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AsiaFlux Newsletter

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Introduction of the AsiaFlux2019 -20th Anniversary Workshop-

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"AsiaFlux2019 -20th Anniversary Workshop-" was held in September 29-October 5, 2019 at Gifu and Takayama, Japan, under the co-organization by AsiaFlux; River Basin Research Center, Gifu University; and National Institute for Environmental Studies (NIES). The purposes of this anniversary workshop are to review and celebrate our past 20 years activities and to discuss future development of our community toward further understanding of terrestrial ecosystems toward sustainability and better quality of life in Asia.

First three days, the training course by Li-COR was held as the pre-workshop at Gifu University, Gifu. The 20 participants attended the training course, which contained series of lectures on eddy covariance theory, eddy covariance applications and experimental design, operation theories of analyzers and sonic anemometer, data processing overview, and so on (the 13 lectures were given by expert scientists).

On third day of training course, Prof. Baldocchi (University of California, Berkeley) had a Special Lecture which entitled as "Trials and Tribulations of Measuring Carbon and Water Fluxes over Ecosystems since 1978". The training course was successfully closed on October 1, 2019 with the closing remarks by Prof. Kato and giving "Certificate of Participation" for all participants by Prof. Baldocchi.

The three days main workshop was held in October 2-4 at Hida Earth Wisdom Center, Takayama. Approximately 180 participants including three plenary speakers (Dr. Benjamin bond-Lamberty, Prof. Dario Papale, and Prof. Dennis D. Baldocchi) from over ten countries and regions attended the main workshop (Figure 1). After opening remarks by Prof. Yu, chair of AsiaFlux and video message by Prof. Moriwaki, President of Gifu University, 44 oral and 93 poster presentations were held in two special 20th anniversary sessions (Review and future perspective, and Linking scientific communities & Linking science and society), 6 general sessions (Soil ecology and biochemistry, Remote sensing, Flux measurements and multi-site synthesis, Trace gases, Modelling, and Ecosystem processes) and 2 poster sessions during the three days of the workshop (for detailed description, see each session reports in this newsletter).

On the end of Day 1 of the workshop, the 20th anniversary ceremony was held. After opening remarks by Prof. Yu, the memorial video which looks back past 20 years activities of AsiaFlux was screened. In the award ceremony, five ex-Chairs (Prof. Yoshihiro Fukushima, Dr. Susumu Yamamoto, Dr. Otani Yoshikazu, Prof. Joon Kim, and Dr. Akira Miyata) and two persons who has rendered distinguished service (Prof. Gen Inoue and Dr. Yoshinobu Harazono) for the exceptional contribution they made towards the growth of AsiaFlux, and two companies (Li-COR and Campbell Scientific) and NIES for their continuous support were awarded. After the anniversary ceremony, the banquet at "Festa Forest in Takayama" was held near venue. In banquet, participants had enjoyed several Japanese traditional foods such as sashimi, soba and sushi, and Japanese traditional crafts "Karakuri dolls" on Dashi which is a symbol that indicates the subtleties of God appears. On the evening of Day 2 of the workshop, Young Scientist Meeting which hosted an activity to share their opinions on 'a good scientist' was held (for detailed description see each YSM reports in this Newsletter). After all sessions on Day 3 of the workshop, General Discussion was organized by outcome reports of each general session and panel discussions (for detailed description see General Discussion report in this Newsletter). The main workshop was successfully closed on October 4 with ceremony for oral and poster presentation awards and the closing remarks by Dr. Saigusa, Director of Center for Global Environmental Research, NIES.

On October 5, parts of participants had enjoyed the excursion to Takayama site with the longest flux observation record in Asia and were impressed by multidisciplinary research at the Takayama site to explore cross-scale mechanisms and consequences of forest and landscape structure and functions (Figure 2).

We have believed that this anniversary workshop was good opportunity to think back the past 20 year activities of AsiaFlux community, to share the current insight and knowledge, and to discuss future perspective of next 10 years AsiaFlux activities.

Figure 1: Photograph of participants in AsiaFlux2019 (Photo by Mr. Narita of NIES)

Figure 2: Photograph of field excursion to Takayama site (Photo by Mr. Narita of NIES)

Part 1: 20th anniversary: review and future perspective

Speech from Professor Guirui Yu (Chair of AsiaFlux)

Guirui Yu
Institute of Geographic Sciences and Natural Resources Research,
Chinese Academy of Sciences, China

Dear all participants, thank you all for coming to celebrate the twentieth anniversary of Asian Flux. On behalf of the Executive Committee, I would like to extend my warmest and sincerest welcome to you all.

Thank JapanFlux and Gifu University very much for the efforts in preparing this conference. Thank all the participants for coming to make this successful workshop possible. Thank all the colleagues and friends for your contribution to the development of AsiaFlux.

Looking back on the development of AsiaFlux in last 20 years, I am very excited. Since established in 1999, AsiaFlux has been dedicated to the long-term observation of carbon, nitrogen, water and energy fluxes at different types of terrestrial ecosystems in Asia, and reveal their dynamics and underlying mechanisms, and to serve the ecosystems management, human life, and social sustainable development in Asia. After 20 years of development, AsiaFlux has developed into a regional research network composing 28 member countries and more than 100 flux observation stations, covering diverse terrestrial ecosystems, including forests from tropical rainforest to boreal forest, temperate and alpine grasslands, cropland and wetland.

In the past 20 years, the community of AsiaFlux have made great progresses in the development of observational techniques, instruments and ecosystem studies, and also made great contributions to the development of global flux network. Here, I would like to thank all the AsiaFlux chairboard and executive committees in the past 20 years for their efforts in organizing the activities and moving AsiaFlux forward, and thank all the workshop hosts to organize the annual conferences and workshops in different countries of Asia over the past 20 years.

The 20 year is a milestone in the history of development and a booster for enterprising spirit. I firmly believe that AsiaFlux will develop better, faster, and farther in the future. The future of flux network will surely be more successful and brilliant. Let's work together and witness together!

Figure 1: Professor Guirui Yu in opening ceremony (Photo by Mr. Narita of NIES)

Memory of the first workshop

Takashi Hirano
Hokkaido University, Japan

In late September 2000, an international scientific meeting was held at Hokkaido University in Sapporo, Japan as the first workshop of AsiaFlux (http://www.cger.nies.go.jp/publications/report/m011/m011_2001.html). Sapporo was chosen for the venue to announce the launch of a new flux site in a larch plantation in Tomakomai, near Sapporo by National Institute for Environmental Studies (NIES) Japan, a principal sponsor of not only the workshop but also AsiaFlux itself. I was involved in the workshop as a member of the local organizing committee and arranged a field tour to the flux site using sightseeing buses. Since the road was narrow, bumpy and dirty around the site, I remember that bus drivers complained so much to me. At this moment nobody could predict that the site was devastated severely by a typhoon attack four years later.

In 2000, when one year had passed since AsiaFlux was launched in 1999, we were still at the early stages of the development of filed flux research. I had joined a research project at the Tomakomai flux site and just started eddy flux studies. Thus, everything during the workshop was new to me, and I was so excited about presentations from international researchers. Obviously, the first AsiaFlux workshop motivated and inspired me to study more about flux. In this year, AsiaFlux has reached a milestone of the 20th anniversary. Along with AsiaFlux, I have become senior by 20 years. AsiaFlux has been encouraging young scientists, especially through workshops. In future, toward the 30th anniversary, I expect young generations to be more active in AsiaFlux activities.

Figure 1: Professor Takashi Hirano in opening ceremony (Photo by Mr. Narita of NIES)

AsiaFlux at 20 years: A Transition from Past, to Present and Future

Dennis Baldocchi
University of California, Berkeley, U.S.A.

Scientists from across Asia and the world met this October at Takayama, Japan, to celebrate the 20th anniversary of AsiaFlux. Two decades of operation of an international network of flux measurement towers is clearly a landmark worth celebrating. Over this period, technology and instrumentation evolved, many new discoveries were produced, many friendships and collaborations were forged, and many esteemed and valued colleagues have come and gone.

As a partner in the global network, FLUXNET, AsiaFlux contributes many unique datasets to our community. AsiaFlux is best noted for having many tropical forest sites, that are in remote and inhospitable locations, but also are well-instrumented. This biome is noted for its large carbon pools and for the perturbation of these pools due to weather and climate extremes and land use change. Another fascinating aspect of AsiaFlux revolves around the fact that many sites experience the distinct wet-dry seasonality of the Monsoon. Changes in moisture and temperature provide excellent natural experiments to how whole ecosystems respond to such forcings. A third subset of sites is subject to typhoons and the disturbance they cause by wind throw. Finally, I note that nowhere on earth do ecosystems experience the unique effects of the high elevation Tibetan plateau or the extremely high temperatures being experienced across India. Clearly, many of the sites across AsiaFlux are serving as sentinels on how the metabolism of whole ecosystems is responding to incipient environmental change.

