen	Progresses and future directions of ChinaFLUX
		Minseok Kang	KoFlux
		Montri Sanwangsri	Research and Activitiy from ThaiFlux Network
		Jehn-Yih Juang	Taiwan Flux
			JapanFlux etc.

Break

	Poster Session (Chair: Youngryel Ryu) See Poster List (Time: TBD)	
	17:10-18:30	Poster Session (including Lightning Talk 33 x 1min)

Day 2: Dec 21, 2021 (TimeZone: Tokyo (JST) GMT+9

	Session 5: Collaboration across network (Chair: Kazuhito Ichii)		
S5-01	12:30-13:00	Trevor Keenan (invited)	The FLUXNET Coordination Project: A new initiative to support global network-enabled science
S5-02	13:00-13:30	Jamie Cleverly (invited)	20 Years of OzFlux: Lessons learned and future OzFlux–AsiaFlux collaborations
S5-03	13:30-13:45	Yuhei Yamamoto	Application of AsiaFlux and OzFlux Network Data to the Validation of Himawari-8/AHI Land Surface Temperature Data
S5-04	13:45-14:00	Akihiko Ito	Global trends in land atmosphere CO2 exchange fluxes: an analysis of a flux measurement dataset and comparison with terrestrial model

Break

	Session 6: New measurements and process understandings (Chair: Yuji Kominami)		
S6-01	14:15-14:45	Daniel Epron (invited)	Emissions of methane from tree stems in forests: where does methane come from and where does it go?
S6-02	14:45-15:00	Heping Liu	Non-Closure of Surface Energy Balance Linked to Asymmetric Turbulent Transport of Scalars by Large Eddies
S6-03	15:00-15:15	Christian Stiegler	Wind regimes above and below a dense oil palm canopy: Detection of decoupling and its implications on CO2 flux estimates
S6-04	15:15-15:30	Xudong Zhu	How land-sea interaction of tidal and sea breeze activity affect mangrove net ecosystem exchange?
S6-05	15:30-15:45	Jiangong Liu	Widespread thermal acclimation of canopy photosynthesis

Break

	Session 7: Modeling and Remote Sensing (Chair: Jehn-Yih Juang)		
S7-01	16:00-16:15	Shaoqiang Wang	Response of crop photosynthesis to water stress in North China Plain based on vegetation chlorophyll fluorescence
S7-02	16:15-16:30	Weikang Zhang	GPPmax dominates the interannual variation of annual GPP in the north hemisphere
S7-03	16:30-16:45	Lang Han	Geographic patterns in the phenology and physiological properties of carbon fluxes and their correlations over the Northern Hemisphere
S7-04	16:45-17:00	Li Zhang	Using model-data fusion to estimate the carbon uptake of terrestrial ecosystems in China
S7-05	17:00-17:15	Desra Arriyadi	Estimating historical and future of water table depth and net ecosystem exchange in Katingan-Mentaya peat hydrological unit
	Closing	Shuli Niu/Minseok Kang	

AsiaFlux Conference 2021 Poster Program (V3, Dec 15, 2021)

No.	Presenter Name	Title
P-01	Bo Liu	Effects of advection on single crop coefficients over a humid paddy field in southern China
P-02	Manoj Hari	Evapotranspiration Estimation Mapping of the Rice Bowl of Tamilnadu, India: A Little Water to Spare
P-03	Shinjiro Ohkubo	Influence of fire and drainage on water fluxes in a degraded tropical peat swamp forest
P-04	Nikolay Zhirenko	Modeling photosynthesis of Rhizophora apiculata (South Vietnam)
P-05	Anuj T. Magar	Environmental control of leaf litterfall rates of species from tropical semi-deciduous ecosystems.
P-06	Sunom Shrestha	Using field measurements and a soil water balance model to investigate changes in soil moisture in oil palm plantations
P-07	Ting-Wei Chang	Establishment of rapid measuring protocol for isoprene emission capacity of palm species
P-08	Yuji Kominami	Change in soil carbon budget by Oak wilt disease in Japan
P-09	Taichi Noshiro	On the use of a light-weighted membrane drier for CO2 flux measurements in the cold environments
P-10	Yin Wang	An open-path ammonia analyzer for eddy covariance flux measurement
P-11	Nurul Ihsan Fawzi	A preliminary result of measuring peatland CO2 flux on coconut plantation in Riau Province of Indonesia
P-12	Linjie Jiao	Monitoring and analyzing latent heat flux simultaneously with leaf wetness by eddy covariance and SVAT multilayer model
P-13	Hojin Lee	Seasonal contrasting effects of PM2.5 on forest productivity in peri-urban region of South Korea
P-14	Sungsik Cho	Differences of CO2/H2O/CH4 eddy fluxes measured at two heights in a rice paddy
P-15	Palingamoorthy Gnanamoorthy	Altered albedo dominates the radiative forcing changes in a subtropical forest following an extreme snow event
P-16	Muhammad Amir	Reflectance and chlorophyll fluorescence-based retrieval of photosynthetic parameters improves the estimation of subtropical forest productivity
P-17	Fathima Abdurazak PA	Mapping the impact of flood using optical remote sensing in Periyar river basin, Kerala, India
P-18	Siyu Chen	Winter leaf reddening phenomenon: Tracking of changing patterns of vegetation indices and eddy covariance fluxes in a temperate Japanese cypress forest at Kiryu Japan
P-19	Jongmin Kim	Monitoring spring phenology of multi-layer canopy in a deciduous broadleaf forest: What signal do satellites actually see in space?
P-20	Da Wang	Changes in terrestrial vegetation activities observed by satellite-based products across Northern Asia

P-21	Tomoki Morozumi	Total and top-to-bottom emissions of solar-induced chlorophyll fluorescence in the canopy of a cool temperate deciduous broad-leaved forest in Takayama, Japan
P-22	Juwon Kong	Monitoring daily canopy photosynthesis using NIRvP maps at 10 m resolution using Sentinel 2 and GK2A
P-23	Yui Shikakura	Estimating diurnal GPP variations in East Asia using Himawari-8 data
P-24	Sungchan Jeong	Tracking diurnal to seasonal variations of gross primary productivity using a geostationary satellite, GK-2A Advanced Meteorological Imager in Korean Peninsula
P-25	Tatsuki Hashimoto	Generating LAI and FPAR Datasets using Himawari-8 AHI data
P-26	Hideki Ninomiya	Simulating the effect of carbon starvation on terrestrial ecosystem by individual-based vegetation model SEIB-DGVM
P-27	Ashehad A. Ali	Implementing a new rubber plant functional type in the Community Land Model (CLM5) improves accuracy of carbon and water flux estimation
P-28	Hina Yamanuki	Upscaling and Intercomparison of Soil Respiration in Japan
P-29	Rahmi Ariani	Improving carbon fluxes and stocks simulations by parameterizing the tropical evergreen plant functional type PFT: Applying CLM5 in Southeast Asia
P-30	Weinan Chen	Maximum leaf area index the seasonal temperature sensitivity of carbon uptake across northern ecosystems
P-31	Xingchang Wang	Interannual variations in CO2 fluxes and its environmental and biotic controls in a typical temperate secondary forest in Northeast China
P-32	Mohammad Samiul Ahsan Talucder	Climate-Smart Agriculture (CSA)-Based Assessment of a Rice Cultivation System in Gimje, Korea
P-33	Bin Chen	Including soil water stress in process-based ecosystem models by scaling down maximum carboxylation rate using accumulated soil water deficit

Oral Session

Day 1: Dec 20, 2021 (TimeZone: Tokyo (JST) GMT+9)

Session 1: Invited Talk/Lecture

S1-01 (INVITED)

FLUXNET-CH_4 – a global database of eddy covariance methane flux measurements

Sara Knox (The University of British Columbia, Canada)

Uncertainties around global CH_4 sources and sinks remain quite large, and much higher than those for CO_2, with uncertainties from natural sources exceeding those from anthropogenic emissions. In particular, one of the largest sources of uncertainty in the global CH_4 budget is related to emissions from wetlands and inland waters. Direct observations of local CH_4 emissions with high measurement frequency are important for constraining CH_4 budgets, for understanding the responses of CH_4 fluxes to environmental factors and climate, and for creating validation datasets for the land-surface models used to infer global CH_4 budgets. However, unlike the well-coordinated efforts for synthesizing CO_2 flux measurements, until recently, no parallel initiative was available for CH_4. Here I present a recent FLUXNET coordination network for CH_4 organized by the Global Carbon Project in collaboration with regional flux networks. I will describe the objectives of the FLUXNET-CH_4 activity and provide an overview of FLUXNET-CH_4 Version 1.0 includes which includes data from 81 sites representing freshwater, coastal, upland, natural, and managed ecosystems. Furthermore, I present recent work which leverages the FLUXNET-CH_4 database to provide improved understanding of the controls and timing of wetland CH_4 emissions, inform CH_4 flux gap-filling and modeling, and generate data-driven CH_4 emissions products. The future of FLUXNET-CH_4 will also be discussed with an opportunity for a community discussion on the next version of the database.

S1-02 (INVITED)

SiF and GPP

Joe Berry (Carnegie Institution for Science, USA)

Photosynthesis is an important global process. Knowledge how much of it occurs, how it is distributed over the Earth, and how it is responding to disturbance and climate change are important starting points for studies of the carbon cycle, agricultural productivity, and the carrying capacity of the planet. We have made significant progress in recent decades with the advent of Earth observing satellites, networks of flux monitoring systems, global atmospheric sampling and Earth system models. However, there is still need for improvement. The recent addition of the ability to measure solar induced fluorescence from chlorophyll at various scales has opened up new opportunities for more mechanistic treatments of photosynthetic physiology, radiation transport, and canopy development. In this presentation, I will review our current understanding in these areas and provide my personal perspective on how these might develop in the near future.

Session 2: Climate Change, IPCC, Political Applications

S2-01 (INVITED)

Global and regional carbon budgets – lessons from IPCC AR6 and MIROC4-ACTM inversions

Prabir K. Patra (JAMSTEC and Chiba University, Japan)

The recently concluded IPCC 6th assessment report issued an alert that CO_2 emissions required to be net-zero by 2050, and the remaining carbon budget is roughly about 140 PgC or 500 $GtCO_2$ for limiting global surface air temperature increase below 1.5 degC by 2100. At the present rate of fossil fuel emissions, at about 10 PgC in 2018, we are set to overshoot the temperature target in less than 15 years, unless a drastic and sustained reductions in emissions from fossil fuel consumption is exercised. In the past 60 years (1960-2019), however, global land and ocean has removed 32% and 24%, respectively, of the global total CO_2 emissions of 7.5 PgC yr^{-1}, jointly from fossil fuel and landuse change. Thus, the nature-based solutions are key part of any CO_2 emission reduction policy. Large uncertainties remain in estimations of CO_2 fluxes from landuse change, forestry, grassland and fossil fuels at country scales, and in the future projection of the efficiency of land and ocean carbon sinks based on the simulations of Earth System Models (ESMs).

In JAMSTEC, we perform top-down estimations of regional CO_2 (and CH_4, N_2O) fluxes using the MIROC version 4.0 AGCM-based chemistry-transport model (MIROC4-ACTM). Our top-down inversion model estimated the land and ocean sink partitioning of -2.1±0.3 and -2.4±0.2 PgC yr^{-1}, respectively, for the period 2011-2020, offsetting about 22% and 25% of global fossil-fuel CO_2 emissions (9.67 PgC yr^{-1}). An assessment of the regional land biosphere fluxes suggests that all the major Asia regions are a net sink of CO_2 in the period 2001-2020. There is a strong need for validation of our results using ground truth observations, which are lacking most significantly in Asian countries. A coordinated carbon flux assessment, by using the flux tower data and other bottom-up approaches, could help us to close the source and sinks budget of CO_2 and improve accuracy of national reporting of emissions to the UNFCCC.

S2-02

Tropical Peatland Conservation as a Natural Climate Solution Provides Significant Avoided Emissions

Chandra Shekhar Deshmukh (APRIL, Indonesia)

Tropical peatlands are threatened by climate and land-cover changes but there remain substantial uncertainties about their present and future role in the regional and global greenhouse gas (GHG) budgets due to limited measurements. The eddy covariance measurements of net ecosystem carbon dioxide and methane exchanges from a coastal peatland in Sumatra, Indonesia indicate that the GHG balance increased from 20.0 ±4.5 tCO_2e ha^{-1} yr^{-1} at the intact site (undrained and undisturbed forest cover) to 43.8 ±1.5

tCO_2e ha $^{-1}$ yr^{-1} at the degraded site (drained with canal system and selectively logged). The significant carbon dioxide emissions from the intact site, during an extreme drought caused by a positive Indian Ocean Dipole phase combined with El Nino event, highlight the potential importance of climate regime in determining the GHG budget of tropical peatlands. Although the measurements indicate that both intact and degraded peatlands in this study are warming the atmosphere, it remains clear that protection of the remaining intact tropical peatlands offers a viable way to avoid substantial GHG emissions from this globally important ecosystem, which for our study in Sumatra was 24 ± 5 tCO_2e ha^{-1} yr^{-1}. These results highlight that protecting all remaining intact peat swamp forests in Indonesia (6.2 Mha) from degradation will avoid GHG emissions of around 0.15 $GtCO_2e$ $yr^{-1.}$ This equates to ~10% of Indonesia's GHG emissions in 2016.

