iLEAPS-Japan 研究集会 2024

大気－陸面プロセスの研究の進展：観測とモデルによる統合的理解

要旨集*

開催日　：2024 年 9 月 26 日(木)・27 日(金)

場所　　：名古屋大学　研究所共同館 II ・409 室

主催　　：名古屋大学宇宙地球環境研究所・日本学術会議 iLEAPS 小委員会

※(兼)

名古屋大学宇宙地球環境研究所

令和 6 年度共同利用・共同研究（研究集会）

報告書

開催趣旨

iLEAPS（Integrated Land Ecosystem-Atmosphere Process Study：統合陸域生態系—大気プロセス研究計画）は、大気と陸域の境界で発生する物理的、化学的、生物学的な過程についての理解を深めることを目的とした国際的な研究計画です。iLEAPS は、持続可能な社会構築を目指す国際研究プラットフォーム「Future Earth (FE)」のグローバルリサーチプロジェクト（GRP）の一部として位置づけられています。日本においては、日本学術会議の環境学委員会・地球惑星科学委員会による FE・WCRP 合同分科会の下部組織として、iLEAPS 小委員会が設けられています。

このプロジェクトでは、野外観測、広域モニタリングデータの解析、数値モデル開発など、様々な手法を用いて研究が行われています。これにより、個葉レベルの環境応答から地球規模の変動に至るまで、多様な時間・空間スケールでの理解が進められています。iLEAPS の目標は、これら多岐にわたる研究手段から得られた知見を統合し、より深い理解を目指すことです。

本研究集会では、大気－陸域プロセスに関心を持つ研究者が集まり、各自の最新の研究成果を共有し、統合的な理解を深めるための議論を行います。特に、観測データと数値モデルを組み合わせたアプローチによる理解の進展に焦点を当て、気候変動予測研究の推進に向けて今後必要な取り組みについて議論する予定です。

文責：佐藤永（海洋研究開発機構）

iLEAPS-Japan2024 研究集会　プログラム

9 月 26 日（木）

14:00～14:05 主催者挨拶と主旨説明（佐藤永、本大会実行委員長）

14:05～14:10 ロジ説明（檜山哲哉、本大会会場係）

セッション 1、座長：佐藤永（JAMSTEC/東京大学）

14:10～14:30 渡辺泰士 [Yasuto WATANABE] (気象庁気象研究所) ほか 5 名
Trend and variability of the land carbon cycle simulated by the MRI-LPJ dynamical global vegetation model

14:30～14:50 中川樹 [Tatsuki Nakagawa] (北海道大学) ほか 2 名
Rice yield reconstruction in the Asian region over the past 100 years through optimizing parameters in the process-based crop model MATCRO

14:50～15:20 佐藤永 [Hisashi SATO] (JAMSTEC) ほか 2 名
Reconstructing spatiotemporal dynamics of mixed conifer and broad - leaved forests with a spatially explicit individual - based dynamic vegetation model

15:20～15:35 休憩

セッション 2、座長： 近藤雅征（広島大学）

15:35～16:00 伊藤昭彦 [Akihiko ITO] (東京大学)
A near-real-time global simulation system of land-atmosphere gas fluxes: a prototype of VISIT-JRA3Q

16:00～16:20 田口琢斗 [Takuto TAGUCHI] (国環研) ほか 2 名
Understanding the impact of high-temperature events on carbon balance in northern mid-to-high latitude regions

16:20～16:40 近藤雅征 [Masayuki KONDO] (広島大学)
Seeming weakening of land CO_2 uptake due to climate and land-use changes

16:40～16:50 第一日目・総括

18:00～20:00 懇親会 (レストラン花の木 052-783-8707) 懇親会担当者：高梨聡（森林総研）

9 月 27 日（金）

セッション 3、座長：伊勢武史（京都大学）

09:00〜9:20 内藤千尋 [Chihiro NAITO] (東京大学) ほか 1 名

Detecting satellite SIF time series change as resilience metrics over 20 years in Malaysia and Indonesia

9:20〜9:40 魏辰然 [Chenran WEI] (名古屋大学) ほか 7 名

Characteristics of the Fluorescence of Water-Soluble Organic Matter in Atmospheric Aerosols in Wakayama

9:40〜10:00 CHEN Zhanzhuo (北海道大学) ほか 8 名

Process-Based modeling of BVOC emissions from forest ecosystem with validation at two monoterpene observation sites.