What about the future? Twenty years can be viewed as the duration of a generation. Consequently, many current members of the AsiaFlux community were not present at the beginning. As an observer, I also came to recognize that fewer AsiaFlux members are in the field making measurements. Instead they tend to hold multiple roles as data users, synthesizers, compilers and modelers. Training and mentoring this next generation with modern skills will be prepare AsiaFlux for the inevitable intergenerational transfer of intellectual leadership.

In addition, it should be expected that the interests and priorities of the next generation of AsiaFluxers will revolve around what AsiaFlux can do next, rather than repeat what has been done. Twenty years ago, we wanted to ensure we could make long term measurements in many difficult and remote environments and trust them. Today, we need to use flux measurements of upscale flux information in time and space. These data are also needed to validate and parameterize remote sensing algorithms, machine learning systems and carbon and water cycle models that will be used to integrate fluxes in time and space. And we need this information to solve societal problems and make better and informed policies.

If the AsiaFlux enterprise is to best serve the growing and expanding needs of its own constituents, and the world, it will need to make more of its data available to the public, and do so readily. For additional motivation, it has been noted in several recent papers that sharing data is expands the impact of the data (Bond-Lamberty, 2018; Dai et al., 2018). This former lacking leads me to lament lost opportunities by not having the data shared widely.

In closing, I am confident that AsiaFlux is well poised to address the environmental problems facing the world that is warming, a water cycle that is becoming very episodic and extreme and as CO2 levels continue to rise to unprecedented levels experienced by humankind. We look forward to the findings from the next 20 years of AsiaFlux and working together as partners in the global FLUXNET endeavor.

References.

Bond-Lamberty, B., 2018. Data Sharing and Scientific Impact in Eddy Covariance Research. Journal of Geophysical Research: Biogeosciences, 123(4): 1440-1443.
Dai, S.-Q. et al., 2018. Assessing the Extent and Impact of Online Data Sharing in Eddy Covariance Flux Research. Journal of Geophysical Research: Biogeosciences, 123(1): 129-137.

Figure 1: Professor Dennis Baldocchi in opening ceremony (Photo by Mr. Narita of NIES)

20 years of AsiaFlux research: Progress, Insights, and Opportunities

Benjamin Bond-Lamberty
Pacific Northwest National Laboratory,
Joint Global Change Research Institute at the University of Maryland, U.S.A

The AsiaFlux 2019 Workshop was held in early October in Gifu and Takayama, Japan, celebrating 20 years of the AsiaFlux network. It provided an excellent opportunity to take stock of current and past network research, highlight trends and emerging opportunities, and think about the future.

The geographic and disciplinary variety of AsiaFlux research was impressive. Attendees listened to talks on the history eddy covariance in the region, closing the water and energy budgets at individual sites, soil respiration research, mapping the fate and interactions of trace gases, and modeling and remote sensing, covering research in Japan, China, South Korea, Malaysia, Indonesia, Australia, Thailand, and elsewhere. Long-standing regional investments in science, and earth and ecosystem sciences in particular, was evident in the sophistication and variety of research. Three guest speakers from the U.S. and Europe discussed the global carbon cycle with respect to east Asia, and how the scientific and organization lessons of FLUXNET can be leveraged to strengthen science in the region.

I found the student presentations, in particular at the vibrant poster sessions, to be a true highlight of AsiaFlux 2019. There was fascinating work on urban, managed, and natural ecosystems under the stress of climate change; synthetic studies inferring regional patterns in carbon, energy, and water; machine learning applied to topical problems in eddy covariance and related research; and technically focused analyses using the latest instrumentation. Remote sensing studies were well represented, using the power of these orbiting platforms (and sometimes unmanned aerial vehicles) to synthesize and examine regional- to continental-scale trends. The biotic and abiotic effects of urgent regional economic trends such as oil palm plantations were presented in a wide variety of studies. Riverine and lacustrine work was also well represented, and a useful reminder that terrestrial scientists must think in integrative and cross-disciplinary terms.

The meeting also offered a useful perspective on future growth opportunities and challenges for AsiaFlux. First, building on the excellent previous research of

Figure 1: Dr. Benjamin Bond-Lamberty
in opening ceremony (Photo by Mr. Narita of NIES)

now-senior scientists, there is an inspiring younger generation—interested in cross-national collaborations using open datasets, open to new technologies and approaches, and more diverse in gender and background—that is (or soon will be) powering new advances in many fields. Second, algorithmic machine-learning approaches are, as in so many other areas of society and science, increasingly being applied to provide new perspective on old problems; it will be fascinating to see what new insights and hypotheses can be generated by these tools. Third, the looming 'open data' and 'open science' movements pose both a challenge and opportunity. Historically the absence of AsiaFlux data from regional or international repositories has, I would suggest, handicapped syntheses and emergent understandings. But this is changing, and in an era when data deposition and open data are increasingly mandated by journals, funders, and individual researchers, it will be fascinating to see how AsiaFlux continues to reinvent itself in the future.

Review and future perspective of AsiaFlux

Ryuichi Hirata
National Institute for Environmental Studies, Japan

The main purpose of the 20th anniversary session is to look at the past, current, and future status of AsiaFlux.

We look back at the history of flux studies and the achievements and progress of AsiaFlux. The study was divided into six subjects: flux measurements and multi-site synthesis, soil ecology and biochemistry, trace gases, ecosystem processes, remote sensing and modeling.

For flux measurements and multi-site synthesis, Dr. Hirata (National Institute for Environmental Studies, Japan) reviewed flux studies in Asia. The first long-term continuous flux measurement started in Takayama in 1994, and others followed in Japan, China, and Korea at the beginning of the 2000s. At the end of the 2000s, flux measurements have been spread to South and Southeast Asia. Site intercomparison studies started in the mid-2000s. Data used in these studies were submitted to databases like AsiaFlux and FLUXNET and have been used for remote sensing and model studies. Dr. Hirata also reviewed studies on temporal and spatial variations in carbon fluxes, the effects of extreme climate events and disturbance on fluxes, and CH_4 fluxes on an ecosystem scale. Dr. Kang (National Center for Agro Meteorology, South Korea) reviewed water and energy flux studies in Asia, such as observation techniques, data processing techniques, model-data fusion, carbon interlinkages, and water and energy fluxes.

Dr. Sha (Chinese Academy of Sciences, China) reviewed soil flux studies in Asia. He reviewed the history of soil respiration measuring methods such as the alkali absorption method, the closed static chamber method using a CO_2 gas analyzer or a gas chromatograph, and automated chamber systems. Dr. Sha also introduced soil respiration experiments such as soil warming experiments in Japan and China and rainfall reduction experiments (water controlling) in China. He mentioned that Asia accounts for 32% of global soil respiration data, collected in the Soil Respiration Database (SRDB ver. 4) developed by Dr. Bond-Lamberty. He also reviewed spatial variations in soil respiration globally and in China using models. The observation of non-CO_2 GHG fluxes in the soil and network research with experiments on warming, water control, nitrogen addition, and grazing should be promoted in future studies.

Prof. Tani (University of Shizuoka, Japan) presented a review on volatile organic compound (VOC) exchange between terrestrial ecosystems and the atmosphere. He introduced evaluation methods for BVOC fluxes from leaf or branch level to the ecosystem level using air samples. Sampled air is analyzed using Proton Transfer Reaction Mass

Spectrometry (PTR-MS) and Gas Chromatography and Mass Spectrometry (GCMS). Canopy-level terpenoid fluxes—a BVOC flux—of various types of vegetation were summarized. The spatial distribution of BVOC estimated by satellite and several models was introduced. Dr. Yonemura explained studies on fluxes of inorganic gases such as O_3, NH_3, and NO_2.

For the ecosystem processes research, Dr. Chang (National Dong Hwa University, Taiwan) presented scaling between leaf photosynthesis and GPP. The GPP was derived from observed NEE and used as ground-truth data in satellite remote sensing and model validation. Directly measuring leaf photosynthesis provided photosynthetic parameters. Dr. Chang mentioned the importance of comparing tower GPP with leaf photosynthesis.

Dr. Kobayashi (Japan Agency for Marine-Earth Science and Technology) reviewed remote sensing studies, consisting of earth observations by satellite, regional observations by aircraft, ground observations by tower system, and modeling. He introduced the Phenological Eyes Network (PEN) as ground observation for satellite validation, a mechanistic model to estimate the spatial variation of GPP and evapotranspiration using satellite data as input data, wildfire studies in Siberia and Southeast Asia, and satellite measurements of Solar-Induced Chlorophyll Fluorescence (SIF). LiDAR and SAR sensor satellites and airborne remote sensing should be introduced in future studies. He also emphasized that open data of ground-based validation should be promoted to advance remote sensing studies.

Dr. Ito (National Institute for Environmental Studies, Japan) presented a review of modeling studies in Asia. Many original models using observation data as validation were developed during the last 20 years. The models have been applied to point- and regional-scale studies, and the model intercomparison project has been promoted. Some terrestrial ecosystem models were linked with Earth System Models, predicting global warming on the earth. Machine learning has been used for spatial evaluation of fluxes by using observation flux data. Data assimilation, disturbance studies, and trace gas models have been useful but not sufficient. The modeling of management practices and urban-natural mapping did not provide many results. These studies might be promoted in the next 20 years.