S2-03

Carbon sequestration potential of urban greenery

Erik Velasco (Molina Center for the Energy and the Environment, Singapore)

Based on a series of unique field experiments, including the deployment of eddy covariance eddy flux towers, soil respiration measurements and the use of a terrestrial scanner to build allometric equations for urban trees in Singapore and Mexico City, my talk will explain how plants and soil regulate the carbon exchange in urban parks, gardens and lawns, and why it is important to identify and implement gardening practices that promote carbon storage and reduce the impact of maintenance activities. Bear in mind that the urban landscape is a disturbed ecosystem, and greenery may act either as a sink or an emission source for atmospheric carbon dioxide (CO_2). Plants remove CO_2 by photosynthesis; the majority is consumed in biomass production, but a fraction is transferred belowground and can return to the atmosphere by soil respiration. Therefore, integral assessments that include plants and soil, and which accounts for the carbon emissions associated with activities for maintaining aesthetic grounds, are needed to determine the real capacity of urban greenery to offset anthropogenic CO_2 emissions.

Session 3: Site Measurements and Applications

S3-01

Dry-season precipitation controls interannual variations in evapotranspiration in a monsoon tropical forest in Vietnam

Olga Kuricheva (A.N. Severtsov Institute of Ecology and Evolution RAS, Russia; Joint Russian-Vietnamese Tropical Scientific Research and Technological Center, Vietnam)
Avilov Vitaly, Nguyen Van Thinh, Vu Manh, Dinh Ba Duy, Do Phong Luu, Kuznetsov Andrey, Kurbatova Juliya

Tropical ecosystems provide around half of global evapotranspiration (E) flux from land to air (Fisher et al., 2009), strongly affecting the total content of the water vapour in the atmosphere. Energy and water availability are two major factors most affecting E in natural ecosystems. In tropical forests both water and energy controlling are possible. Our recent study (Kuricheva et al., 2021) using eddy covariance data for 6 years showed that in the monsoon tropical forest of Nam Cat Tien, Southern Vietnam, daily E was closely linked with the net radiation (Rn) in a seasonal cycle, except one to two driest months each year. Up to date, we expanded the period under study, and our dataset now covers 9 years (2012-2020). Annual E was roughly estimated at 1530±100 mm per year (mean±SD). Both interannual variation of Rn (the coefficient of variation=3.2%) and variation of average Rn between wet seasons (CV=2.9%) were very slight. Annual values of E were relatively stable (CV=7.0%) in comparison with fluctuations in annual precipitation (CV=12.8%). In contrast to daily values, the correlation of annual values of E with net radiation was insignificant. The main factor determining the interannual variation in E was the amount of precipitation in dry seasons (r=0.79, n=8). Interannual variation in dry season precipitation in Southern Vietnam was proved to be connected with the phase of El Niño-Southern Oscillation phenomena. According to our measurements, in the year of El Niño (2016), the lowest annual E total was recorded across the observation period and in the year of La Nina (2017), the highest E was recorded.

S3-02

Effect of strong El Nino on net ecosystem CO_2 exchange and grain yield from Thai rainfed rice field

Arnon Setsungnern (The Joint Graduate School of Energy and Environment (JGSEE), Thailand)

Rainfed rice field is one of the dominant landscapes in many Asian countries including Thailand. Crop productivity in this rice ecosystem especially in Southeast Asia is sensitive to climate variability such as El Nino /Southern Oscillation (ENSO). However, evaluation of the impact of ENSO on carbon dioxide fluxes and evapotranspiration over rainfed rice ecosystem is still limited. Here we reported the impacts of El Nino on CO_2, H_2O, and energy fluxes using eddy covariance technique in Thai rainfed rice field during 2015-2017. The results reveal that during rice growing season, cumulative rainfall and effective rainfall were

reduced in 2015 strong El Nino year by approximately 18.3% and 19.8% compared to non-strong El Nino year (2016 and 2017), respectively. This led to less water level flooded above paddy surface and more irrigation water requirement (IWR) especially at the beginning of rice cultivation. In the 2015 El Nino year, gross primary production (GPP) during cropping season was reduced by 31.5% and 26.5% as compared to 2016 and 2017 neutral years, respectively. Moreover, higher fraction of sensible heat (H) exchange contributed to higher bowen ratio along with high incoming solar radiation was found in 2015. This led to higher evapotranspiration especially in post-booting stage. Strong El Nino in 2015 had reduced rice grain yield by 2.8% - 5.7% in relation to the non-strong El Nino year.

S3-03

Investigating the influence of extreme climatic events on net ecosystem carbon dioxide exchange (NEE) in a commercial oil palm plantation, Indonesia.

Madan Subedi (Bioclimatology, University of Gottingen, Gottingen, Germany)
Christian Stiegler, Alexander Knohl

Climate change has altered weather and climate extremes in their frequency, severity, intensity, and duration. Extremity and interannual variability of climatic variables induce anomalies in ecosystem carbon flux. In recent decades, Indonesia has faced large-scale land transformation from primary forest to oil palm (Elaeis guineensis Jacq.) plantation and other cash crop monocultures. However, the impact of extreme climatic events (ECE) on the net ecosystem CO_2 exchange (NEE) of oil palm (OP) remains poorly understood. Thus, we identified hydrometeorological extreme events in a commercial OP plantation in Jambi province (Sumatra, Indonesia) and studied their influence on NEE, using micrometeorological and eddy covariance measurements, and multiple linear regression model (MLRM).

Overall, extreme low-temperature (ELT) events significantly enhanced net CO_2 uptake, but extreme soil moisture drought reduced uptake. Extreme high-temperature (EHT) events, extreme meteorological drought and wet events did not significantly impact NEE. A key insight of this study is the duration of extreme events, which can lead to highly nonlinear ecosystem responses, e.g. short-term EHT and drought enhanced CO_2 uptake while long duration of EHT reduced CO_2 uptake. Further, the consecutive dry days (CDDs) and combined temperature and CDDs extreme significantly ($P < 0.01$) enhanced net CO_2 uptake by 59 % and 17 %, respectively. The MLRM showed that smoke haze conditions, with high atmospheric vapour pressure deficit and reduction in light intensities are major disturbances for the OP plantation, e.g. haze drought conditions nearly ceased net carbon accumulation of OP for about 40 days and reduced the accumulated carbon by 85 %. Concerning a projected increase in ECE, this study showed an increase in CDDs, and EHT might positively impact net CO_2 uptake if soil moisture is not limited, while extreme haze can reduce net CO_2 uptake, which emphasizes the role of fire prevention and irrigation.

Session 4: Regional Network Reports

Progresses and future directions of ChinaFLUX

Zhi Chen (Institute of geographic sciences and natural resources research, CAS, China)
Guirui Yu, Shuli Niu

Eddy Covariance technique (EC) achieves the direct measurement on ecosystem carbon, nitrogen and water fluxes, and it provides scientific data for accurately assessing ecosystem functions in mitigating global climate change. This presentation briefly reviewed the construction and development of Chinese terrestrial ecosystem flux observation and research network (ChinaFLUX), and summarized the main progresses of ChinaFLUX in the ecosystem carbon, nitrogen and water exchange and environmental controlling mechanisms, the spatial pattern of carbon, nitrogen and water fluxes and biogeographical mechanisms, and the regional terrestrial ecosystem carbon budget assessment. Finally, the future directions and emphases of ChinaFLUX are put forward to provide references for the development of flux observation and research in China.

KoFlux

Minseok Kang

Research and Activity from ThaiFlux Network

Montri Sanwangsri (Chiang Mai University, Thailand)

Taiwan Flux

Jehn-Yih Juang

JapanFlux

Kentaro Takagi

Day 2: Dec 21, 2021 (TimeZone: Tokyo (JST) GMT+9)

Session 5: Collaboration across network

S5-01 (INVITED)

The FLUXNET Coordination Project: A new initiative to support global network-enabled science

Trevor Keenan (University of California, Berkeley, US)
Kyle Delwiche

Global ecosystems are undergoing profound environmental change, and understanding the effects of these changes on ecosystem-atmosphere interactions is an urgent challenge. This challenge has motivated scientists worldwide to maintain eddy covariance flux measurement sites, which allow us to measure the exchange of carbon dioxide, water, energy, and other greenhouse gas fluxes between ecosystems and the atmosphere. Such measurements have proven essential for understanding ecosystem function, calibrating space-borne observations, and developing models used to project future climate. The FLUXNET Coordination Project aims to maximize the impact of these measurements, and will fill fundamental knowledge gaps in science, engineering, and societal issues associated with ongoing changes in ecosystems around the world. FLUXNET is a global network of networks, including over ten existing national and international networks focused on continuous observations of ecosystem-atmosphere interactions at over 1000 locations around the world. The recently-funded FLUXNET Coordination Project aims to bolster FLUXNET by providing novel training and exchange opportunities, developing strong international collaborations, and building tools and protocols that ensure continued growth of FLUXNET beyond the life of the project. To do so, the project will develop both data-focused processing protocols and pipelines, and people-focused education and exchange opportunities. Here, we give an overview of the FLUXNET Coordination Project, including various opportunities for involvement and activities planned for the coming year.

S5-02 (INVITED)

20 Years of OzFlux: Lessons learned and future OzFlux–AsiaFlux collaborations

Jamie Cleverly (Associate Director of OzFlux, and James Cook University, Australia)

Just over 20 years ago, four regional flux networks were established—AsiaFlux, OzFlux, AmeriFlux and Euroflux.　In 2020, OzFlux celebrated its 20-year anniversary by meeting to consider the lessons learned since its founding.　Notably, climate extremes experienced by ecosystems across Australia and New Zealand have provided a natural laboratory for understanding what climate change is expected to bring to the world.　Droughts, heatwaves and flooding rain can push these ecosystems across carbon cycle tipping

points, shifting between carbon sinks and sources across years, and with large potential impacts on the carbon balance at regional and global scales. This climate-extreme-induced variability in carbon and water cycles illustrates the resilience of these ecosystems upon the return of favourable conditions. Located in under-represented areas, elucidation of these dynamics provides a valuable underpinning for remote sensing cal/val and parameterisation of Earth system models, both of which struggle to provide a realistic picture of the Earth system without these under-represented areas. Representing another set of under-represented areas across Asia, efforts by AsiaFlux complements that of OzFlux, further strengthening our understanding of ecosystem dynamics globally. We in OzFlux would like to celebrate our past successes with AsiaFlux and look forward to a fruitful future of integration across our networks.

S5-03

Application of AsiaFlux and OzFlux Network Data to the Validation of Himawari-8/AHI Land Surface Temperature Data

Yuhei Yamamoto (Chiba University, Japan)

Kazuhito Ichii, Minseok Kang, Youngryel Ryu, Shohei Murayama

Geostationary satellites can observe the diurnal variation of land surface temperature (LST) with moderate spatial resolution, providing a new scale of thermal environment monitoring. The uncertainty of the LST varies depending on errors of the input parameters and the retrieval conditions such as viewing geometries and water vapor content. This study evaluated the uncertainties of the LSTs retrieved by three operational algorithms from Himawari-8 data: two nonlinear split-window algorithms (SOB and WAN algorithms) and a nonlinear three-band algorithm (YAM algorithm). First, the error characteristics of the retrieved LSTs considering the input errors were investigated under various land-atmospheric conditions simulated using an atmospheric radiative transfer model. Then, the retrieved LSTs using actual Himawari-8 data were validated using in-situ observations by AsiaFlux and OzFlux and the ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS) LST. In this conference, we will mainly present the latter validation results. Validation of the three algorithms using in-situ LSTs at 12 sites showed that the mean RMSEs for all sites during nighttime were approximately 1.7° C, and the mean RMSEs for semi-arid and humid sites during daytime were approximately 3.0° C and 2.0° C, respectively. These were comparable to the accuracies for satellite LST products with higher spatial resolution. Within the Himawari-8 disk, the LST error by YAM algorithm was about 1.0° C smaller than that by split-window algorithms in high viewing zenith angle, LST, and precipitable water regions such as North China, Australia, and Southeast Asia. Furthermore, Himawari-8 LST showed closer agreement with the ECOSTRESS LST than the in-situ LST, suggesting that ECOSTRESS data are effective to evaluate diurnal variations in Himawari-8 LST by accounting for spatial scale gap. The resulting LST products with the knowledge of their error characteristics have a potential to improve our understandings of terrestrial energy and water cycles based on improved accuracy and robustness.