10:00〜10:20 伊勢武史 [Takeshi ISE] (京都大学) ほか 2 名

Detecting graminoids in wetlands: a method with UAV and deep learning

10:20〜10:30 第二日目・総括、閉会の挨拶

10:45〜11:30 第 26 期・第 2 回 iLEAPS 小委員会（小委員会メンバーのみ参加・非公開）

※発表は、各議題質疑込み 20 分 or 25 分 or 30 分

会場のご案内

名古屋大学東山キャンパス 宇宙地球環境研究所 研究所共同館 II・409 号室(地球水循環共用室)

https://www.isee.nagoya-u.ac.jp/directions.html

発表要旨

Trend and variability of the land carbon cycle simulated by the MRI-LPJ dynamical global vegetation model

Yasuto Watanabe[1*], Makoto Deushi[1], Seiji Yukimoto[1], Yukimasa Adachi[1], Masahiro Hosaka[1], Hiroyuki Tsujino[1]

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Background

The land ecosystem responds to the anthropogenic climate change and increase of atmospheric pCO2, so it is fundamentally important in estimating future carbon budget and climate change. It also responds to the interannual climate variability related to the El Niño-Southern Oscillation (ENSO), which would help constrain the response of the land carbon cycle to future climate change (Cox et al., 2013). In the Meteorological Research Institute, the Meteorological Research Institute Earth System Model MRI-ESM2.0 has been developed and contributed to the CMIP6 model intercomparison (Yukimoto et al., 2019). MRI–ESM2.0 is superior in reproducing the surface air temperature, and the model also includes the land carbon cycle model. However, it tended to overestimate the gross primary production (GPP) and leaf area index (LAI), leading to the net land carbon absorption being higher than other models.

Methods

In this study, we developed a dynamical global vegetation model MRI-LPJ model, which is developed based on the LPJ-LMFire model (Pfeiffer et al. 2013), for improving the land carbon cycle coupled to the MRI-ESM2.0 (Yukimoto et al., 2019). We drive the offline version of the MRI-LPJ model by daily meteorological data based on JRA-3Q (Kosaka et al., 2024), which is an up-to-date reanalysis data of the Japan Meteorological Agency, and simulate the variability of the land carbon cycle from 1948 to 2015. We also run the model with and without the changes in the atmospheric pCO2 to elucidate the impact of the CO2 fertilization effect on the modern land carbon cycle.

Results

Using the MRI-LPJ model, the reproduction of the present GPP and LAI was improved especially in the tropics when compared with the previous land carbon cycle model employed in the MRI-ESM2.0. On the other hand, the GPP and LAI at the high-latitude regions of the northern hemisphere exhibited values higher than observation-based estimations (e.g., Zhao and Running 2010). The GPP estimated using JRA-3Q meteorological data increased by nearly 20% from 1948 to 2015, which is associated primarily with CO2 fertilization effect in the tropic regions. The interannual variations of the net ecosystem productivity (NEP) was consistent with the results of the previous studies (Sitch et al. 2008; Zhang et al., 2016). When El Niño events occur, NEP decreases primarily in the northern part of South America, resulting in the net CO2 supply to the atmosphere. When La Niña events occur, on the other hand, the opposite pattern of the case of El Niño events was observed in South America, while the responses in Africa were similar to the pattern of the case of El Niño.

Discussion

In this study, the variability of the modern land carbon cycle was reproduced using the MRI-LPJ model. The MRI-LPJ model has already been coupled to MRI-ESM 2.0 and the next-generation Earth system model that is currently under development at the Meteorological Research Institute. These Earth-system models include the atmospheric ozone chemistry model, and thus this would allow us to investigate the interaction between land vegetation, global carbon cycle, and tropospheric ozone chemistry in the future.

References

Cox et al. (2013). *Nature*, 494(7437), 341-344.; Kosaka et al. (2024). *J. Met. Soc. Japan. Ser. II*, 102(1), 49-109.; Pfeiffer et al. (2013). *Geosci. Model Dev.*, 6(3), 643-685.; Sitch et al. (2008). *Global Change Biology*, 14(9), 2015-2039.; Yukimoto et al. (2019). *J. Met. Soc. Japan. Ser. II*, 97(5), 931-965.; Zhang et al. (2016). *Geophys. Res. Lett.*, 43(4), 1607-1614.; Zhao and Running (2010). *Science*, 329(5994), 940-943.

Rice yield reconstruction in the Asian region over the past 100 years through optimizing parameters in the process-based crop model MATCRO

Tatsuki Nakagawa[1*], Tomomichi Kato[2], Yuji Masutomi[3]

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Abstract

Rice yield in Asia have more than doubled over the past 100 years (Teng, Paul P. S., et al. 2016). Meanwhile, since the Industrial Revolution, the global mean surface temperature has increased by approximately 1.26℃, and atmospheric $CO2$ concentration has risen by over 100 ppm since the post-war period (IPCC, 2021). These changes in climate conditions have had various impacts on rice production (Zhao et al., 2016; McGrath & Lobell, 2013). At the same time, crop improvements have been a significant factor in increasing yields (Miflin, 2000). However, the precise contribution of these improvements to yield increase has not been clearly quantified.