At last, I want to introduce a message from Dr. Gen Inoue (National Institute for Environmental Studies at that time), written in the first AsiaFlux Newsletter published in 2002.

"*AsiaFlux Network is expected to be one of the important research flame work of this project, especially to answer the question; "What are the geographical and temporal patterns of carbon sources and sinks?" The flux observation network should cooperate with other activities, such as a process study of carbon cycle within the forest, a remote sensing to map the forest canopy image spectra, and the boundary layer atmospheric measurement. The measurements of key isotopes and oxygen budgets, nitrogen cycle and others will give us a better understanding.*"

I believe we can find answers to the questions following his suggestions.

Based on reviews, we can find two main driving forces for the advancement of flux studies in Asia in the last 20 years. The first is the development of hardware and software; the second is data accumulation and distribution. The following are examples of hardware developments: gas analyzers, automated chamber systems, optical spectrometers, fixed-point cameras, new satellites, mass spectrometers, advancing supercomputers, general-purpose computers, and storage. Examples of software developments are standardized flux calculations and post-processing software, new flux correction methods, new analysis methods, model developments, and new methods for machine learning and data assimilation.

Accumulated data have been distributed by databases such as AsiaFlux and FLUXNET and projects such as A3. Advancements in data distribution have accelerated site-comparison studies and multidisciplinary co-studies. For the next 20 years, developments in hardware and software, and data accumulation and distribution, will be essential to promote flux studies in Asia.

Reference

Inoue, G., 2002. Role of AsiaFlux Newsletter. AsiaFlux Newsl. 1, 1.

Figure 1 Speakers in the session of Review and future perspective of AsiaFlux

Part 2: Summaries of the sessions in the workshop

Soil ecology and biogeochemistry

Munemasa Teramoto
National Institute for Environmental Studies, Japan

Center for Global Environmental Research, National Institute for Environmental Studies

In the soil ecology and biogeochemistry session, there were 5 oral and 6 poster presentations. Research topics ranged from site-based observation studies for soil greenhouse gas (GHG) fluxes and environmental parameters in several ecosystems to synthetic analysis using a global database. In this review, these presentations will be briefly introduced.

Accumulation of good-quality observation data and their synthetic analysis is a straight forward strategy for precise estimation of global soil GHG fluxes. Plenary speaker, Dr. Benjamin Bond-Lamberty (Joint Global Change Research Institute, Pacific Northwest National Laboratory, USA) made a presentation about pioneering challenges to estimate global soil respiration (R_s) from observed GPP and vice versa. In his presentation, a difference (10-20%) between estimated global R_s based on observed GPP and estimated global R_s based on observed R_s was shown. He mentioned that one possible reason for this discrepancy might be a bias of observed R_s data. For example, many observations were conducted in temperate regions but observations in tropical regions are limited. It is expected that future work also in the Asian region will solve the observation bias. For example, in the poster session, Dr. Jeyanny Vijayanathan (Forest Research Institute Malaysia, Malaysia) presented her study in a tropical lowland ever-green secondary forest in Malaysia and suggested that soil moisture is the primary control factor for R_s in that forest. Such observations of soil GHG flux in data-limited regions will be a steady solution for solving the bias of observations of soil GHG fluxes.

Evaluation of the influence of climate change and associated disturbance on soil GHG fluxes is one of the important topics when we focus on future climate change and the feedback of soil GHG fluxes. Dr. Munemasa Teramoto (National Institute for Environmental Studies, Japan) made a presentation about soil warming experiments in Asian monsoon regions using an automated chamber network. He showed a large and sustained stimulatory soil warming effect on heterotrophic respiration (R_h) in Asian monsoon forests and suggested that the increase of Rh in the region might be larger than previously estimated under a warmer environment in the future. Integration of these datasets using model analysis or machine learning will further enhance the understanding of the feedback of soil organic carbon decomposition under global warming.

In the poster session, there were presentations focusing on the relationships between disturbance and R_s. Mr. Liguo Zhou (Xishuangbanna Tropical Botanical Garden, China) introduced his study about R_s measurement after 6 years of continuous drought stress in a tropical rainforest in Southwest China. In this study, drought stress decreased root biomass and root respiration but increased R_h partly associated with the increase of inorganic nitrogen. Ms. Gyeongwon Baek (Gyeongnam National University of Science and Technology, Korea) presented a study about R_s in Japanese cypress stands planted after the clearcutting of severely damaged pine stands because of pine wilt disease. In this study, R_s in forest stands that regenerated after the clearcutting was more sensitive to changes in soil temperature compared with undisturbed stands.

The influence of nitrogen addition on soil GHG fluxes (CO_2 and N_2O) was also a hot topic in this session. Dr. Tao Yan (Lanzhou University, China) introduced his study about the response of R_s to nitrogen addition in temperate plantation forests in northern China. In this presentation, he showed that R_s decreased due to nitrogen addition, but the magnitude of decrease depended on the annual precipitation and stand age of the forest. Such a decrease of R_s was also reported in the poster session by Ms. Wei Du (Beijing Normal University, China). In her study, R_s in semiarid grass land in China was reduced by nitrogen addition due to decreased microbial biomass carbon and altered microbial composition. On the other hand, Dr. D. Balasubramanian (Xishuangbanna Tropical Botanical Garden, China) showed that soil CO_2 and N_2O were both significantly increased due to nitrogen addition in a rubber plantation forest in a tropical region in southern China, and any significant increase of soil GHG flux due to nitrogen addition was only detected in N_2O in the neighboring tropical forest. In this study, it was suggested that nitrogen addition accelerated decomposition of free light and occluded the light fraction of soil organic matter. As suggested from these presentations, the response of GHG fluxes to nitrogen addition is different in each ecosystem, and assessment in several ecosystems will be certainly necessary for further understanding of the mechanism.

There were presentations introducing methodologies for measuring soil GHG fluxes and related environmental parameters. Dr. Chuying Guo (Institute of Geographic Science and Natural Resources Research, China) showed the results of continuous measurements of multiple soil GHG fluxes (CO_2, CH_4 and N_2O) for five years using a dynamic chamber system in a broad-leaved Korean pine mixed forest in the Changbai Mountains in Northeast China. In this study, a large N_2O efflux during the soil thawing period was reported. Long-term continuous measurement data of multiple soil GHG fluxes is totally limited, and such data will become increasingly important for a better understanding of the soil GHG flux response to climate change. Soil moisture is an essential environmental parameter related to soil GHG fluxes. However, no standard method for the calibration of soil moisture sensor has been established yet and this causes measurement errors in field observation. In the poster session, Mr. Sung-Won Choi (National Center for Agro-Meteorology, Korea) mentioned the necessity of precise calibration of soil moisture value at each measurement point and measurement depth in his study about the relationship between soil characteristics and soil moisture measurement data in Korea. Mr. Jongho Kim introduced a reference soil moisture measurement system that makes it possible to detect measurement errors in the soil moisture sensor and calculate its calibration coefficients. These studies can be a clue for establishing more accurate soil moisture measurement and calibration methods.

Figure 1 Speakers in the session of Soil ecology and biogeochemistry

Remote sensing

[1]Hideki Kobayashi, [2]Tomomichi Kato
[1] Japan Agency for Marine-Earth Science and Technology
[2] Hokkaido University, Japan

The AsiaFlux remote sensing session contains the remote sensing studies associated with the AsiaFlux observation network. The observations from various platforms such as ground (flux towers), UAVs, aircrafts, satellites are included. Remote sensing technology is widely used to scale up the site scale flux observation to regional and global scale photosynthesis and ecosystem respiration. Disturbance monitoring such as wildfire is also a common use in order to understand the flux modification due to environmental changes nearby the flux site. Remote sensing technology is also useful to extract the ecosystem structure parameters (leaf area index, biomass etc.) at flux tower sites.

In the remote sensing session in AsiaFlux 2019, there were 25 oral and poster presentations in total: 6 oral presentations including two invited talks and 19 poster presentations (11 presentations in Day 2 and 8 presentations in Day 3). We had diverse remote sensing topics covering traditional optical remote sensing measurements (11 presentations), solar-induced chlorophyll fluorescence (SIF) (4 presentations), photochemical reflectance index (PRI) (2 presentations), geostationary satellite (2 presentations), synthetic aperture radar (SAR) observations (2 presentations), unmanned aerial vehicle (UAV) (1 presentation), LiDAR (one presentation) and multiple data sources (2 presentations).

Two invited talks covered long-term ground-based measurements of phenological camera images, visible to shortwave spectral reflectance, and aerosol measurements by sunphotometer (Skyradiometer) called Phenological Eyes Network (PEN) by Kenlo Nasahara and scalable remote sensing biosphere model "Breathing Earth System Simulator (BESS)" by Youngryel Ryu. Nasahara introduced several outcomes from the PEN project and emphasized the importance of working with communities. Ryu introduced the history and development of the scalable remote sensing -based biosphere model, BESS. His group's model has been extending with multiple remote sensing data sources with BESS platform. This type of diagnostic model can be promising tool to interpret the inter-relationship between the ecosystem variables, not only for the carbon and water flux estimation.