S5-04

Global trends in land atmosphere CO_2 exchange fluxes: an analysis of a flux measurement dataset and comparison with terrestrial model simulations

Akihiko Ito (National Institute for Environmental Studies, Japan)

The increasing amount of measurement data on land-atmosphere flux has made it possible to assess the interannual and longer processes that are driven by environmental change and disturbance of terrestrial ecosystems. In this study, I used a global dataset of carbon dioxide (CO_2) fluxes at eddy-covariance tower sites (FLUXNET2015) to investigate long-term trends of net ecosystem CO_2 exchange (NEE), gross primary production (GPP), ecosystem respiration (RE), and related variables. From 118 sites with records of at least 5-years duration, I extracted 1198 site-years of data for use in my analyses. Applying moderate screening by data quality, I found that 58% of the sites showed increasing trends as net CO_2 sinks, in which median slopes of annual NEE of -1.4 and -4.1 g C $m^{-2}y^{-2}$ were obtained by linear regression and Sen's slope estimator. Both GPP and RE showed increasing trends at different slopes; their slopes were positively correlated among sites. Across-site variation of NEE trends was analyzed by generalized linear mixed modeling; the best statistical model used temperature, stand age, and biome type as explanatory variables. The trend of increasing CO_2 sinks differed among biome types, from almost none in grassland and savanna to steep slopes in deciduous broad-leaved forest sites. The flux trends derived from terrestrial model simulations showed that the increasing sink trend also prevails over the land. The global model simulations implied that the increasing land sink is primarily attributable to elevated CO_2 concentration. These results demonstrate the usefulness of flux measurement datasets, especially in conjunction with models, to deepen our understanding of long-term terrestrial ecosystem processes. Finally, I would like to make discussions in relation to flux measurement networks in Asia.

Session 6: New measurements and process understandings

S6-01 (INVITED)

Emissions of methane from tree stems in forests: where does methane come from and where does it go?

Daniel Epron (Kyoto University, Japan)
Takumi Mochidome, Masako Dannoura, Ayaka Sakabe

Forests are a well-known carbon sink, which mitigate the rise in atmospheric CO_2 and hence global warming. However, methane emissions by stems of living trees become a major concern due to the increasing contribution of methane to global warming. Indeed, methane is the second most important anthropogenic greenhouse gas. Until now, most global and regional methane budgets of forests, which cover one third of the land area (67% in Japan) have only considered the source and sink functions of soils, ignoring stem emissions. However, there are growing evidences that trees emit methane through their stem, and the role of trees, in addition to that of the soil, must be considered in the methane budget of forests. Our final goal will be to evaluate how to upscale stem CH_4 emissions to the ecosystem level. A first prerequisite was to understand the variability of stem CH_4 emissions across individuals and species, and within individuals. A second was to clarify if methane is produced within the heartwood of the trunk, and how heartwood production and trunk emission are related. Measurements were made in the Ashiu Experimental Forest on two to five trees of 13 species and at two or three positions along the trunk. The trunk of several major species at this site emitted CH_4, with a large variability among species. CH_4 emission were higher for large trees than smaller ones for a given species and varied with the position along the trunk. Interestingly, several species which exhibited low CH_4 emission have however the potential to produce CH_4 in their heartwood. We present ways for estimating stem CH_4 emissions at the stand level considering tree species diversity (contribution of the main species) and the stand structural attributes (tree diameter and height).

S6-02

Non-Closure of Surface Energy Balance Linked to Asymmetric Turbulent Transport of Scalars by Large Eddies

Heping Liu (Washington State University, Pullman, Washington, USA)

How large turbulent eddies influence non-closure of the surface energy balance is an active research topic that cannot be uncovered by the mean continuity equation in isolation. It is demonstrated here that asymmetric turbulent flux transport of heat and water vapor by sweeps and ejections of large eddies under unstable atmospheric stability conditions reduce fluxes. Such asymmetry causes positive gradients in the third-order moments in the turbulent flux budget equations, primarily attributed to substantially reduced flux contributions by sweeps and sustained large flux contributions by ejections. Small-scale surface

heterogeneity in heating generates ejecting eddies with larger air temperature variance than sweeping eddies, causing asymmetric flux transport in the atmospheric surface layer. Changes in asymmetry with increasing instability are congruent with observed increases in the surface energy balance non-closure. To assess the contributions of asymmetric flux transport by large eddies to the non-closure requires two eddy covariance systems on the tower to measure the gradients of the turbulent heat flux and other third-order moments.

S6-03

Wind regimes above and below a dense oil palm canopy: Detection of decoupling and its implications on CO2 flux estimates.

Christian Stiegler (University of Goettingen, Germany)
Tania June, Christian Markwitz, Nicolo Camarretta, Ashehad Ashween Ali, Alexander Knohl

In tall vegetation canopies, e.g. forest or oil palm (Elaeis guineensis Jacq.) plantations, calm weather conditions, which are common in the tropics, may result in the formation of an isolated near-surface air layer, which is decoupled from the above-canopy air layer. During decoupling, -often occurring at night -, above-canopy measured carbon dioxide (CO_2) fluxes based on eddy covariance (EC) might not represent the true ecosystem CO_2 flux, commonly known as the nighttime problem. In this study, we investigated EC-based CO_2 flux measurements, wind and micrometeorological patterns, and LiDAR-derived terrain and canopy structure in a mature commercial oil palm plantation (canopy height approx. 15 m) in the tropical lowlands of Jambi province, Sumatra, Indonesia. Over 3 years, we assessed the strength of turbulent and thermal mixing and tested four different flux filtering methods to determine decoupling, i.e. (i) above- and (ii) below-canopy friction velocity (u*), (iii) above- and below-canopy standard deviation of the vertical wind (σw), and (iv) bulk Richardson number (Rib). Decoupling occurred frequently, with above-canopy u* as a pragmatic option that can be applied at this site to detect decoupling, and σw being most sensitive in the determination of decoupling. Diel advection and storage fluxes of CO2 were small but during decoupling, both contributed, on average, 0.52 µmol m-2 s-1 to the net ecosystem CO2 exchange (NEE), corresponding to 6.5 % of average nighttime NEE fluxes. Leaf-area density and vertical temperature measurements suggest that the oil palm canopy exerts a pronounced decoupling barrier at ~10 m height. During decoupling, a slope of 3° at the study site was enough to create thermally-induced drainage flow. The presented results highlight that determination of decoupling between above- and below-canopy layers is crucial to derive accurate estimates of NEE and accumulated carbon, especially in such a weak-wind and dense-canopy tropical environment.

S6-04

How land-sea interaction of tidal and sea breeze activity affect mangrove net ecosystem exchange?

Xudong Zhu (Xiamen University, China)

Coastal mangrove wetlands experience unique land-sea interaction including periodic tidal and sea breeze activity; however, their impacts on mangrove net ecosystem exchange (NEE) of carbon dioxide have not been well investigated. In this regard, continuous eddy covariance and auxiliary measurements were conducted to characterize the temporal variations in NEE and environmental controls in a subtropical mangrove of southeastern China. Over a 3-year measurement period, this mangrove acted a consistent carbon sink showing weak seasonality in NEE with a stronger sink in spring. Environmental controls on NEE varied across time scales: (1) at half-hourly time scale especially for summer and autumn, high temperature and vapor pressure deficit (VPD) suppressed daytime carbon uptake, while inundation fraction and rain restrained nighttime carbon efflux; (2) the importance of environmental impacts on daily NEE decreased in the order of photosynthetically active radiation, air temperature, sea breeze, VPD, tidal salinity, and inundation; (3) monthly carbon uptake was statistically negatively and positively correlated with inundation fraction and rain, respectively. Periodic tidal inundation exerted both direct and indirect effects, but their relative importance changed across time scales. Cooling and wetting effects from regular sea breeze relieved atmospheric temperature/moisture stresses at afternoon, acting as an important indirect effect to promote carbon uptake. This study confirms the importance of previously neglected indirect effects of land-sea interaction of tidal and sea breeze activity on mangrove NEE.

S6-05

Widespread thermal acclimation of canopy photosynthesis

Jiangong Liu (Seoul National University, South Korea)

Most plant leaves acclimate to warming by adjusting their photosynthetic capacities over a timescale of weeks to months. However, little evidence is available for photosynthetic thermal acclimation at the canopy level. Here we derived ecosystem-scale maximum photosynthetic assimilation rates (Amax, μmol m^{-2} s^{-1}) using light response curves across 206 sites in the FLUNXET2015 database. We explored the correlations between Amax samples and their corresponding temperature across different rates of photosynthetic photon flux density (PPFD) and different levels of canopy foliage amount. Singular spectrum analysis (SSA) and multi-scale correlations suggested that most variations in Amax occurred within weekly time scales. Furthermore, we found that the correlation between temperature and Amax over a 10-day averaging window was positive in 90% of bins, among which 57% of the linear relations were significant. The mean rate of thermal acclimation of Amax was 1.08 μmol m-2 s^{-1} $°C^{-1}$ across different ecosystem types. Croplands displayed the highest thermal acclimation rate with an average of 4.85 μmol m^{-2} s^{-1} $°C^{-1}$, while evergreen broadleaf forests showed a limited acclimation capacity with an average rate close to 0. Furthermore,

remote-sensing proxies of canopy structure (e.g., NDVI, EVI and LAI) also showed strong evidence of thermal acclimation. A process-based model with the incorporation of an optimality-based photosynthetic capacity module can better reproduce the pattern of the thermal acclimation rates observed from FLUXNET2015 sites than conventional settings. Overall, our results provide widespread evidence of thermal acclimation of canopy photosynthesis at weekly time scales, which is likely attributable to both canopy physiology and structure. We encourage model developers to consider the eco-evolutionary optimality theory when estimating canopy productivity.

Session 7: Modeling and Remote Sensing

S7-01

Response of crop photosynthesis to water stress in North China Plain based on vegetation chlorophyll fluorescence

Shaoqiang Wang (Institute of Geographic Sciences and Natural Resources Research, China)
Li Ma

The North China Plain is the main grain-producing area in China, but it is often affected by water stress. It has great significance to study the effects of drought on the growth of winter wheat and summer maize in the North China Plain. Sun-induced chlorophyll fluorescence (SIF) is directly related to photosynthesis and generally showed a good linear relationship with gross primary production (GPP). However, so far, researches on crop drought stress based on chlorophyll fluorescence are still relatively deficient. We measured the chlorophyll fluorescence and photosynthesis data during the growing season of summer maize in 2020 through water control experiments at Yucheng site in the North China Plain to quantitatively analyze the effects of water stress on chlorophyll fluorescence and photosynthesis. Furthermore, we combined the satellite SIF, SIF and PRI-based GPP (GPPSP), BEPS model-based GPP (GPPBEPS), and Palmer Drought Severity Index (PDSI) data of the North China Plain to analyze the spatial and temporal patterns of SIF and GPP of cropland in the North China Plain under drought event and explore the possibility of SIF for drought monitoring in this area. The results show that the actual photochemical efficiency of PSII (ΦPSII) can be a good probe for summer maize under stress ($R2=0.42$, $p<0.05$). SIF and Fs were positively correlated ($R2=0.22$, $p<0.05$) under non-stress condition, but decoupled while water stress occurred. SIF, VIs, GPPSP, and GPPBEPS all show obvious bimodal seasonal changes for cropland in the North China Plain. The GPPBEPS showed a gradually increasing spatial distribution pattern from northwest to southeast coastal areas. SIF shows a higher correlated spatial distribution with GPPBEPS than VIs. For the drought events from March to September 2014, the anomaly values of SIF and GPP have the strongest ability to characterize the spatial and temporal patterns of the drought. SIF is more advantageous for the early monitoring of drought events in the cropland of the North China Plain.

S7-02

GPPmax dominates the interannual variation of annual GPP in the north hemisphere

Weikang Zhang (IGSNRR, CAS, China)

The annual gross primary productivity (AGPP) of terrestrial ecosystems is the largest carbon flux component in the ecosystem, better understanding of the interannual variation mechanism of AGPP could contribute to the estimation of carbon sink with the climate change. Based on the formation mechanism,

AGPP of 39 observation sites in the Northern Hemisphere terrestrial ecosystems were first decomposed into three GPP seasonal dynamic attribute parameters (growing season length (CUP), maximum daily GPP (GPPmax), and the ratio of average daily GPP to GPPmax (α GPP)), and then GPPmax was split into leaf area index (LAIm) and photosynthesis per leaf area (GPPlm), finally climatic variables during the period when GPPmax appeared were extracted. After that this study discussed the formation of interannual variability mechanism of AGPP. The results showed that the ecosystem AGPP in the Northern Hemisphere increased after 2003, with an average increasing rate of 6.64g C m^{-2} yr^{-1}. The interannual variation of temperature, water and radiation during the period when GPPmax appeared affected the interannual variation of GPPlm, and then determined that of GPPmax, which dominated that of AGPP. Based on the new approach of "climatic variables – GPPlm - GPPmax - AGPP" cascade relationship, this study clarified the formation mechanism of the interannual variation of ecosystem productivity, and could provide a new idea for the assessment model of AGPP based on the seasonal dynamics of GPP.