The optical remote sensing (visible to near infrared spectral reflectance and vegetation index-based analysis) has been widely used as a conventional approach to extract the amount of vegetation, phenological changes, photosynthetic activities, and disturbance monitoring. In the AsiaFlux 2019, there is a wildfire monitoring and carbon estimation study by Haemi Park "Relationship between surface dry conditions and carbon dioxide emission of forest fire in Far East Russia", and ecohydrological analysis in the Eurasian inland steppe regions by Tianyou Zhang "Precipitation-use efficiency in Eurasian steppe region: spatial pattern and influence factors", and carbon cycle changes in Mongolia by Zaya Mart "Changes in terrestrial carbon cycle in Mongolia: Synthesis analysis". The other type of optical remote sensing studies was the reliable estimation of gross primary production (GPP) via remote sensing indices. In these studies, GPPs were related with the vegetation indices (e.g. Kanako Muramatsu "GPP capacity estimation algorithm using light response curve in various vegetation types for global observing satellite data") or estimated by the data driven approach (e.g. Zhiyan Liu "Data Driven GPP and NEE Estimation with Lag Effect, Remote Sensing and Machine Learning").

Solar-induced Chlorophyll Fluorescence (SIF) and Photochemical Reflective Index (PRI) studies were also a major topic in the AsiaFlux meeting. There are two presentations using satellite-based SIF data (GOAST) (Tomoki Kiyono "Temporal dynamics of satellite-derived photochemical reflectance index (PRI) and solar-induced fluorescence (SIF) in climate-changing Mongolia" and Hibiki Noda "Phenological changes in in-situ and GOSAT-based SIF in evergreen coniferous forest in Japan"). The other type of studies was to utilize the ground-based SIF and PRI observations. SIF studies have been one of the essential measurements to extract the information regarding the photosynthesis pathways. In order to further understand how it is useful for photosynthesis (GPP), we need a better and standard instrumental setting at the flux site that can be used in various locations.

In summary, the remote sensing session in AsiaFlux 2019 had a good balance in terms of ground to satellite remote sensing as well as various approaches and applications. There was only one LiDAR presentation by Robert John Short "Lidar-derived canopy structure of restored temperate wetlands" due probably to the cost of the LiDAR measurements. However, detailed ecosystem structure measurements are not ignored when looking at the ecosystem scale flux changes. We hope to have more structure measurements in the future AsiaFlux workshop.

Figure 1 Speakers in the session of Remote sensing

Flux measurements and multi-site synthesis

Hiroki Iwata
Department of Environmental Sciences,
Shinshu University, Japan

In Flux Measurements and Multi-Site Synthesis session, we had six oral and 39 poster presentations, including ten student posters. These researches worked on CO_2, CH_4, and water vapor exchanges in a wide range of ecosystem type in Asia, including forest, grassland, tropical peatland, mangrove, and freshwater ecosystems. About 20% of the presentation included CH_4 exchange indicating that CH_4 exchange studies are spreading also in Asia as commercial CH_4 analyzers are becoming more common.

The session started with an invited talk by Prof. Baldocchi from University of California Berkley, USA. He presented results from CH_4 flux observations conducted across a network of sites in Sacrament-San Joaquin Delta of California including restored wetland, rice paddy, and irrigated pastures. Other topics of oral presentations were CH_4 emission from a tropical mangrove wetland (Jiangong Liu from The Chinese University of Hong Kong, China), greenhouse gas exchange in small aquaculture ponds (Mi Zhang from Nanjing University of Information Science and Technology, China), CO_2 exchange in tropical peatlands (Frankie Kiew from Sarawak Tropical Peat Research Institute, Malaysia), evaporation from a subtropical lake (Wei Xiao from Nanjing University of Information Science and Technology, China), and CO_2 exchange multi-site synthesis (Weikang Zhang from Chinese Academy of Science, China).

A modulation of CH_4 emission by environmental drivers is complicated due to an asynchronous and nonlinear response of CH_4 emission to environmental changes over different time scales. For evaluating such responses more sophisticated data analysis are emerging. One such example is data analysis based on the information theory in combination with the wavelet decomposition employed in a few studies presented during the workshop. Interested readers are referred to Sturtevant et al. (2016) for more information.

From this session, two student presentations were selected for best presentation award: an oral presentation made by Jiangong Liu and a poster presentation made by Tsukuru Taoka from Shinshu University, Japan. They studied CH_4 exchange at a mangrove wetland and a lake, respectively, applying new techniques to clarify the detail of environmental response of CH_4 exchange. As a community, we are glad to see vigorous activity of young scientists during the workshop.

In the chairman's opinion, more micrometeorological researches should be necessary to further improve the accuracy of flux observation. Observed fluxes are now used in various aspect of environmental studies, including ecosystem modelling and remote sensing data synthesis, and the accuracy of flux data is a prerequisite to advance such studies. The lack of surface energy balance closure and the difficulty in flux evaluation during the stable night-time are something we should overcome, to name a few. We need continuous efforts to improve the accuracy of flux observation and such studies are expected to be stimulated.

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Figure 1 Speakers in the session of Flux measurements and multi-site synthesis

Trace gases

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[2]University of Shizuoka, Japan

Six aural and four poster presentations were presented in trace gases session. VOCs flux studies are now very hot—T5: Urban VOCs emission; T6: Leaf uptake of VOCs; P1-T1: isoprene emission from bamboo; P2-T1: isoprene and mono-terpene concentrations in forests; P2-T3: temperature on monoterpene as poster presentations. The limited studies of fluxes of inorganic trace gases are partly due to low precisions of gas analyzers to measure trace gases are still low, in comparison with CO_2, water vapor and temperature. Then, technical development to measure fluxes of trace gases are critically important--T1:NO and N_2O by laser spectroscopy; T2: open pathNH3 measurement; T3: simultaneous measurements of soil N_2O, CH_4 and CO_2 emissions by MULTUM; P2-T2: system to NO emission in laboratory. Numerical scheme to estimate vertical profile of trace gas fluxes are important to understand complex mechanisms of trace gases (presented in T4).

Furthermore, trace gases have many scientific importance and meaning over various mechanisms. Studies about trace gas fluxes are cutting edge in Flux communities because integrated studies using many sites of CO_2 and H_2O flux data are now established and studies only about CO_2 fluxes without adding novelty are not so interesting at this stage and because all the trace gases are connected through chemical reactions in/outside of plants, soil and other components in ecosystems. Measurements of trace gas fluxes can also give deep insights further to mechanisms behind CO_2 and H_2O fluxes.

Figure 1 Speakers in the session of Trace gases

Modelling

Kazuhito Ichii
Chiba University, Japan

The model session started with a 20th anniversary session (review session) talk on the background and future direction of model research in the AsiaFlux community by Dr. Akihiko Ito of the National Institute for Environmental Studies (Japan), followed by six oral presentations and nine poster presentations. The topic was wide from observation site scale to regional, continental, and global scale, and the target materials and methodologies are various such as CO_2, CH_4, and N_2O as materials and methods, process models, application of remote sensing data, and empirical models as approaches.

Dr. Ito reviewed previous studies on modeling related to Asia and AsiaFlux in the past 20 years (and more). Even in this AsiaFlux meeting, he pointed out that the application of the model was presented in various sessions. In addition to the research presented in the model session, modeling was applied in various presentations in other sessions. Models have also been used to various phenomena, such as models for vegetation canopies, biophysical/biochemical aspects, dynamic vegetation, nutrient dynamics, and radiation budget. Many different types also exist, such as data-driven models, diagnostic models, and prognostic models. In Asia, we believe that land-use change and disturbance are some of the critical phenomena in Asia. Besides, he presented that it has been developed into integrated analysis using various models and observational data in an integrated manner, and research on continental-scale CO_2 balance. In the 20 years since the birth of AsiaFlux, various developments have been made in model development, application to sites and regions, participation in model comparison research, various integrated analysis, and machine learning-based models. In the future, fusion research of data models, modeling of disturbances, trace gas. He hopes that further research on modeling, cultivation activities, and urban area modeling will be further developed.

The regular sessions cover broad topics. The target region covers from tropical to boreal/arctic ecosystems, natural to managed ecosystems. Methodologies include hyperspectral remote sensing, process-based modeling, diagnostic modeling, data-driven modeling, and inverse modeling. Target gases cover various greenhouse gases, such as CO_2, CH_4, and N_2O. Studies on energy and water budget were also included. Based on the broad topic ranges, we will expect further progress of modeling studies and integrative studies among the AsiaFlux community.