S7-03

Geographic patterns in the phenology and physiological properties of carbon fluxes and their correlations over the Northern Hemisphere

Lang Han (Tianjin University, Tianjin, China)

The phenology and physiological properties of carbon fluxes are crucial determinant of the change on annual carbon sequestration in ecosystems. However, the geographic variations in phenology and physiological properties of carbon fluxes on large scale are still poorly understood, which limits our ability to evaluate the terrestrial carbon acquisition and to predict its response to climate change. In this study, eddy covariance data from 106 natural ecosystems in the Northern Hemisphere were integrated, and the phenology and physiological properties of GPP, RE, and NEP were described. The phenological properties (including growing season length (GSL), growth respiration period (GRP), and net carbon uptake period (CUP)) linearly shorten with increases in latitude, but the physiological properties (maximum daily GPP (GPPmax), RE (REmax), and NEP (NEPmax)) showed no linear trends with latitude. The REmax peaked in the tropical region, while the maximum GPPmax and NEPmax appeared in the temperate region, suggesting that temperate ecosystems had high carbon absorption strength. GSL varied with climate regions and vegetation types, which primarily resulted from the variation of the start date of GSL. The spatial variations of the phenology and physiological properties of GPP and RE closely correlated with each other and co-determined the spatial variation of the phenology and physiological properties of NEP. The spatial distribution of CUPstart was regulated by GSLstart and GRPstart, but the factors affecting the spatial distribution of CUPend were more complicated. GPPmax and REmax could explain 89% of the spatial variation of NEPmax. The systematically recognized phenology and physiological properties of carbon fluxes and their geographic variability and correlations have provided essential parameters and basic knowledge for the simulation of terrestrial ecosystems carbon budget.

S7-04

Using model-data fusion to estimate the carbon uptake of terrestrial ecosystems in China

Li Zhang (Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, China)

Terrestrial ecosystems in China function as strong carbon sinks and play an important role in mitigating the effect of industrial carbon emission. Accurate estimation and prediction of terrestrial carbon uptake in China is of great importance for providing useful information to achieve the carbon neutrality by 2060. Based on our existing model-data fusion framework for estimating the carbon uptake of terrestrial ecosystems in China, we analyzed carbon fluxes and pools by assimilating long-term multi-observation data of Chinese Ecosystem Research Network (CERN) and ChinaFLUX and effectively reduced the uncertainty in ecosystem C sequestration estimations. Modeled results revealed underestimated ecosystem carbon turnover time and sequestration rate under the steady state assumption and the necessary of incorporating temporal variations of parameters in terrestrial carbon cycle models. The model-data fusion was also used to optimize key parameters in the new developed process-based ecosystem services model (CEVSA-ES) so as to have a good performance in simulating spatial-temporal variations of annual carbon sequestration and other ecosystem services. Moreover, the pattern, trend, variation, and influencing factors of terrestrial carbon sink in China in the past 30 years have been systematically analyzed. Our results show that the monsoonal region of China dominates the magnitude, trend, and interannual variation of national terrestrial net ecosystem productivity. Future changes in the East Asia summer monsoon should be paid more attention in the projection of terrestrial carbon uptake in China under future global change scenarios.

S7-05

Estimating historical and future of water table depth and net ecosystem exchange in Katingan-Mentaya peat hydrological unit

Desra Arriyadi (Katingan Mentaya Project)
Albertus Sulaiman, Awaluddin, Taryono Darusman, Dwi Puji Lestari, Aryo Witono

Net ecosystem exchange (NEE) in tropical peatland reflects the capability of the peat ecosystem to be a carbon source or sink. We studied NEE based on the historical water table depth (WTD) in the Katingan-Mentaya peat hydrological unit (PHU). We estimated historical WTD by linear regression of observed WTD and soil moisture content produced by the fifth generation European Center for Medium-Range Weather Forecast atmospheric reanalysis of the global climate (ERA5) from 2015 to 2020. We classified the land-used as undrained forest, drained forest, and degraded area, with the correlation between soil moisture and WTD being 0.70, 0.76, and 0.70, respectively. Historical NEE was estimated using empirical

equations from a previous study in the Sebangau National Park (SNP). Vegetation composition and physical properties were similar between SNP and Katingan-Mentaya PHU. Estimated mean annual NEE in undrained forest was 60.75 ± 16.43 gC m^{-2} $year^{-1}$, drained forest was 80.92 ± 18.37 gC m^{-2} $year^{-1}$, and degraded area was 507.74 ± 7.61 gC m-2 year-1. In addition, we analyzed land cover-change and climate variability (Nino 3.4 and Dipole Mode Index) that affected variation of NEE. Future WTD and NEE up to 2100 was estimated using CSIRO-Mk3-6-0 soil moisture content outputs based on CMIP5 scenarios. Result showed a lowering trend of annual WTD, with slope ranging from -0.05 to -0.12 cm year-1. The accumulative NEE from 2006 to 2100 for the best-case RCP 2.6 of undrained forest was 5.6±03 gC m-2 and the worst-case RCP 8.5 of degraded area was 4.8±04 gC m^{-2}.

Poster Session

Poster Session

P-01

Effects of advection on single crop coefficients over a humid paddy field in southern China

Bo Liu (Yangzhou University, China)

Accurate estimation of crop coefficient (Kc) is important to acquire water crop water requirements and determine optimal irrigation scheduling. Sensible heat advection is expected to increase crop evapotranspiration (ETc) and Kc by adding more energy, while its effect on Kc over paddy field was rarely featured. A three-year experiment was conducted over a paddy field to develop local Kc using the eddy covariance technique (EC) in the Poyang River basin, southern China. The local Kc curve, the characteristics of advection and its contribution to Kc were investigated. The three-year average local Kc values during the initial, mid-season and late-season were 1.12, 1.29 and 1.13 for the early rice and 1.11, 1.39 and 1.01 for the late rice, respectively. The advection was more likely to occur during the late rice season than the early rice season. The three-year average advective days were 29.7 for the late rice season and 8.0 for the early rice season, respectively. The contribution of advection to daily Kc ranged from 0.5% to 8.1% for the early rice season and 0.5% to 22.6% for the late rice season. The occurrence and intensity of advection were closely related to air temperature (Ta) and wind speed (u2). Higher Ta and u2 were associated with stronger advection, especially in the mid-season stage. Our study indicated advection also existed in the humid paddy field and had considerable effects on Kc. These results are helpful for decision-makers to quantify crop water consumption and improve irrigation water efficiency.

P-02

Evapotranspiration Estimation Mapping of the Rice Bowl of Tamilnadu, India: A Little Water to Spare

Manoj Hari (National Institute of Technology Rourkela, India)

Evapotranspiration-ET, being an inevitable component of water cycle is mediated by stomatal closure of the biota which corresponds the efflux and influx of carbon through ecosystem respiration. Among other biophysical factors, ET influences efficient water management especially in agricultural production. Here we estimated and mapped crop ET for the delta regions of Tamilnadu, India by integrating earth observation -SENTINEL 2- and surface energy model -METRIC- isolated to the year 2016-2019. The analysis projects overall good agreement with $R2 \geq 0.72$, MBE ≤ 0.01 and RMSE ≤ 0.67. This highlights the optimal irrigational practices in lieu of traditional practices of the local agrarian structure.

P-03

Influence of fire and drainage on water fluxes in a degraded tropical peat swamp forest

Shinjiro Ohkubo (Hokkaido University, Japan)
Takashi Hirano, Kitso Kusin

Tropical peatland, which is widely distributed in insular Southeast Asia, had been disturbed by deforestation and drainage mainly for agricultural land use. These disturbances resulted in aridification, and then increase the risk of fire. In this study, influences of such disturbances on water fluxes are examined in an ex-peat swamp forest, Central Kalimantan, Indonesia (2.34° S, 114.04° E). Eddy flux of water vapor and other meteorological factors had been measured from April 2004 to December 2016. The site was forested until 1997, when a fire destroyed the forest, and left the site in ruins. Since then, the site had been burned at least three times in 2002, 2009 and 2014. Evapotranspiration (ET) was relatively stable irrespective of precipitation (P). However, ET decreased with extremely deepened groundwater level (GWL, GWL<-0.5 m). This would be due to disconnected capillary force and ceased root water uptake, although rainwater shortage was usually compensated by soil water. It was observed that the basal flow rate increased by 116 mm month-1 after ditch excavation for drainage in 2014, suggesting that drainage has a significant impact on the water balance of the system. The rate of GWL rise in relation to rain water infiltration into the soil (P-ET) did not change before and after the fire in 2009, supporting that the fire occurred only above ground and the physical properties of the soil did not change. Estimation using existing model equations shows that transpiration (T) increased after the ditch excavation, while ET slightly decreased. Increased contribution of T might be explained by decrease in evaporation from the ground surface due to drying of the soil surface after the long-lasting decline of the GWL. Further analysis on the validity of these models is going on.

P-04

Modeling photosynthesis of Rhizophora apiculata (South Vietnam)

Nikolay Zhirenko (A.N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, Russian Federation. Joint Russian - Vietnamese Tropical Scientific Research and Technological Center, Southern Branch, Vietnam)
Van Thinh Nguyen, Vu Manh, Phong Luu Do

The paper presents the results of our research related to the study of the intensity of photosynthesis at the leaf level of an adult tree Rhizophora apiculata Blume, 1827 of natural origin. The research was carried out in the mangrove forests of South Vietnam. The diurnal dynamics of the intensity of photosynthesis and PAR for the upper, middle and lower parts of the tree crown were obtained. The Michaelis - Munten equation was used to describe the dependence of photosynthesis on PAR. The coefficients of this equation were used to assess the photosynthetic characteristics of the leaf. It was shown that the depression of

photosynthesis in the upper part of the crown of a tree is caused by a violation of the water balance of the leaves. The dependences of the intensity of photosynthesis on temperature and CO_2 concentration in the air were obtained. It has been shown that the optimum temperature for the growth of R. apiculata is (34.5 ± 0.7) ℃. As the concentration of CO_2 increases, the rate of photosynthesis also increases. Based on the obtained dependences, a mathematical model of the intensity of photosynthesis as a function of PAR, temperature and CO_2 concentration was developed. It was shown that the main inhibiting factor affecting photosynthesis (if we do not take into account PAR) is the deviation of air temperature from the values optimal for R. apiculatta growth.

P-05

Environmental control of leaf litterfall rates of species from tropical semi-deciduous ecosystems.

Anuj T. Magar (University of Goettingen, Germany)

Ashehad A. Ali , Alexander Olchev, Martyna M. Kotowska, Edzo Veldkamp, Alexander Knohl

Unlike evergreen or fully deciduous ecosystems from the tropics, carbon cycling in semi-deciduous ecosystems is challenging to observe because plant species from such ecosystems shed their leaves for a short period (between four to six weeks). Sometimes plant species from semi-deciduous ecosystems are dormant only for three weeks. Subsequently, the above observations limit the representation of such ecosystems in land surface models. Therefore, literature data on leaf litterfall (mass area-1 time-1) from semi-deciduous ecosystems (natural forests and plantations) were used in this study. We also obtained data on environmental (precipitation, air temperature, vapor pressure deficit, global radiation and day length) and edaphic (available water storage capacity, topsoil bulk density, cation exchange, capacity of the clay fraction in the topsoil, topsoil clay fraction, topsoil sand fraction, topsoil pH (in H_2O), topsoil carbon content, area weighted topsoil carbon content) conditions. We developed several multiple linear regressions to investigate the environmental and edaphic factors that control leaf litterfall rates. We found that they explained 36% variation in measured leaf litterfall rates across semi-deciduous ecosystems in the tropics. When we included ecosystem-level plant parameters (leaf biomass and leaf age), the model's ('universal model') explanatory power almost doubled (r^2 = 68%). The predictors of the unified model were precipitation, sand fraction in the soil, bulk density of the soil, leaf biomass, and leaf age. After separating the data into natural forests and plantations and deriving a regression model for forests (r^2 = 69%), the application of this model on plantations showed an r^2 of 61%, suggesting that litterfall dynamics of plantations can be predicted using the litterfall model of natural forests. Overall, our universal model can be used to predict leaf onset and offset, thus enabling land surface models to represent phenology of these ecosystems.

P-06

Using field measurements and a soil water balance model to investigate changes in soil moisture in oil palm plantations

Sunom Shrestha (University of Goettingen, Goettingen)
Ashehad A. Ali, Christian Stiegler, Justus v. Ramshorst, Edzo Veldkamp, Alexander Knohl

Understanding how soil moisture changes with time in oil palm plantations is crucial because it is one of the main determinants of how oil palms function. Low soil moisture content in dry seasons often limits evapotranspiration (ET), which oil palms use for cooling themselves. However, it is unclear to what extent soil moisture changes under oil palms and how sensitive ET is to rainfall, which is often one of the main drivers of soil moisture change. Therefore, this study gathered temporal data on soil moisture and climate from a large scale and four smallholder oil palm plantations from Jambi province, Sumatra, Indonesia. Since an eddy correlation tower was available at the large-scale oil palm plantation, we obtained ET data from this site. To study relationships between soil moisture and rainfall changes, we used a process-based stochastic non-linear differential model that links climate, soil and vegetation to soil moisture by means of rainfall, evapotranspiration, runoff and drainage. We found that (1) the sensitivity of ET to rainfall under low soil moisture values was higher than under high soil moisture, and (2) the soil moisture did not change as much as rainfall changed. Further, we found similar climatic factors (vapor pressure deficit, radiation, and soil temperature) impacting soil moisture changes in large-scale and smallholder oil palm plantations. However, the explanatory power of these combined predictors increased from 19 to 37% as we moved from large-scale plantation to smallholder plantation. Although there was an apparent change in soil moisture between large-scale and smallholder plantations, we did not find differences in ET between these plantations when we used a modified soil water balance model. Our study indicates that management intensity in oil palm plantations could weaken climate and soil moisture relations.

P-07

Establishment of rapid measuring protocol for isoprene emission capacity of palm species

Ting-Wei Chang (University of Shizuoka, Japan)
Hiroshi Okamoto, Akira Tani

Recently, plantation area of palm species such as oil palm has been expanded in southeast Asia. Due to the large potential of isoprene emission from palms, this can lead to rising of oxidant concentration in troposphere. Selective propagation of individual with low isoprene emission capacity is considered as an approach to reduce the total isoprene emission. However, sampling amount and speed of current method (enclosure method) would be limited by the system size and portability. This study aims to establish a method which is capable of rapid screening of isoprene emission from palm species. The concept of this method (leaf-slice method) consists with following procedures: first, cut the target leaf into a small slice; second, seal the slice into a small glass vial; third, incubate the glass vial with leaf slice under a constant

temperature and light intensity with a water bath and LED light panel, respectively; finally, collect the air in the glass vial into an adsorbent tube to trap the isoprene. By observing the isoprene emission of different incubation periods, this study found that isoprene emission rate showed its maximum at approximately 40 minutes after incubation, then, the emission rate decreased with longer incubation period. Significant linear correlations were detected between the enclosure measurements and the leaf-slice measurement, suggesting this method is suitable for evaluating the isoprene emission rate from palm species.

P-08

Change in soil carbon budget by Oak wilt disease in Japan

Yuji Kominami (FFPRI, Japan)

Yu Fukasawa, Masahiro Takagi, Satoshi Suzuki, Syuhei Takemoto

Recently, Oak wilt disease have spread in Japan. CWD respiration and soil respiration around CWD have continuously measured at 5 sites (from 2016 (CWD), and from 2020(Rsoil)). Larger CWD respiration comparing with CWD occurred by wind injury. And soil respiration around CWD also have increased by the effect of fragmentation of CWD.

P-09

On the use of a light-weighted membrane drier for CO_2 flux measurements in the cold environments

Taichi Noshiro (Hokkaido University, Japan)

Daiki Nomura, Fumiyoshi Kondo, Keisuke Ono, Hiroki Ikawa

Eddy covariance is a useful technique to measure air-ecosystem CO_2 exchange. However, its application is difficult in cold environments because of the difficulty to detect small CO_2 fluxes. The difficulty for detecting small CO_2 flux is partly attributed to the error of the water vapor cross-sensitivity which occurs when CO_2 density is measured by an infrared gas analyzer. It may be effective to eliminate vapor in the air sample. However, it is unclear to what extent the air sample needs to be dried such that the effect of the water vapor cross-sensitivity becomes negligible while maintaining accurate high-frequency measurements. Here, we report a pilot study on the CO_2 flux measurements using a light membrane drier. The eddy covariance system with a light-weighted membrane drier was employed in a grassland within the property of the Institute for Agro-Environmental Sciences, NARO (Tsukuba, Japan) in the winter 2020. Then the extent of the drying was controlled by regulating the pressure of the counterflows within the membrane drier that was originated from the outlet of the sample air stream. The high-frequency fluctuations of the CO_2 density decreased with the extent of the drying increasing. Based on the WPL correction' formula, however, the error associated with water-vapor cross-sensitivity seems to have a greater impact on the CO_2 flux than that of the error associated with the loss of the high-frequency fluctuation of the CO_2 density.

P-10

An open-path ammonia analyzer for eddy covariance flux measurement

Yin Wang (HealthyPhoton (Ningbo) Technology Co., Ltd., Ningbo, China)

Kai Wang, Ting-Jung Lin, Xunhua Zheng

,

Ammonia (NH_3) in the atmosphere has a vital impact on the environment. Based on previous studies, fertilization and livestock are the two main anthropogenic sources of NH3. However, NH3 is easily diffused and deposited, so its concentration in the atmosphere varies widely. Meanwhile, NH3 gas has strong adsorption and viscosity. Hence, conventional NH_3 sensors often suffer from slow response time, limited precision, intensive, or high power consumption due to the closed-path sampling systems. This work presents a quantum cascade laser (QCL)-based open-path analyzer (model: HT8700, HealthyPhoton Co., Ltd, Ningbo, China) for eddy covariance (EC) measurement of NH3 fluxes. The analyzer design based on an open-path optical Herriott cell minimizes the sampling artifacts due to surface adsorption of NH3. Without the vacuum pump, the power consumption and the instrument size were greatly reduced, making the HT8700 convenient to use in field deployment without a power grid. We have tested the analyzer through laboratory experiments and field deployment. For concentration measurement, we compared the data from the HT8700 and other commercial high-sensitivity NH3 analyzers. The results showed that the differences between different analyzers were within the measurement uncertainty of HT8700 (±15%). For flux measurement, the average random error was 26 ± 28% during the experimental period. The instrumental noise with a sampling frequency of 10 Hz is estimated to be 0.286 and 0.302 nmol・(ppbv) under the laboratory and field conditions, respectively. Under the given test conditions, the detection limit of the EC system is 7.1±1.1 g N m^{-1}・h^{-1}・ for half-hourly NH_3 flux measurement. The HT8700 has the sensitivity competitive with other commercial NH_3 analyzers, which proved it a useful tool for understanding the biosphere-atmosphere NH_3 exchanges at various ecosystems.

P-11

A preliminary result of measuring peatland CO_2 flux on coconut plantation in Riau Province of Indonesia

Nurul Ihsan Fawzi (Tay Juhana Foundation)

Annisa Noyara Rahmasary, Ika Zahara Qurani, Raihan Garin Naufaldary, Suwardi, Basuki Sumawinata

Our research has been conducted in coconut plantations in Indragiri Hilir, Riau Province of Indonesia. The plantations operate water management that control the water table between 25 to 70 cm below the surface, depending on rainfall variations. Close chamber method was employed and CO_2 measured by Fujifilm Infrared Gas Analyzer. The flux was collected with a weekly interval in seven locations (different peat depth and coconut density) and one control plot. We put a closed chamber next to the coconut tree and between the trees to measure root respiration contribution, while the control plot is located at the bare

peat soil. This preliminary result examined a two-month measurement from 27 August to 1 November 2021; however, this research still continues until February 2022. It is found that average root respiration and non-root respiration was 16.0-ton CO_2 ha^{-1} $year^{-1}$ and 7.7-ton CO_2 ha^{-1} $year^{-1}$, respectively; compare the value in bare peatland respiration was only 7.0-ton CO_2 ha-1 year-1. In this research, root respiration contributes 51.8% in peatland emission; and CO_2 emission (include root respiration) 66.3% lower compared calculation with subsidence method. The preliminary result also shows peatland soil emission is similar to emission from mineral soil non-peat. Hence the emission in peatland soil is relatable to heterotrophic respiration that depends on vegetation types and its productivity.

P-12

Monitoring and analyzing latent heat flux simultaneously with leaf wetness by eddy covariance and SVAT multilayer model

Linjie Jiao (Kyoto University, Japan)

Yoshiko Kosugi, Yuichi Sempuku, Ting-wei Chang

As the predominant source of leaf wetness in the temperate Asian monsoon area, rainfall interception not only influences canopy gas exchange by contributing a lot to the wet canopy evapotranspiration but may also block the stomata and depress transpiration and photosynthesis. However, due to the limits of using eddy covariance in wet environment, few studies made direct observation and analysis on the second point. This study adapts an enclosed-path gas analyzer in the eddy covariance system to obtain a precise and direct measurement of latent heat flux during and after rainfall. Meanwhile, more than 20 wetness sensors are set at different height of the canopy to simultaneously measure the change of leaf wetness. The measurements are conducted at a Japanese cypress forest of Kiryu experimental watershed (FLUXNET code: KEW) in Shiga, Japan. Apart from the in-situ measurement, we developed sub-models that have different amounts of maximum abaxial leaf water storage based on one SVAT (soil-vegetation-atmosphere-transfer) multilayer model. Comparing the simulated and measured flux enables us to revealing the gas exchange and interception process of wet canopy (leaves) during and after rainfall. Current results indicate that (1) the chance abaxial surface of Japanese cypress leaves can intercept rainfall increased after heavy rainfall; (2) leaf wetness on the abaxial surface is more possible to happen during rainfall. Therefore, the low evapotranspiration during rainfall is partly attributed to the blockage by abaxial wetness on Japanese cypress leaves.

P-13

Seasonal contrasting effects of PM2.5 on forest productivity in peri-urban region of South Korea

Hojin Lee (Seoul National University, Korea)

Urban forests are recognized as an eco-friendly filter to absorb PM2.5, but PM2.5 could also affect forests productivity in highly polluted urban area. Although huge attention has been given to the role of PM2.5 in absorbing and/or scattering light, there remains a lack of consensus on how forests productivity can be affected by changing solar radiation components by PM2.5. Our objective is to test the hypothesis that the effect of PM2.5 on the solar radiation components and forest productivity differs by season because of seasonal variations in solar elevation angle and PM2.5 chemical compositions. The PM2.5 concentrations and carbon dioxide fluxes were measured using optical particle counters and an eddy covariance system, respectively, from April 2018 to December 2019 at an evergreen Korean pine plantation and a deciduous oak stand in the peri-urban region of the Seoul metropolitan area, South Korea. Complex relationships among PM2.5 concentrations, direct radiation (Sdir), diffuse radiation (Sdf), air temperature (Ta), and net ecosystem production (NEP) were disentangled by season and solar elevation angle (β) using structural equation modelling. In the oak stand, the increase in PM2.5 concentrations enhanced Sdf and NEP, and it was more remarkable as β increases from 10-20° to >60° when oaks hold their leaves (i.e., May - Oct.). However, in the pine plantation, increase in PM2.5 concentrations enhanced Sdf and NEP only when β is over 50° (i.e., Mar - Sep.). When β is below 50°, PM2.5 had negative effects on Sdf and NEP except for summer season, possibly due to different PM2.5 chemical compositions. Our results imply that the effects of PM2.5 on solar radiation components and forest productivity vary by season and PM2.5 induced changes in ecosystem productivity should be quantified by season.

P-14

Differences of $CO_2/H_2O/CH_4$ eddy fluxes measured at two heights in a rice paddy

Sungsik Cho (National Center for AgroMeteorology, South Korea)
Minseok Kang

Before changing the flux measurement height of the CRK (Cheorwon Rice paddy) site from 10 m to 5 m, another eddy covariance system was installed at 5 m, and the $CO_2/H_2O/CH_4$ fluxes at both heights from April 2020 to April 2021 were compared. As the measurement height increased, the contribution by the large eddies increased and the random uncertainties of the fluxes increased. It is confirmed that the differences of the fluxes increased as the footprint differences at the two heights increased. Based on the results of this intercomparison experiment, we will identify the main factors that are expected to cause the flux differences between the two heights, to secure the continuity of the $CO_2/H_2O/CH_4$ fluxes time series at the CRK site, which is required to understand the flux variabilities over the next several years.