Figure 1 Speakers in the session of Modelling

Ecosystem Processes

Hiroyuki Muraoka
River Basin Research Center, Gifu University, Japan

Fluxes of carbon, water, GHG and other elements involved in the biosphere and their interaction with the atmosphere are well known to be largely driven by the ecosystem processes such as carbon, nutrient and water cycles. The challenges of ecosystem science community under the current and future changing environment will be to deepen our mechanistic understandings on the temporal and spatial dynamics of the above cycles with the changes in ecological structure. Long-Term Ecological Research (LTER) enables us to address why and how questions on ecosystems particularly from biological aspects such as phenology, succession of vegetation, plant-soil microbial interactions, physiological and ecological responses organisms and resulting ecosystem functions to changing environments. This session was organized jointly by AsiaFlux and Japan Long-Term Ecological Research network (JaLTER) with the objectives to (1) view our state-of-the-art mechanistic understanding on the components involved in the given ecosystem by long-term observations and open-field experiments at in-situ research sites, and their integrated analysis and future predictions, and (2) identify thematic gaps and our challenges to deliver our scientific findings to policy, which should be filled and tackled by cross-scale, cross-disciplinary and cross-platform observations and knowledge production by pulling the efforts of research networks together.

The session was organized by five oral presentations and 14 poster presentations. Oral papers included, nitrogen biogeochemistry in a forest ecosystem under climate change with particular attention to changing snow regime in the northern Japan (Dr. Hideaki Shibata, Hokkaido University); tree species diversity and individual growth, and their consequences with primary productivity in forest ecosystems (Dr. Masae Ishihara, Kyoto University); open-field warming experiments on canopy trees and soil in a cool-temperate forest to examine the impacts of rising temperature on tree leaf traits, plant herbivore and soil respiration (Dr. Tatsuro Nakaji, Hokkaido University); open-field temperature and water regime experiments to address the question how the water availability impacts on carbon cycle in a grassland ecosystem under increasing temperature (Dr. Shuli Niu, Chinese Academy of Sciences); introduction of multidisciplinary and cross-scale observations on forest ecosystems in Takayama site, Gifu, by combining eddy covariance observations, tree biomass survey, plant ecophysiology and soil respiration, and in-situ remote sensing (Dr. H. Muraoka, Gifu University). Poster presentations also covered a broad range of the questions on processes in ecosystem such as, tree stem surface respiration; seasonal patterns in energy balance in Alps; litter decomposition and biogeochemical processes; tree root exudation and tree root system dynamics (respiration and morphology) in various forests along environmental gradients; impacts of water regime on carbon fluxes in grassland ecosystems; water storage and hydrological processes in individual trees; insect-plant interaction by soil warming experiments; modeling analysis on the influence of rain-fall event on gas exchange in a forest ecosystem.

Fruitful discussion was made by the presenters and the audience, and challenges to further mechanistic understanding on the trace gas fluxes, biogeochemical cycles and ecological dynamics were shared (see Figure). One of the important outcomes from this joint session by AsiaFlux and JaLTER was to seek collaborative research by sharing not only the data through databases but also to work together at their research sites in our region.

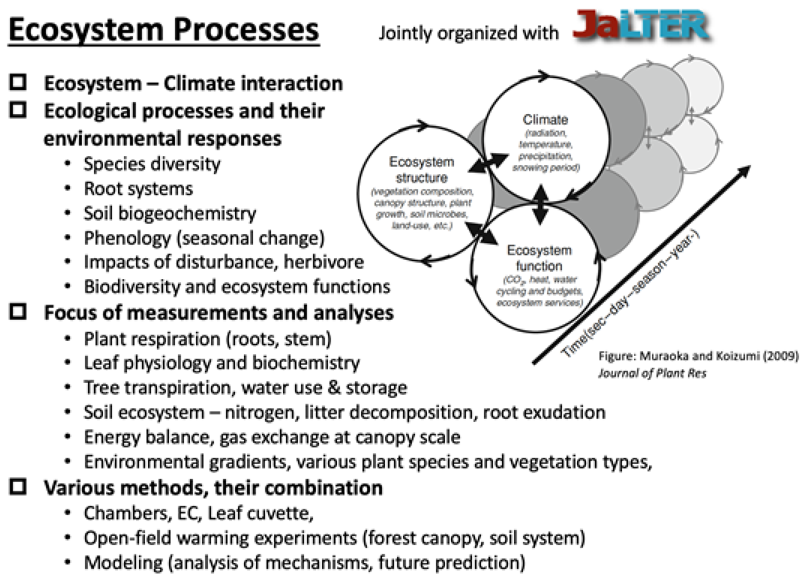

Figure 1 Ecosystem Processes

Figure 2 Speakers in the session of Ecosystem processes

Linking scientific communities & Linking science and society

Ryuichi Hirata
National Institute for Environmental Studies, Japan

Cross-disciplinary research provides new ideas for the next 20 years of AsiaFlux.

For this session, we invited researchers from other scientific communities and social communication sciences. They provided us with ideas and directions for AsiaFlux research in the future. Prof. Papale (Tuscia University, Italia), one of the leaders of FLUXNET, presented the latest information on FLUXNET. Dr. Tachiiri (Japan Agency for Marine-Earth Science and Technology, Japan), who studies global warming using an Earth System Model, indicated his expectations for AsiaFlux. Dr. Emori (National Institute for Environmental Studies) pointed out that scientists should communicate with the society.

Dr. Papale introduced the standardization of post data-processing and data sharing in FLUXNET. He introduced the software “ONEFlux,” which automatically calculates u* correction, gap filling, and portioning. The concept of a FLUXNET shuttle connecting to data from each global flux community was also specified.

Dr. Tachiiri, who participated in the development of an ESM, introduced studies on global warming using ESM and demonstrated that there are still significant uncertainties in the carbon balance of terrestrial ecosystems. FLUXCOM research was introduced as an example of collaborations with researchers involved with flux studies. He suggested that flux scientists should clarify processes such as the CH_4 release by permafrost thawing or wetlands, emission of N_2O, phosphorus and dust, and the effects of wildfires to contribute to global warming studies. Despite the large temporal and spatial discrepancy between flux observations and EMS, both methods can complement each other in detecting hotspots, comparing models, and remote sensing. Flux research should also take into account global carbon and nitrogen cycles, spatial and temporal representativeness of data, mechanisms of flux changes, uncertainties of ESM, and other processes not considered in ESM. Finally, clarifying flux mechanisms will contribute to modifying ESM and global warming studies.

Dr. Emori encouraged communication between scientists and society and emphasized the importance of providing information under the recent climate crises. There was a very intense discussion among guest speakers from the US and Europe. Various considerations should be taken into account on the relationship between science and society.

Figure 1 Speakers in the session of Linking scientific communities & Linking science and society

Summary of general discussion

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On Day 3 of the workshop, General Discussion was organized by two parts: (1) outcome reports by the coordinators of thematic sessions during the three days, and (2) panel discussions by the speakers of the thematic sessions. The panelists were Dr. Shuli Niu and Dr. Hideaki Shibata (ecological processes), Dr. Yongryel Ryu (remote sensing), Dr. Jeyannu Vijayanathan (soil system), Dr. Jiangong Liu (flux observations), Dr. Akihiko Ito (modeling), Dr. Akira Tani (trace gases), and Dr. Hiroyuki Muraoka (chair of the panels). The second part of this session was mostly held by findings and/or comments by the speakers based on their participation to the workshop as well as their experiences in research and networking. They were also requested by the session chair to give any thoughts on the following items, i.e., (a) achievements and lessons learned in 20 years of AsiaFlux, (b) challenges in future research and observations, (c) recent arguments for terrestrial observations, and (d) opportunities by broadening and strengthen the network.

Major points of the findings/suggestions by the panelists were as following:

- Combination of multiple approaches to address one specific scientific questions is valuable, for example to use site-level manipulative experiment and global data synthesis to study how ecosystem responds to environmental change. Site-level experiment will offer deep insight for a better understanding in processes while global synthesis will provide general response patterns which links to regional and global issues, and policy making. This workshop is very amazing and exciting -- saw the expectation and promotion of previous generation on young generation, and also the grow-up of young students who contributed lots of excellent posters (S. Niu).
- Addressing research hypothesis on the consequences of short-term and long-term climate change, vegetation dynamics, and nutrient cycling should be one of highly important challenge. Long-term data base and knowledge by research networks are fundamental to these research, and further cooperation of AsiaFlux and LTER (long-term ecological research network) will be the key to make a difference. In addition to the presentations of the research findings, it should also be valuable to organize a group work to develop new joint research projects and activities (H. Shibata).
- In-situ observation network like AsiaFlux sites is essential to achieve higher accuracy in satellite remote sensing of ecosystems. Since the estimated physical parameters by satellite remote sensing rely on the spectral reflectance from the Earth surface, cooperative activity with observation network like PEN (Phenological Eyes Network) should be advanced to gain reliable in-situ data (Y. Ryu).
- Soil system is often treated as 'black box' in flux observation research, but it is quite important to deepen our understanding on the 'inside' and 'outside (carbon budget)' of the box. Soil respiration varies in time and in space and cannot be observed globally by satellites. It also varies by ecosystems and the observations are not held uniformly in space. Therefore, integration of observations and efforts is highly recommended in Asian region and in global, for which networking and data sharing would be the key (J. Vijayanathan).
- Our knowledge about blue carbon systems has been growing rapidly these years. At the same time, we still have many gaps to fill. Also, we should not be too optimistic about the point that blue carbon systems are the secret

weapons against climate change. We are still far from the conclusion. The major challenge for estimating the role of CH_4 emission in offsetting blue carbon is the lack of local carbon and hydrology, and how to properly interpret the interaction between CH_4 and biophysical variables. Always being critically thinking may help us reexamine the past knowledge and think about the future challenges (J. Liu).