Acknowledgement This work was carried out with the support of "Cooperative Research Program for Agriculture Science and Technology Development (Project No. PJ014892022021)" provided by Rural Development Administration, Republic of Korea and "R&D Program for Forest Science Technology (Project No. 202018B10-2022-BB01)" provided by Korea Forest Service (Korea Forestry Promotion

Institute).

P-15

Altered albedo dominates the radiative forcing changes in a subtropical forest following an extreme snow event

Palingamoorthy Gnanamoorthy (Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, China)

Subtropical forests are important ecosystems globally due to their extensive role in carbon sequestration. Extreme climate events are known to introduce disturbances in the ecosystem that cause long-term changes in carbon balance and radiation reflectance. However, how these ecosystem function changes contribute to global warming in terms of radiative forcing (RF), especially in the years following a disturbance, still needs to be investigated. We studied an extreme snow event that occurred in a subtropical evergreen broad-leaved forest in southwestern China in 2015 and used 9 years (2011–2019) of net ecosystem CO2 exchange (NEE) and surface albedo (α) data to investigate the effect of the event on the ecosystem RF changes. In the year of the disturbance, leaf area index (LAI) declined by 40% and α by 32%. The annual NEE was -718 ± 128 gC m^{-2} as a sink in the pre-disturbance years (2011–2014), but after the event, the sink strength dropped significantly by 76% (2015). Both the vegetation, indicated by LAI, and α recovered to pre-disturbance levels in the fourth post-disturbance year (2018). However, the NEE recovery lagged and occurred a year later in 2019, suggesting a more severe and lasting impact on the ecosystem carbon balance. Overall, the extreme event caused a positive (warming effect) net RF which was predominantly caused by changes in α (90–93%) rather than those in NEE. This result suggests that, compared to the climate effect caused by forest carbon sequestration changes, the climate effect of α alterations can be more sensitive to vegetation damage induced by natural disturbances. Moreover, this study demonstrates the important role of vegetation recovery in driving canopy reflectance and ecosystem carbon balance during the post-disturbance period, which determines the ecosystem feedbacks to the climate change.

P-16

Reflectance and chlorophyll fluorescence-based retrieval of photosynthetic parameters improves the estimation of subtropical forest productivity

Muhammad Amir (Institute of geographic sciences and natural resources research, CAS ,Beijing, China)

Forest ecosystems play a significant role in climate change mitigation and uptake a larger amount of atmospheric CO_2 than other terrestrial ecosystems via photosynthesis process in form of gross primary production (GPP). The photosynthesis or GPP is largely determined by the photosynthetic capacity of vegetation (i.e., maximum rate of carboxylation, Vcmax) in ecosystem models. However, considerable

uncertainties of Vcmax estimates may limit our potential to address scientific issues of GPP related to the increasing emission of atmospheric CO_2. Recently, solar-induced chlorophyll fluorescence (SIF) signals have been used as a proxy for resolving photosynthesis. In this study, the biochemical and structural parameters were retrieved from hyperspectral reflectance and fluorescence quantum efficiency (FQEs) was retrieved from ground-based SIF. Then, retrieved parameters were incorporated into the Soil Canopy Observation Photosynthesis and Energy (SCOPE) model to explore the potential of ground-based SIF to track Vcmax variability for a subtropical evergreen mixed forest. Then, SIF-derived Vcmax was used to parameterize Boreal Ecosystem Production Simulator (BEPS) model to simulate the GPP. With retrieved vegetative parameters and FQEs, the ground-based SIF was strongly correlated with the model-based SIF simulation at O_2-B and O_2-A bands, demonstrating that the coefficient of determination (R^2) improved from 0.15 (constant values) to 0.60 (retrieved values) for SIFB and from 0.79 to 0.94 for SIFA simulation. Using SIF-derived Vcmax, the R2 value of simulated GPP against eddy covariance-based measurements substantially increased from 0.18 (constant Vcmax) to 0.38 (SIF-derived Vcmax) for dry season and from 0.56 to 0.67 for wet season respectively. The utilization of SIF-derived Vcmax with its corrected temperature response function reduced the relative error in annual GPP simulations by 24.9%. Our results support the significant references toward reducing unbiased SIF simulation and highlighting the potential of ground based SIF in deriving Vcmax at site scale for defining forest management options.

P-17

Mapping the impact of flood using optical remote sensing in Periyar river basin, Kerala, India

Fathima Abdurazak PA (Kerala University Fisheries and Ocean Studies, India)

Floods are one of the most devastating natural disasters, threatening human lives as well as ecosystems. Most of the information needed to demarcate flood-affected areas, assess damage, and feed models that can predict inland and coastal flooding vulnerability may be obtained using remote sensing technology on satellites and airplanes. Microwave remote sensing is the most widely utilized data for the assessment and analysis, whereas optical remote sensing is found limited utility due to the low penetrative capacity of the visible and infrared radiations through clouds and haze. This paper analyses how optical remote sensing data can be employed for mapping the post flood situation at the ground after the massive flood that hit the Kerala State in 2018. The lower reaches of Periyar River was taken for the study. A series of Sentinel 2A and 2B images for the post flood time period of August to September, 2018 were acquired from the USGS Earth Explorer. Cloud affected regions were removed through AOI (Area of Interest) operation, and these gaps were filled with cloud free data that were extracted from the nearby dates images. In this way, a cloud free mosaicked post flood data was generated. In order to measure the impact of flood on different land use, a Sentinel 2 data of August 2017 was used. Four land use land cover classes, i.e., water body, paddy vegetation, land vegetation, and built-up areas, were chosen and supervised classification was carried out. The change analysis was carried to determine the area lost in various categories of land use land cover. The

results showed that 20 percent of built-up areas, 5.4 percent of paddy, and 8.9 percent of land vegetation affected by flood. The study demonstrated that stitching of cloud free pixels acquired multi-temporarily helps in the assessment of flood impacts on various land covers.

P-18

Winter leaf reddening phenomenon: Tracking of changing patterns of vegetation indices and eddy covariance fluxes in a temperate Japanese cypress forest at Kiryu Japan

Siyu Chen (Kyoto university, Japan)

Yoshiko Kosugi, Linjie Jiao, Tatsuro Nakaji, Hibiki Noda, Kouki Hikosaka, Kenlo Nishida Nasahara

Winter leaf reddening is a phenomenon that evergreen conifer species - leaf changes color from green to red before or during winter due to the accumulation of red pigment (rhodoxanthin in case of Japanese cypress). The photoprotection strategy of plant leaves in response to excessive light stress is the classic explanation for this phenomenon. In gymnosperms, the xanthophyll cycle (VAZ cycle) and accumulation of rhodoxanthin are preventing excess light damage to the photosynthetic apparatus during winter and early spring. However, the interaction of these two processes with canopy photosynthesis under excessive light stress in winter has not been further studied. During this phenomenon, changes in canopy gas exchange, vegetation indices and environmental conditions are also an unsolved question. Therefore, the purpose of this study is to clarify whether: (1) the low temperature is the dominant factor affecting the phenomenon and ascertain the air temperature conditions when the winter leaf reddening phenomenon occurs; (2) the accumulation of rhodoxanthin, the VAZ cycle and low light-use efficiency (LUE) correspondingly occurs in low air temperature conditions during the winter season. To track the winter leaf reddening phenomenon, we utilized the photochemical reflectance index (PRI) as a tool to reflect the VAZ cycle. A digital camera was used to monitor the phenological changes. The RGB channels of image data were extracted to calculate the Red-Green vegetation index (RGVI) to track the color changes of canopy leaves. The canopy CO_2 flux was measured with the eddy covariance method, which can be used to calculate LUE. Micrometeorological data were also monitored. Our findings demonstrated that low air temperature in winter plays a leading role in the occurrence of the winter leaf reddening phenomenon. The winter leaf reddening phenomenon occurs along with the lower level of PRI and LUE.

P-19

Monitoring spring phenology of multi-layer canopy in a deciduous broadleaf forest: What signal do satellites actually see in space?

Jongmin Kim (Seoul National University, South Korea)

Monitoring spring phenology is essential to understanding feedbacks of vegetation to the climate system.

To this end, normalized difference vegetation index (NDVI) from satellite remote sensing has been widely used. However, we do not fully understand what satellite NDVI derived leaf-out and full leaf dates actually observes because deciduous broadleaf forest consists of multi-layer canopies typically and mixed signal from multi-layer canopies could affect satellite observation. Here, we report the results of 8 years of continuous observations of multi-layer phenology and climate variables in a deciduous broadleaf forest, South Korea. Multi-channel spectrometers installed above and below overstory canopy allowed us to monitor over- and understory canopy phenology separately, continuously. We evaluated the widely used phenology detection methods, curvature change rate and threshold with NDVI observed above top of the canopy and compared leaf-out and full leaf dates from both methods to in-situ observed multi-layer phenology. First, we found that NDVI from the above canopy had a strong linear relationship with satellites NDVI (R^2=0.95 for MODIS products and R^2= 0.85 for Landsat 8). Second, leaf-out dates extracted by the curvature change rate method and 10% threshold were well matched with understory leaf-out dates. Third, the full-leaf dates extracted by the curvature change rate method and 90% threshold were similar to overstory full-leaf dates. Furthermore, we found that overstory leaf-out dates were closely correlated to accumulated growing degree days (AGDD) while understory leaf-out dates were related to AGDD and also sensitive to the number of chill days (NCD). These results suggest that satellite-based leaf-out and full leaf dates represent understory and overstory signals in the deciduous forest site, which requires caution when using satellite based phenology data into future prediction as overstory and understory canopy show different sensitivities to AGDD and NCD.

P-20

Changes in terrestrial vegetation activities observed by satellite-based products across Northern Asia

Da Wang (Chiba University, Chiba, Japan)
Kazuhito Ichii, Yuhei Yamamoto

The Earth's warming trend is intensifying, particularly in the boreal and cold-temperate areas, where yearly average temperatures are rising at an increasing rate. A state of greening of vegetation is growing in connection with the rise in temperature. However, most studies still show that as the temperature rises, there is no significant change in vegetation dynamics in a large section of the cold-temperate zone. Therefore, in this study, we used multiple satellite datasets from 2000 to 2019 to understand the long-term trends of vegetation changes across Northern Asia. We used multiple Terra and Aqua MODIS products, multiple climate datasets and land cover and burned area data from the C3S to understand changes and non-changes in vegetation and multiple reasons cause of these vegetation changes. Regions with increased NDVI are widely distributed in Northern Asia. There is an increasing trend in 46.8% of the regions and a decreasing trend in 1.4% of the regions. NDVI increased significantly in North-central, west-central and part of northeastern China. On the other hand, NDVI decreased regions distributed in a dotted pattern and more in the west. After analyzing climate factors such as temperature and precipitation, we found that

vegetation and temperature have the same trend in extreme low and high temperatures in the area north of 60N, but not in the area south of 60N. The land cover obviously affect the change of NDVI, and the change of vegetation is greater in forest areas such as DNF, DBF, and MF than where no change. In addition, 2.5% of the areas had land cover changes, and 61.5% of the areas with land cover changes had no vegetation changes. For the effect of fire, results show that the burned area is greater than 6% after 2010 will have a significant effect on the NDVI growth trend.

P-21

Total and top-to-bottom emissions of solar-induced chlorophyll fluorescence in the canopy of a cool temperate deciduous broad-leaved forest in Takayama, Japan

Tomoki Morozumi (Hokkaido University, Japan)

Tomomichi Kato, Kanokrat Buareal, Naohisa Nakashima, Yuma Sakai, Hideki Kobayashi, Kenlo Nishida Nasahara, Tomoko Akitsu, Shohei Murayama, Hibiki Noda, Hiroyuki Muraoka

Solar Induced chlorophyll Fluorescence (SIF) has been suggested to be a remote sensing proxy of gross primary productivity (GPP) in many types of terrestrial vegetation. While many studies focus on SIF emitted from the canopy surface, we concern multi-layer processes between canopy SIF and bottom layer's SIF. Multi-layer canopy spectral measurement assumed to be applied to both the extinction of downwelling radiation and the integration of vertical-sectional upwelling SIF emissions. The purpose of this study is to examine whether the ground-based SIF at the top to the bottom layers and sum of those values could respond to GPP from eddy covariance flux data. We continuously observed ultra-fine (full width at half maximum < 0.4 nm) spectral radiation in a deciduous broadleaf forest ecosystem, at TKY Asiaflux site (36.15° N, 137.42° E), Takayama, Japan since April to November 2020. A spectrometer (QEpro, Ocean Optics, Dunedin, FL, USA) captured the upward and downward spectral radiation at three heights: 8, 14, and 18m (canopy top) with the yield of view (FOV) of 180° . SIF was retrieved using the spectral fitting method for O2-A (759-770 nm) and O2-B (685-697 nm) absorption bands. Monthly mean SIF varied 0.1-0.4 to 0.02-0.1 (mW m^{-2} nm^{-1} sr^{-1}) from summer to early winter. Sum of the multi-layer SIF were positively correlated to GPP. The proportion of top layers SIF were increased from April to June-August and decreased to November. We discuss the utilization of multi-layer SIF to tracking seasonal photosynthetic activity and the potential approach for total SIF detection.