- More than 20 years ago validation of simulation models had been quite limited due to lacking flux data, but only annual data of NPP or biomass were available from IBP. Flux observation and its network of multiple sites in the world provided valuable data on diurnal, seasonal, inter-annual patterns for many years, and for global, which are quite essential for validation and further advancement of simulation models. While we acknowledge the developments of various models, we still need to work together with in-situ flux observations and process research to address the uncertainties in estimation (A. Ito).
- Emission of reactive gases such as isoprene and monoterpene are predicted to increase by global warming. Further analysis on the possible impacts of these gases on the atmosphere is needed since their reactive rates may increase. To address these issues combined research and integrated analysis by in-situ observations, satellite observations and model simulation should be advanced. Coupled observations of greenhouse gases and reactive gases may provide further added value of the research by the AsiaFlux community (A. Tani).

The comments and suggestions by the panelists provided all participants to consider more about their future activities in research and networking in our region and globally. We also shared the feeling that young generation is the engine of AsiaFlux which has a role to advance the science and deliver the data and knowledge to other scientific disciplines as well as to contribute to sound decision making on our environment under climate and societal changes.

Figure 1 Panelists of general discussion (Photo by Mr. Narita of NIES)

General Discussion

Lessons learned and next design

Achievements and lessons learned in 20 years

- Fundamental concept was proposed 20years ago
- Numbers of obs. sites, data sharing, integrated analysis, models, link between in-situ and satellite data
- What do we want to see in the future?

Challenges – future research and obs. themes/targets

- Greater needs to carbon, water and GHG research
- Network research
- Advanced technology (measuring systems, new models, machine learning, etc.)

Recent arguments for terrestrial observations

- Coordinated (systematic) observations – cross disciplines, multiple platforms
- Essential Climate Variables, Essential Biodiversity Variables

Opportunities by broadening and strengthen the network

- Intra- and inter- regional cooperation
- Network with other networks (LTER, BON, etc.)

Figure 2 Summary of discussions

Part 3: Summaries of Young Scientist meeting

AsiaFlux 2019 Young Scientist Meeting

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National Agriculture and Food Research Organization, Japan

Introduction

"*The key of success is to give and take the technical information, the data themselves and the method of data analysis under the spirits of equality and reciprocity*" – Dr. Gen Inoue wrote in the first AsiaFlux Newsletter (Inoue, 2002). Inspired by his words, the Young Scientist Meeting hosted an activity to share our opinions on 'a good scientist', hoping that our thoughts will supplement the legacy of AsiaFlux toward the next generation.

Messages from guest speakers

A good scientist is someone who is curious about the world around him/her. This person addresses this curiosity by conducting a set of experimental measurements and theoretical calculations to test hypotheses about how the world functions. And this person completes the work by writing about the research so others can learn about what was found and by becoming a better scientist through the give and take of peer review.
Dr. Dennis Baldocchi

A good scientist is one who is never happy with the easy answer and is ready to change position and idea. Furthermore, a good scientist is one who does not see the colleagues as competitors but as collaborators and for this reason shares with them data and tools in name of scientific progress.
Dr. Dario Papale

How to be a good scientist:
Be aware of your biases and be aware that you cannot control all of them (Moss-Racusin et al., 2012). Be generous with your data and code (It's not *your* data.) (Piwowar et al., 2007; Piwowar and Vision, 2013). Practice reproducible, transparent science (Wilson et al., 2014). "*Everyone here is smart. Distinguish yourself by being kind*" (Powell, 2018)
Dr. Benjamin Bond-Lamberty

Messages from participants

A good scientist is one who can maintain strength, both physically and mentally. Persons with healthy body and mind can stay positive, appropriately competitive, and considerate to others beyond their community. Also, the person does not forget to smile to colleagues, friends, and family.
Hiroki Ikawa (Organizer)

A good scientist is one who is curious. Be curious about the world around you. If you see something interesting, find out how it works and why it is that way. And not just in your field of interest. We often pull ideas from Economics and technology from the Maker community to help us understand ecosystems.
Joe Verfaillie (University of California, Berkeley, Contributor to the 'good scientist' task)

In the following sections, I categorized participants' messages about how good scientists would obtain their ideas, how their personality would be, and how their ability would contribute to the advancement of science. Some contents may be similar and I intentionally kept original messages from each participant as possible.

Idea

A good scientist is one who is curious, confident, critical, as well as persistent about what they do. A good scientist is one who is questioning with commonsense and visualizing the unseen. A good scientist is one who is able to find an interesting topic with a long-term vision. A good scientist is one who keeps different point of view in mind and anytime even if when someone criticizes or deny one's data that the one considers is correct. We should be aware of that that human tends to consider what we are doing is correct. Someone may have another perspective. A good scientist is one who can enjoy thinking about new ideas, pick up ideas (eg, analysis method) from other research fields and be tough even in the face of a lot of errors. A good scientist is one who can think widely about research. A good scientist is one who creates ideas and connect them with each other. A good scientist is a flexible thinker (meaning: is comfortable being wrong and is not beholden to a particular idea, set of hypotheses, or methods; is able to update thinking according to data & discovery). A good scientist is one who approaches the world with curiosity.

Personality

A good scientist is one who is not afraid of changing former knowledge, his/her study area, and himself/herself. A good scientist is one who can be persistent. A good scientist is one who is honest with data, results, and team members. A good scientist is one who is responsible for students. A good scientist is one who is independent but good at corporation. A good scientist is one who is able and willing to continuously learn new things in honest and admit mistakes, lack of knowledge or skills. Someone who is critical both for others and their own work and data to understand how and why things work. Someone who is passionate about inspiring the view and understanding and willing to share his/her insights and within the community. A good scientist is one who can inspire people. A good scientist is one who never stops contributing to the advance of science. A good scientist is one who is detail-oriented. A good scientist is one who is self-motivated. A good scientist is one whose mother is proud of him/her with respect to their research. A good scientist is one who has a passion to know the truth and put all his/her effort on it. A good scientist also should be able to separate his/her sets of belief from the fact. To do this he/she must be able doubt whatever he/she already know in order to know something with absolute certainty and be open to new ideas. Never stop learning. I choose the word passion as opposed to curiosity because I believe passion derives performance and keep us going even when things are hard. A good scientist is one who likes own research themes. A good scientist is one who never gives up seeking the results of what they want to reveal. A good scientist is one who is going high-quality work and likes sharing. A good scientist is one who inspires people who do not know science well also. A good scientist is one who has high curiosity and be patient during research and communicate science to the public. A good scientist is one who understands his or her work very well and shares the findings for common good. There is no end in learning and continuous curiosity even if one experience failures. A good scientist is one who is curious, generous with their time and data, creative and kind. A good scientist is one who is always curious and is always trying to understand how things work. A good scientist is also someone who seeks to find better ways to communicate their research to the general public. A good scientist is one who is honest, confident in what they know, and open to collaboration. Scientists must above all be honest and transparent, there can be no higher crime in science than deceit, theft of data, or omitting another's contributions to a body of work. Good scientists do not pretend to be experts in all fields but are confident of what knowledge they do have as well as open about their limitations. Since one cannot expect to be an expert in everything, good scientists are also receptive to offers to collaborate. The very best scientists bring many experts together to answer a question which is beyond the skills any of them possess alone. A good scientist is one who considers errors as part of the learning process, an explorer, with curiosity as impulse. A good scientist is well-organized.

Ability

A good scientist is one who is efficient in time for themselves and others. A good scientist is one who is ready to take a chance. A good scientist is one who is alert. A good scientist is one who can see things from others perspective and able to analyze it and translate it into words in other societies. A good scientist is one who conveys their word with more heartily and harmony with diligence and curiosity. A good scientist is one who can change what we see in the world. A good scientist is one who is highly productive and responsible and keep going. A good scientist is one who can lead us to the next step of the topic. A good scientist is one who has a high view point and does not hesitate to work on the ground. A good scientist is one who makes mistake to find. A good scientist is one who creates ideas and connect them with each other. A good scientist is one who is good at presentation. A good scientist is one who works with good scientists to grow in science to understand and solve problems and challenges faced by humanity. And who works to translate disagreements in nature into manageable challenges. A good scientist is one who writes good papers. A good scientist is one who takes interest in many various things. A good scientist is one who knows all the details of his/her science including even values of coefficients used in measurements and models, and the person can also output publications. A good scientist is one who doesn't intend to fatten the volume of science, but rather increases its treasure. Making society to have much less to read and much more to reap. A good scientist seeks complete the story & is patient enough to delve deep works collaboratively and appreciates a diversity of expertise and experience in colleagues.

Acknowledgment

This activity was not possible without Mr. Joseph Verfaillie who encouraged our activity and helped collecting some messages included in this report. I thank Dr. George Burba and Dr. Kaoru Tachiiri for participating in the meeting. Dr. Burba commented that *persistence* is an important quality as a scientist in industry in addition to the factors mentioned by invited speakers. Dr. Tom Avenson reminded me of Platt (1964) and the article was introduced at the meeting. This activity was supported by the AsiaFlux steering committee members, in particular, Dr. Ryuichi Hirata, Dr. Taku M. Saitoh, and Ms. Yukimi Nakata.