P-22

Monitoring daily canopy photosynthesis using NIRvP maps at 10 m resolution using Sentinel 2 and GK2A

Juwon Kong (Seoul National University, Republic of Korea)

Youngryel Ryu, Sungchan Jeong, Monseok Choi, Henock Mamo

Our understanding of photosynthesis across the scales has been advanced by using satellite remote sensing. However, clouds cause the data gaps that limit our ability to monitor photosynthesis. At the same time, the geostationary satellite that can frequently sense land surface provides the opportunity for filling the gaps in satellite data. To fully monitor terrestrial photosynthesis, we propose a spatiotemporal image fusion system that integrates polar-orbiting (i.e., Sentinel 2, MODIS) and geostationary satellite (i.e., GK2A) data. To generate daily gap-free 10 m canopy photosynthesis maps using the spatiotemporal image fusion, we conducted a series of processes: 1) generating daily nadir bidirectional reflectance distribution function-adjusted reflectance data (NBAR), 2) harmonizing GK2A NBAR and MODIS NBAR into same map projection and resolution, 3) fusing the harmonized data and Sentinel 2 NBAR, and 4) adapting a spatial gap-filling method to achieve daily gap-free surface reflectance data with 10 m resolution. Then, we calculated near-infrared radiation reflected from vegetation (NIRvP) using daily gap-free surface reflectance data with 10 m resolution and daily photosynthetically available radiation data from Breathing Earth System Simulator to estimate canopy photosynthesis. The NIRvP maps were evaluated in space and time by using hyperspectral maps derived from unmanned aerial vehicle (UAV) and tower-based hyperspectral measurements. We expect that our estimated photosynthesis maps will expand our understanding of the cloud-bound areas in space and time.

P-23

Estimating diurnal GPP variations in East Asia using Himawari-8 data

Yui Shikakura (Chiba University , Japan)

Kazuhito Ichii, Yuhei Yamamoto, Minseok Kang, Youngryel Ryu, Shohei Murayama

Geostationary satellites provide hyper-temporal resolution earth observation data, and are expected to produce terrestrial carbon fluxes at sub-daily temporal scales. In this study, we estimated GPP in East Asia using two diagnostic GPP model, MODIS-GPP model and EC-LUE model with inputs of Himawari-8 solar radiation and land surface temperature and reanalysis-based meteorological variables. In the current version, MODIS FPAR product with 8-day composite is used. We focused on May-August, 2018. First, we tested and improved the models at four sites (CRK, GCK, GDK, and TKY). Then, using the established model, diurnal variation in GPP in East Asia was estimated. In the default model runs, we found that both GPP models underestimated GPPs in the afternoon due to excess water stresses (expressed by VPD). Water stress in MODIS-GPP was more severe than that in EC-LUE. In particular, we found a large GPP discrepancy in the afternoon of heat wave days. Model parameter optimization successfully improved the model with relaxed water stress in the afternoon. Our study demonstrated that existing LUE models can be applicable to reproduce diurnal GPP variability after model parameter optimization. Furthermore, the geostationary satellites based GPP can provide hypertemporal GPP and be used for near real time assessment of GPP.

P-24

Tracking diurnal to seasonal variations of gross primary productivity using a geostationary satellite, GK-2A Advanced Meteorological Imager in Korean Peninsula

Sungchan Jeong (Seoul National University, South Korea)

Youngryel Ryu, Benjamin Dechant, Bolun Li, Jiangong Liu, Jongmin Kim, Juwon Kong, Wonseok Choi, Jeongho Lee, Sangjun Lee, Minseok Kang

Advances in satellite remote sensing can make up the limitation of flux towers and conventional polar-orbiting satellites. In particular, the diurnal sampling capability of geostationary satellites provides unprecedented opportunities for understanding diurnal cycles of gross primary productivity (GPP), which is of fundamental importance for predicting the diurnal courses of the interaction within the soil-plant-atmosphere continuum. Furthermore, geostationary satellites could reduce the uncertainties of GPP estimates from temporal upscaling methods by using more temporally continuous observations. However, the potential of applying geostationary satellites on GPP research has not been explored in depth. Here, we used NIRvP, the product of NIRv times PAR which is a robust structural proxy of sun-induced chlorophyll fluorescence and photosynthesis, to track diurnal to seasonal variations of GPP over different vegetation types across the seasons. We generated GK-2A AMI surface reflectance using the 6S radiative transfer model and semi-empirical BRDF model, and GK-2A AMI photosynthetically active radiation using Forest Light Environmental Simulator which is combined with an artificial neural network. At the hourly scale, we found a significant relationship between NIRvP and GPP at six flux tower sites. The coefficient of determination (R2) between NIRvP and GPP for individual sites have a range of from 0.57 to 0.77 for hourly and 0.52 to 0.82 for daily scale, and linear regression slope showed a range of from 0.03 to 0.08 for hourly and 0.03 to 0.08 for daily scale. NIRvP showed a strong linear relationship across the different vegetation types except for one evergreen needleleaf forest site (SAC), which has a lower linear regression slope and R2 compared to other sites. Our findings highlight the potential of geostationary satellites could help to understand the diurnal to seasonal dynamics of GPP.

P-25

Generating LAI and FPAR Datasets using Himawari-8 AHI data

Tatsuki Hashimoto (Chiba University, Japan)

Kazuhito Ichii, Yuhei Yamamoto, Wei Yang, Hideki Kobayashi

Himawari-8 is a new generation geostationary meteorological satellite that observes the Asia-Oceania region at a frequency of every 10 minutes with a spatial resolution of about 1 km. The LAI is an indicator of the amount of leaves on vegetation and can be an important input data for the estimation of photosynthesis, as well as a parameter for vegetation structure such as the amount of vegetation. So far,

there have been very few studies on the construction of LAI using Himawari-8 and there are no publicly available data sets. This study aims to estimate the LAI from the Himawari-8 data using a three-dimensional radiative transfer model of vegetation, FLiES. The FLiES model is used in the generation of the FPAR/LAI product for the SGLI sensor onboard the GCOM-C satellite launched by Japan in 2017. The FLiES model is a core radiative transfer model in the construction of the FPAR/LAI product for the SGLI sensor. FLiES is operated with solar and satellite geometric conditions, vegetation landscape information, and leaf area index as inputs to construct a look-up table (LUT). Using the LUT, we estimated the inverse of the LAI by using the surface reflectance observed by the satellite. So far, we have confirmed the operation of the FLiES model and constructed LUEs for each vegetation type. In the future, we would like to estimate the spatial distribution of LAI by using actual data from Himawari-8. In addition, we would like to improve the accuracy of LAI estimation by comparing with field observation data and other satellite products.

P-26

Simulating the effect of carbon starvation on terrestrial ecosystem by individual-based vegetation model SEIB-DGVM

Hideki Ninomiya (Hokkaido University, Japan)

To understand the effect of climate change on the terrestrial ecosystem, the response of vegetation to atmospheric carbon is critical. As global warming is getting worse, it would contribute to widespread tree mortality related to drought, increased temperature, pest outbreak to name a few. However, it is challenging to estimate the negative impact due to the unsolved carbon flow in trees. Trees have grown to control their carbon resources to extend lives and strategically allocate them to growth, respiration, storage, reproduction, and defense (Hoch et al, 2003; Henrik et al, 2018). Among carbon resources, non-structural carbon (NSC) is commonly considered a repository depending on the balance between the supply of assimilated carbon and carbon demand. NSC could be the threshold of the conceptual "Carbon starvation" as one of the mechanisms after drought (Hoch et al, 2003; McDowell et al., 2008). The objectives of the research are to apply the process representing NSC dynamics to the ecological model and expect the potential effect of carbon starvation in the future. The process-based Spatially Explicit Individual-Based Dynamic Global Vegetation Model (SEIB-DGVM; Sato et al., 2007), representing three-dimensional tree structure and individual tree growth, was used in this study. Then, we newly created a process of accumulating NSC and carbon starvation in tree bodies for SEIB-DGVM. Assimilated carbon from photosynthesis is mainly allocated to maintenance respiration and growth respiration of plant structure: leaf, stem, and root. In the new process, all carbon is not consumed but some of them are stored in three organs of plants each day. When photosynthesis rate declines, NSC compensates for maintenance respiration and gradually close to zero. The study contributes to improving the physiological leaf life cycle of the model, and understanding how carbon starvation will affect the vegetation distribution, gross primary production (GPP), woody biomass in the future.

P-27

Implementing a new rubber plant functional type in the Community Land Model (CLM5) improves accuracy of carbon and water flux estimation

Ashehad A. Ali (University of Goettingen, Germany)

Yuanchao Fan, Fernando E. Moyano, Christian Stiegler, Rahmi Ariani, Tania June, Suria Tarigan, Edzo Veldkamp, Alexander Knohl

Rubber plantations are an economically viable land-use type that occupies large swathes of land in Southeast Asia that have undergone conversion from native forest to intensive plantation forestry. Such land-use change has a strong impact on carbon, energy, and water fluxes in ecosystems, and uncertainties exist in the modeling of future land-use change impacts on these fluxes due to the scarcity of measured data and poor representation of key biogeochemical processes. In this current modelling effort, we utilized the Community Land Model Version 5 (CLM5) to simulate a rubber plant functional type (PFT) by comparing the baseline parameter values of tropical evergreen PFT and tropical deciduous PFT with a newly developed rubber PFT (focused on the parameterization and modification of phenology and allocation processes) based on site-level observations of a rubber clone in Indonesia.

We found that the baseline tropical evergreen and baseline tropical deciduous functions and parameterizations in CLM5 poorly simulate the leaf area index, carbon dynamics, and water fluxes of rubber plantations. The developed rubber PFT and parameterizations (CLM-rubber) showed that day-length could be used as a universal trigger for defoliation and re-foliation of rubber plantations. CLM-rubber was able to predict seasonal patterns of latex yield reasonably well, despite highly variable tapping periods across Southeast Asia. Further, model comparisons indicated that CLM-rubber could better simulate carbon and energy fluxes than the existing rubber model simulations available in the literature.

Our modeling results indicate that CLM-rubber can be applied in Southeast Asia to examine variations in carbon and water fluxes for rubber plantations and assess how rubber-related land-use changes in the tropics feedback to climate through carbon and water cycling.

P-28

Upscaling and Intercomparison of Soil Respiration in Japan

Hina Yamanuki (Center for Environmental Remote Sensing (CEReS), Chiba University, Chiba, Japan)

Kazuhito Ichii, Yuhei Yamamoto, Shunji Kotsuki, Lifei Sun, Naishen Liang, Munemasa Teramoto, Hirohiko Nagano, Takashi Hirano, Kentaro Takagi, Sachinobu Ishida, Masahiro Takagi, Toshiaki Kondo, Jun Koarashi, Mariko Atarashi-Andoh, Yoshiyuki Takahashi

Soil Respiration (SR), the sum of root respiration and heterotrophic respiration, is one of the most essential

components of soil carbon cycles. So far, various efforts have been conducted to understand SRs. Many observation stations directly measure SR using chambers. Using these observation data and literature surveys, several studies estimated spatial and temporal patterns of SR at global and regional scales based on semi-empirical equations and machine-learning methods. However, the database (e.g. SRDB) used in these large-scale studies contains inconsistently observed datasets. These inconsistencies may produce additional uncertainties in estimated fluxes. The largest SR observation network across Asia developed and maintained by NIES, Japan can be a good candidate to estimate spatio-temporal variations in SR across Asia, since these observations have been conducted with a consistent observation protocol and quality controls. In this study, we updated our data-driven estimation of SR across Japan with observation data (eight sites across Japan), remote sensing data (MODIS land products), and random forest regression. As soil meteorological variables, we used soil temperature and moisture by a process-based model, the Simple Biosphere model including Urban Canopy (SiBUC). Our estimation shows a reasonable performance with R^2=0.72 for the in-situ model and R^2=0.73 for remote sensing and in-situ combined model on average. Based on the established model, we also produced upscaled estimations of SR across Japan with a spatial resolution of 1 km from 2000 to 2020. Intercomparison of our estimation with other available datasets was also conducted to understand the advantages of our estimation. Our results show spatially more explicit variations compared with other global products. In addition, our advantage is to capture temporal variations (e.g. 8days). We also confirmed that previous estimations do not reproduce our observation network datasets, indicating consistent observation approach is important to upscale soil respiration.