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Figure 1 Young Scientist Meeting (Photo by Mr. Narita of NIES)

Part 4: Highlight Graduate Student or Young Scientist

Highlight Graduate Student

Jiangong Liu

My name is Jiangong Liu, a fourth-year Ph.D. student studying at The Chinese University of Hong Kong. As an environmental scientist, I have been working on a project measuring carbon exchange between the atmosphere and mangrove ecosystems in Hong Kong. My strategies are based on eddy covariance measurements, wavelet analysis, information theory, and some machine learning algorithms. I used to play with process-based models to estimate CH_4 emissions from natural wetlands during my mater programme.

Blue carbon refers to the carbon stored and sequestered at vegetated coastal wetlands, like mangrove forests, salt marshes, seagrass


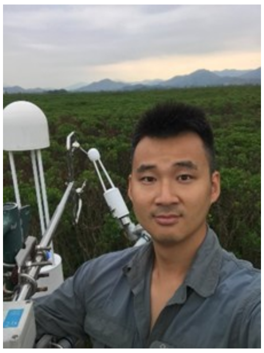


Figure 1 Jiangong Liu work in the field site at Mai Po Nature Reserve in northwest of Hong Kong

beds. Currently, people are increasingly recognizing the powerful ability of blue carbon ecosystems to uptake and store atmospheric carbon in their biomass and sediments. There are two main reasons for that. First, these coastal wetlands are storing large amount of carbon owing to their waterlogged environments. The carbon density can be five times as high as terrestrial forests. Second, their carbon sequestration rate per area is the highest among all natural ecosystems. In summary, these amazing wetlands are pumping atmospheric carbon from the atmosphere to their habitats at a high rate, meanwhile they can secure the carbon for a long time. Currently, some existing greenhouse gas mitigation schemes, like Reduced Emissions from Deforestation and Degradation and Global Commission on Adaptation, as well as Nationally Determined Contributions made for Paris Agreement, have prioritized climate policy to mangrove conservation and restoration.

Our study site is located at Mai Po Nature Reserve in northwest of Hong Kong (Figure 1). It is a subtropical estuarine mangrove wetland, representing the single largest mangrove stand at Hong Kong, and the sixth in China. The dominant tree species, *Kandelia Obovata*, is one of the most typical mangrove species in Southern China. We began to collect flux information including CO_2, CH_4, water and energy since February 2016. Long-term and continuous measurements of the fluxes can provide us the information regarding how their variations look like at different time scales. Furthermore, we compare the fluxes with meteorological and hydrological variables to investigate the controlling drivers of major greenhouse gases CO_2 and CH_4. Thus, we can better predict the climate benefits of mangroves in a changing environment. Our research results demonstrate that the mangroves at Hong Kong have a similar annual carbon sequestration rate with other mangroves in Southern China. They are among the most productive ecosystems. The Hong Kong mangroves are a stronger carbon sink during dry seasons rather than wet seasons. Together with other findings over the world, it is suggested that this counterintuitive seasonal pattern of CO_2 uptake can be universal for mangroves. The seasonality is dominated by a mechanism that the carbon stored in plant biomass and sediments is highly sensitive to temperature. Therefore, a climate warming may largely weaken the ability of mangroves in absorbing and storing carbon.

The processes associated with CH_4 emissions in wetlands have been widely described as non-linear, scale-emergent and asynchronous. Pairing CH_4 fluxes and their biophysical drivers using traditional statistical methods may not work well for a coastal wetland. In our study, we introduce random forest, wavelet decomposition and information theory to address the puzzle. Wavelet analysis can decompose the signals into different time scales, and then random forest and information theory take advantage of that and analyze data without linear assumptions and add temporal direction to the result. Our findings challenge the traditional thought that mangroves are a minor CH_4 source. The radiative forcing induced by CH_4 emissions can offset 26% to 54% of the carbon sequestration rate of mangroves, over decadal to centennial time horizons. Meteorological (e.g. temperature) and biophysical variables (e.g. GPP and latent heat) dominate CH4 variations at shorter daily periods, whereas hydrological variables (e.g. salinity and dissolved oxygen) determine them at longer multi-day periods. In the future, the changing environments including global warming, eutrophication, decreasing salinity and extreme weather may reduce the cooling potential of this subtropical mangrove.

Here are some of my opinions on doing research. For the people like me who are doing ground-based measurements, the very first thing we need to do is to know our study site. It is important to know the unique and universal characters of each site. A full understanding of study sites underpins every of our next moves, and all good research stories come from it. Another interesting thing in doing science is to test those long-standing assumptions with your own data. For example, mangroves have been regarded as a prime candidate in forest restoration because of its significant contribution to sequestrate CO_2, on the other hand, their CH_4 emissions are assumed to be negligible due to the saline environment. However, our study tells people it may take a high cost of CH_4 during mangrove restoration if we ignore the hydrological condition. To verify if our data march, or partly march or mismatch the existing theory may help us understand what we have known and what we need to know. Last, as climate scientists, we should also have the skills to present our work to different people and let them know what is happening to our planet.

The next step of my research would be to combine satellite images, global carbon and water data sets, machine learning tools and process-based models for a better understanding of global carbon-water-climate cycling. It would be a great challenge for me to upscale my knowledge from a specific ecosystem to the global. I am looking forward to making use of all the fancy tools.

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Highlight Graduate Student — *Tsukuru Taoka*

I am Tsukuru Taoka from Japan and 23 years old. I lived in Mino city, Osaka-fu, Japan, until I was 18. Now, I study in laboratory of micrometeorology, Shinshu University, Matsumoto city, Nagano Prefecture, Japan. I am a first-year master's student. I am honorable to receive the 'student best poster award'.

My major is micrometeorology. Our main work is measuring methane flux from a mid-latitude shallow lake using eddy covariance technique (Figure 1a). Along with the flux measurement, we also collect lake water (Figure 1b), bubble (Figure 1c) and the sediments (Figure 1d) for analyzing methane concentration, because it is important to understand methane dynamics in the sediments and lake water to know the controlling mechanisms of methane emission.

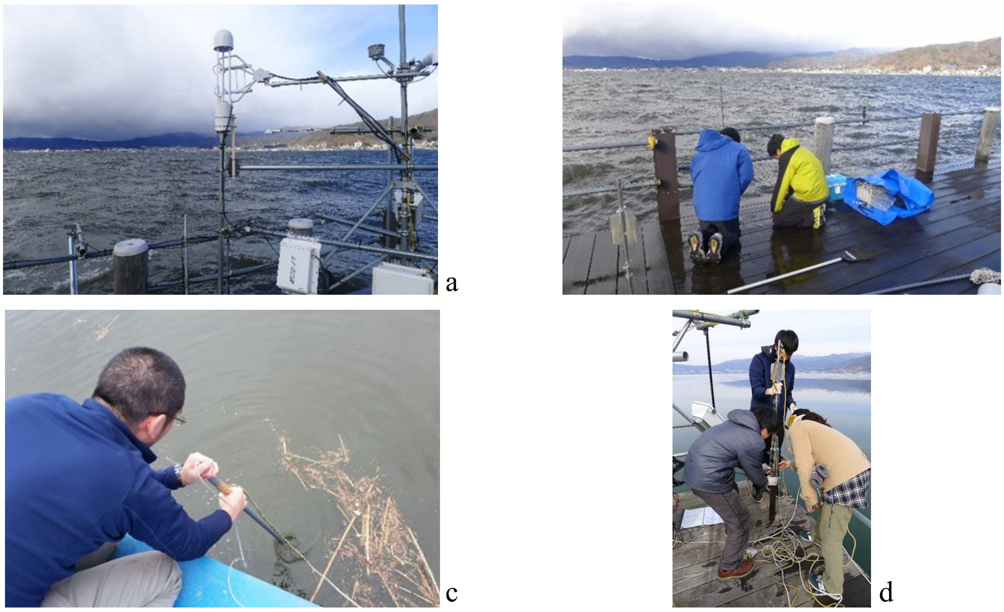

Figure 1 Measurements (a: eddy covariance system; b: water sampling; c: methane bubble collection; d: sediment sampling) in Lake Suwa

Methane is an important greenhouse gas. In lakes, methane is produced in anoxic sediments by methanogenic bacteria, and emitted to the air via diffusion and ebullition. Previously, floating chambers and funnels were generally used for measuring methane flux from lakes. However, these methods cannot detect the sub-dairy change of methane emission due to their limited time resolution. Also, the spacial coverage of eddy covariance technique is larger than floating chambers and funnels. So, we used eddy covariance technique to detect the sub-dairy change in methane emission, and analytically partitioned total methane flux into diffusive and ebullitive flux. The analysis period is September 2017 to August 2018. On seasonal scale, both diffusive and ebullitive flux became highest in the summer due to enhanced methane production in the sediments. Diffusive flux increased with increasing wind speed due to enhanced gas transfer efficiency, and it became highest in the afternoon when wind speed is also high. Also, it became higher in the summer than in the winter due to higher dissolved methane concentration in surface water. Ebullitive flux showed clear diurnal variation with highest in the morning and lowest in the afternoon though such a variation was relatively obscure in the summer. In the winter, the amount of bubble accumulated in the sediments would be generally too small to be emitted to the air in the afternoon due to slow methane production. However, such a limitation of ebullition was not seen in the summer. From these results, we should consider the bubble accumulation in addition to the triggers of ebullition.

Our major study site, Lake Suwa, is located in the center of Nagano, and it is also surrounded by mountains. It takes about 1.5 hours by car from Matsumoto to Lake Suwa. Lake Suwa is famous for a display of fireworks held in summer. In the event, about 40,000 fireworks can be seen, and about 500,000 people visit Suwa to see the fireworks. In Lake Suwa, an ice ridge called *omiwatari* (Figure 2b), literally god's footsteps, is formed on the surface of the lake in winter. *Omiwatari* has been recorded for more than 600 years. From the record, it is clear that the frequency of this phenomenon is decreasing in these days, and it is said to be the result of global warming. In the winter of 2018, *omiwatari* was seen for the first time in 5 years. The whole surface of the lake is covered with ice in winter (Figure 2a). In this site, steady methane bubble emitted areas are observed in the north of the mast. From this area, clearly high methane emission is observed. The wholes on the ice are created due to steady methane bubble emission. We are studying the controlling factors of methane emission from Lake Suwa, a mid-latitude shallow lake. We go to Lake Suwa at least once a month for maintenance and sampling. I would like to briefly introduce our research. This is based on my bachelor thesis.


a


b

Figure 2 Lake Suwa in winter (a: ice cover the lake; b: *omiwatari* in the lake)

For more precise estimation for the emission of greenhouse gases from lakes, flux measurements in several conditions are necessary. I am now engaged in verifying and modifying the model of methane emission via diffusion and ebullition for more accurate estimation. In 'young scientist meeting' held on October 3, we discussed on how a good scientist should be. My group finally came to the idea that a good scientist is one who can open up new field by challenging and keep questioning. I will work harder in order to become such a good scientist.

Tsukuru Taoka
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Part 5: Short essay from Invited researchers

Regional leaders responsible for the next generation of AsiaFlux network in Southeast Asia (SEA)

Amnat Chidthaisong
AsiaFlux Steering Committee members
The Joint Graduate School of Energy and Environment,
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Participating in the "AsiaFlux2019 -20th Anniversary Workshop-" in Takayama this October, I am very delighted to see the active participation of young researchers from Asian countries. In fact, nurturing young scientists in flux-related research fields have been given one of the AsiaFlux priorities since its establishment many years ago. A training workshop at every annual AsiaFlux meetings has provided a great opportunity for young scientists to gain new knowledge and development, as well as to get to know young scientist from other countries. Young participants become the valuable and essential seeds for our AsiaFlux networks and future collaborations. Advancement in researches related to exchanges of carbon dioxide, water vapor, and energy between terrestrial ecosystems and the atmosphere across daily to inter-annual time scales needs their active participation and contribution.

I myself is one of those who have received training from AsiaFlux network (I was trained at AsiaFlux Training Course 2006 on Micrometeorology in Tsukuba, Japan). When coming back to Thailand, together with colleagues we launched the eddy tower network, today known as a "ThaiFlux". At the beginning I can say that no researcher in Thailand who works on eddy tower and on monitoring the exchanges of carbon and other elements at ecosystem level. Building capacity for our young researcher was thus one of the priorities. Since then we have been trying hard to push for capacity building of young researchers in Thailand. Without supports through various activities of AsiaFlux, we would not be able to pursue our research on ecosystem carbon and energy exchanges as it is of today. Furthermore, we now can reach out to support many young scientists from and collaborated with those in SEA region such as Myanmar, Laos, Cambodia, Philippines, Malaysia, Indonesia, and Vietnam. We have hopes that in the near future we could connect them together and become a real "regional network" in Southeast Asia.

I would like to encourage young researchers in SEA to join our regional network. We have so many interesting research topics that we can work together. SEA is situated between the southwestern Pacific Ocean and eastern Indian Ocean. This makes SEA exposed to various multi-scale meteorological features, including ENSO, MJO, Rossby wave, tropical cyclones and isolated convection. We now know that these features are subject to change as global warming is escalated. Vegetation in SEA is also highly diverse and its responses to climate change is still poorly understood. On top of these, SEA is one of the fastest growing economic regions in the world. This leads to a rapid change of land-use and intensification of atmospheric pollutants, causing a change in atmospheric composition and affecting ecosystem processes. In fact, deforestation rate in SEA has been very high and forest regeneration has made secondary forest a majority in SEA. From these unique characteristics, we can imagine that SEA is hosting one of the most complex land-ocean-atmospheric systems in the world. How climate change and variability affect to these complex systems especially the tropical forest of SEA, and how these have the consequences to our sustainability development are still poorly understood. Filling such knowledge gaps requires a continuous and highly interdisciplinary science team working as a multi-institutional-international research network. We need the young to participate in our SEA ecosystem research network and contribute to the advancement of science and sustainable development of our region.

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Figure1 starting from the left; Prof. Chidthaisong, Dr. Hirata and Dr. Kho at Banquet

Part 6: Introduction of next conference

Welcome to attend next AsiaFlux 2020 in Malaysia

Lulie Melling, Angela Tang
Sarawak Tropical Peat Research Institute (TROPI)
Lot 6035, Kuching-Kota Samarahan Expressway, 94300 Kota Samarahan Sarawak, MALAYSIA

In 2020, the AsiaFlux Conference moves to the southeast of Asia, and more specifically to Kuching. Kuching is the capital city of Sarawak, the largest state of Malaysia situated on the island of Borneo. Sarawak is a home to a wide range of nature and cultures, and Kuching is the ideal base for exploring Sarawak. The nearby national parks include the Bako - Sarawak's oldest national park featuring multiple biomes including rainforest, Gunung Gading - home to Rafflesia, world's largest flower, Kuching Wetlands - a fascinating mangrove ecosystem, Kubah – mixed dipterocarp forest which is known for its diversity of palms and orchids, and Semenggoh Wildlife Center - an orangutan rehabilitation centre and sanctuary.

The next AsiaFlux Conference will be held on 22-24 September 2020. The conference is jointly organized by Malaysian Peat Society (MPS), Sarawak Tropical Peat Research Institute (TROPI) and AsiaFlux Science Steering Committee, in collaboration with National Institute for Environmental Studies (NIES) and Hokkaido University of Japan, and supported by Sarawak Convention Bureau.

AsiaFlux 2020 is a prestigious event organized with a motivation to provide opportunities for the delegates to present their most recent research activities, to exchange new ideas and experiences, to establish research relations and to explore possibilities of collaborative research. With the conference theme, "The Nexus of Land Use Change, Ecosystems & Climate: A Path towards Sustainable Development Goals (SDGs)", we intend to make this Conference as the platform to raise awareness to the Government, the Industries and the People especially potential young scientist from Southeast Asia such as Indonesia, Philippines, Thailand and Vietnam on the importance of GHG cycling in guiding sustainable land use policies in the region. Together with several invited talks from internationally renowned scientists, training course, young scientist meeting and tropical excursion, AsiaFlux 2020 will offer a rich, stimulating and enthralling programme.

Social events will also be an important part of AsiaFlux 2020. Besides having a chance to schmooze with colleagues and new acquaintances in an informal atmosphere, you will be able to enjoy an extensive variety of mouth-watering local delicacy and traditional cuisine.

In 2020, Sarawak TROPI will be celebrating our 10th anniversary of flux tower measurements. Thus, we are very excited and looking forward to welcoming you in Kuching next September!

Find more information at the conference website:https://www.asiaflux2020.com/index.php

From Editor

This issue of AsiaFlux newsletter mainly reports the AsiaFlux2019 -20th anniversary workshop -.

In this successful workshop, many new and excited researches and results were showed. The great development of AsiaFlux in last 20 years will encourage young scientists to get excellent achievements in future.

I am so glad I am a member in this community and make my effort to the development.

At last, I am so glad I have the chance to edit the newsletter. Thanks Ms Yukimi Nakata for her help. Thanks the contributions of Prof. Guirui yu, Prof. Takashi Hirano, Prof. Taku M. Saitoh, Prof. Dennis Baldocchi, Dr. Benjamin Bond-Lamberty, Dr. Ryuichi Hirata, Dr. Munemasa Teramoto, Dr. Hideki Kobayashi, Dr. Tomomichi Kato, Prof. Hiroki Iwata, Prof. Kazuhito Ichii, Prof. Hiroyuki Muraoka, Dr. Hiroki Ikawa, Mr. Jiangong Liu, Mr. Tsukuru Taoka, Dr. Amnat Chidthaisong, Prof. Lulie Melling, and Ms Angela Tang to the newsletter.

The Editor of AsiaFlux Newsletter No. 41

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