P-29

Improving carbon fluxes and stocks simulations by parameterizing the tropical evergreen plant functional type PFT: Applying CLM5 in Southeast Asia

Rahmi Ariani (Bioclimatology, University of Gottingen, Gottingen, Germany)

Tropical forests account for almost half of global terrestrial carbon uptake. Disturbance in this ecosystem can contribute to a sizeable CO_2 emission to the atmosphere. Hence, reliable carbon prediction in tropical forests becomes more crucial considering the high conversion rates from natural forests to plantations over the last decades. One of the tools to predict carbon changes in terrestrial ecosystem are land surface models; however, most of the model performance in the tropics is still relatively poor. Thus, we aimed to improve the parameterization of the Community Land Model 5 (CLM5) by calibrating the model predictions of carbon fluxes and stocks with field measurement for tropical forests in Jambi, Indonesia. To understand how modelled values of CLM5 responded to changing parameter values, we performed a systematic sensitivity analysis. The results revealed eleven out of fifteen parameters that significantly affected the carbon fluxes and stocks prediction. We then used the sensitivity results to guide model calibration. We determined values of optimized parameters by minimizing model errors against field measurements. The final optimum parameter has three key parameters, i.e. base rate respiration (br_mr) and ratio of root to

leaf (froot_leaf) and ratio of root to stem (croot_stem) improved model's prediction by reducing the sum of squared error by 50 %. Then we used the values of the final optimum parameter set and ran CLM5 at three different forest locations which differs in climate and disturbance history in Southeast Asia. Compared to the results of the baseline CLM5 simulations, the optimized parameter values showed an improvement with a considerably lower sum of squared error in predicting carbon fluxes and stocks at all of the sites. Our modeling results indicate that tropical forest species from Southeast Asia could be different in trait values from South American continent, where CLM5 has been more intensively calibrated.

P-30

Maximum leaf area index the seasonal temperature sensitivity of carbon uptake across northern ecosystems

Weinan Chen (Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, China)

The temperature sensitivity of land carbon uptake (γ) plays a pivotal role in shaping the strength and dynamic of biosphere-atmosphere feedbacks. However, we know little about the variations of γ values and its determinants across different ecosystems. Based on observational data derived from the FLUXNET2015, we investigated spatial patterns of the seasonal temperature sensitivity of net ecosystem productivity (γNEP) across northern biomes and the controlling factors. Then we simulated γNEP in the present-day and future scenarios according to a ridge regression model. γNEP showed a bell-shaped latitudinal distribution ranging from 0.06 to 1.49 g C/m2/d/°C. Among biomes, the largest mean γNEP was found in cropland (CRO) while the smallest one in shrubland (SHR). Ridge regression analysis indicated that γNEP increased with the maximum leaf area index (LAImax), mean annual temperature (MAT) but decreased with vapor pressure deficit (VPD). Both across sites and vegetation types, γNEP was mostly determined by LAImax. Further, the variation of γNEP were mostly determined by the temperature sensitivity of gross primary productivity (γGPP) rather than changes in the temperature sensitivity of ecosystem respiration (Q_{10}). In addition, γNEP can affect the maximum net ecosystem productivity (NEPmax) and thus plays a significant role in determining annual NEP. In recent decades, ecosystems at high latitudes had relatively low temperature sensitivity but will show a sharp increase by the end of the 21st century under the RCP4.5 scenario. These findings indicated that positive feedback between global warming and carbon cycle of northern ecosystems might be overestimated in most ESM models. Considering the spatial variations of seasonal temperature sensitivity of carbon fluxes and its determinants will advance the current understanding and improve land model predictions in climate change-carbon cycle feedback.

P-31

Interannual variations in CO_2 fluxes and its environmental and biotic controls in a typical temperate secondary forest in Northeast China

Xingchang Wang (Northeast Forestry University, China)
Fan Liu, Chuankuan Wang

Based on the CO_2 fluxes of the typical temperate secondary forest at Maoershan site over 11 years (2008 – 2018), ground measurements and remote sensing, we explored the responses of the CO_2 fluxes to biotic (leaf area index, seasonal peaks of fluxes, and canopy phenology) and environmental factors. we provided the standard protocols of leaf area index measurement of deciduous forests by litterfall collection. The main results were as follows: The average values of net ecosystem exchange (NEE), gross primary production (GPP), and ecosystem respiration (Re) of the stand over the 11 years were -157 ± 64, 1356 ± 148, and 1200 ± 138 g C m^{-2} yr^{-1}, respectively. The IAV of NEE was jointly controlled by the length of net CO2 uptake period and the summer peak of the net CO2 uptake, whereas those of GPP and Re were dominantly controlled by the summer peaks. The increasing trend of annual GPP was dominantly controlled by GPPmax due to the leaf-level photosynthetic capacity rather than the maximum leaf area index. The environmental factors showed weak impact on the IAV of NEE largely because of the offset between the positive responses of the annual GPP and Re to the spring and autumn soil water content, respectively. Phenology was the dominant biotic drivers of the spring and autumn CO2 fluxes. Spring precipitation and autumn photosynthetically active radiation were the main environmental drivers of the spring and autumn NEE, respectively. Taking the influences of the ecosystem- and leaf-level physiology, canopy structure, and phenology, together with environmental interactions, on CO2 fluxes into account will improve the understanding and prediction of the temporal dynamics in forest carbon budgets. This work highted the importance of ecosystem- and leaf-level physiology.

P-32

Climate-Smart Agriculture (CSA)-Based Assessment of a Rice Cultivation System in Gimje, Korea

Mohammad Samiul Ahsan Talucder (Department of Agroforestry and Environmental Science, Bangladesh)
Joon Kim, Kyo-Moon Shim

The overarching question is how a typical rice cultivation system in Korea is keeping up with the triple-win challenge of CSA. The study site was one of the Korean Network of Flux measurement (KoFlux) sites (i.e., GRK) located at Gimje, Korea, managed by National Academy of Agricultural Science, Rural Development Administration. Fluxes of energy, water, carbon dioxide (CO_2) and methane (CH_4) were directly measured using eddy-covariance technique during the growing seasons of 2011, 2012 and 2014. The production indicators include gross primary productivity (*GPP*), grain yield, light use efficiency (*LUE*), water use efficiency (*WUE*) and carbon uptake efficiency (*CUE*). The GHG mitigation was assessed with indicators

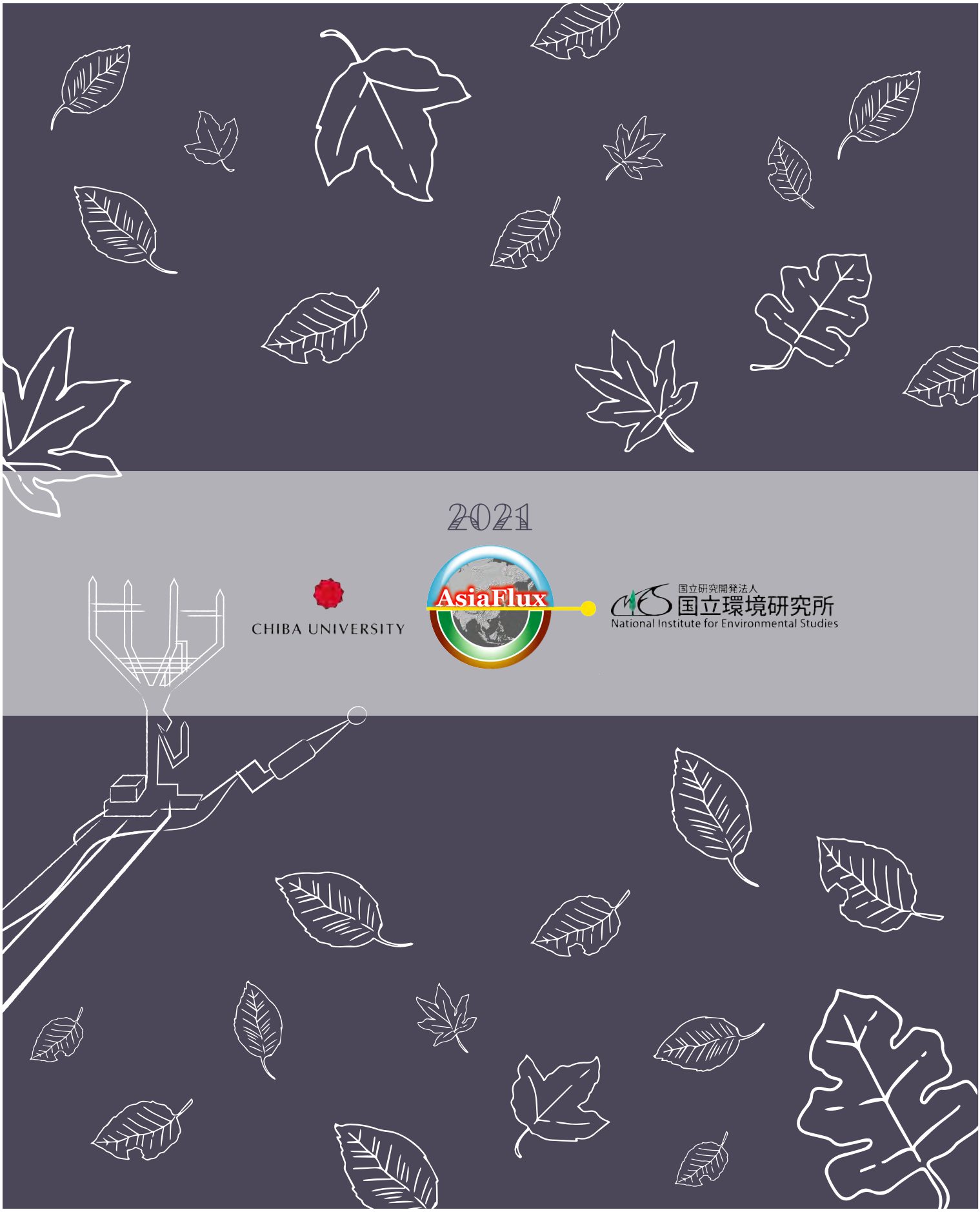
such as fluxes of carbon dioxide (F_{CO2}), methane (F_{CH4}), and nitrous oxide (F_{N2O}). Resilience was assessed in terms of self-organization (S), using information-theoretic approach. Overall, the results demonstrated that the rice cultivation system at GRK was not fulfilling the CSA's triple-win challenges. In fact, the competing goals and trade-offs among productivity, resilience, and GHG mitigation were found within individual years as well as between the three years, causing clashes and difficulties in achieving seamless harmony under the triple-win scenarios. The pursuit of CSA requires for stakeholders to prioritize their goals (i.e., governance) and to practice opportune interventions (i.e., management) based on the feedback from real-time assessment of the CSA indicators (i.e., monitoring) - i.e., the purpose-driven visioneering.

P-33

Including soil water stress in process-based ecosystem models by scaling down maximum carboxylation rate using accumulated soil water deficit

Bin Chen (IGSNRR, China)

The impacts of soil water stress on photosynthesis and stomatal conductance have not been uniformly parameterized in terrestrial ecosystem models. This study firstly quantifies diurnal variations in canopy conductance (gc,w) during full-leaf periods from eddy covariance flux data at four flux sites by inverting the Penman-Monteith equation. Then, the Ball-Woodrow-Berry (BWB) slopes were derived and compared under contrasting water stress conditions by linear regression of gc,w and gross primary productivity (GPP) derived from EC measurements. Finally, the response of the leaf maximum carboxylation rate to accumulated soil water deficit (ASWD) was explored to develop a better scheme of soil water stress. Our results show: (1) The thresholds of relatively available soil moisture under which soil water stress occurs were 0.575, 0.885, 0.495 and 0.653 for the tropical savanna site (AU-How), the Mediterranean forest site (IT-Col), the Mediterranean grassland site (US-Var) and the boreal forest site (CA-Oas), respectively, derived from the logistic functions of fitting gc,w to relatively available soil moisture; (2) similar to previous work, we found that ensemble average gc,w of dry periods were lower than those of wet periods at the studied sites, and that BWB slopes did not change significantly during droughts, indicating that BWB slopes may be conserved under prolonged drought; and (3) EC-derived GPP gradually decreased with the increase of ASWD, which can be well captured by a Vmr-ASWD scheme developed in this study. In sum, the Vmr-ASWD scheme would increase the accuracy of GPP simulations of ecosystem models. This study suggests that the change of BWB slopes under prolonged drought is not justified according to the experimental data examined while adjusting Vcmax with ASWD accounts for the change in leaf physiology due to prolonged drought and is computationally feasible and efficient.


2021
CHIBA UNIVERSITY
AsiaFlux
国立研究開発法人
国立環境研究所
National Institute for Environmental Studies