The aim of this study is to quantify the impact of climate change and breeding improvements on rice yield in Asia. Using the process-based crop model MATCRO (Masutomi et al., 2016), we reconstructed regional rice yield over the past 100 years and evaluate the contributions of these factors.

We have collected paddy rice yield statistics at the prefectural level in the Asian region from various references. Based on these datasets, we optimized seven parameters in MATCRO related to leaf thickness, temperature tolerance, and photosynthetically assimilated carbon allocation for reconstruction. We used the Bayesian Optimization method, conducting the optimization in 20-year windows, going back in 10-year intervals. The objective function was set as follows:

$$objective\ function = \frac{RMSE}{Var_{obs}} = \frac{\sqrt{\frac{1}{20}\sum_{i=year\_st}^{year\_ed}(sim_i - obs_i)^2}}{\frac{1}{20}\sum_{i=year\_st}^{year\_ed}\left(obs_i - \overline{obs}\right)^2}$$

where Var_{obs} is the variance of observation, RMSE is derived from the difference between simulation and observation, and year_st and year_ed are the starting and ending years for each optimization window, respectively.

The optimization result for Gyeonggi-do in South Korea is shown in Figure 1. Challenges remain in reconstructing the yield during the periods when the transition from rain-fed to irrigated farming occurred. Moreover, while single-cropping regions allow for more accurate reconstruction by optimizing phenological parameters, multi-cropping regions, particularly those with three crops per year, present difficulties due to the lack of specific yield data per cropping cycle, as yields are typically recorded on an annual basis.

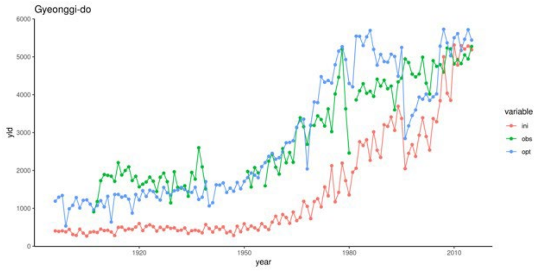

Figure 1. Optimization result for Gyeonggi-do, South Korea.

Our study is still in the experimental phase, and we are considering which regions to target for optimization.

Day 1, 14:50~15:20

Reconstructing spatiotemporal dynamics of mixed conifer and broad‐leaved forests with a spatially explicit individual‐based dynamic vegetation model

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A dynamic vegetation model was adapted to a mixed forest of deciduous broad-leaved trees and evergreen conifers in Hokkaido, the northernmost main island of Japan, located within a transition zone between cool temperate and sub-boreal forest ecosystems. In this forest, elevation and a terrestrial-wetness index affect tree biomass and the percentage of conifers. We maximized agreement between this observed pattern and model output by calibrating parameters that control drought and excessive soil-moisture tolerance, establishment rate, and background mortality rate. In the simulation, biomass increased as a single peak curve with simulation year, while the percentage of conifers increased until the end of 200 simulation years. The 75-year simulated forest was most comparable to the adapted forest, consistent with the average frequency of catastrophic storm disturbances in Hokkaido. The model also reconstructed a reasonable succession pattern based on temperature and soil moisture. Therefore, the model mechanistically reconstructed the mixed forest via spatial niche segregation and succession after catastrophic disturbances. However, the model did not reconstruct the percentages of broad-leaved trees and conifers of forests prior to the disturbance in independent validation plots, demonstrating that additional processes should be considered in future models.

Reference

H. Sato, M. Shibuya and T. Hiura (2023) Reconstructing spatiotemporal dynamics of mixed conifer and broad‐leaved forests with a spatially explicit individual‐based dynamic vegetation model. Ecological Research 2023 Vol. 38 Issue 3 Pages 465-478

Acknowledgments

We acknowledge funding provided by the Arctic Challenge for Sustainability II (ArCS II) JPMXD1420318865 and the Japan Society for the Promotion of Science KAKENHI (Grant Numbers 22H02378, 21H05316, and 26292076).

Day 1, 15:35~16:00

A near-real-time global simulation system of land-atmosphere gas fluxes: a prototype of VISIT–JRA3Q

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A near-real-time analysis becomes increasingly important not only for short-lived climate forcers including air pollutants but also for long-lived greenhouse gases. For example, a quick analysis of the high CO_2 growth rate in 2023 was conducted by the GCP task force using available observational data and model simulations, implying the importance of anomalous land budgets such as surge emissions from mega-fires. Such a quick analysis is also effective for policy-relevant issues to detect the footprint of human activities.

In this study, a prototype of a near-real-time simulation system of land fluxes is presented. Atmosphere-land ecosystem fluxes of CO_2 and CH_4 are simulated using a process-based model, VISIT (Vegetation Integrative SImulator for Trace gases), at a 1-hour time step. Meteorological data are derived from the third-generation reanalysis of the Japan Meteorological Agency covering three-quarters of a century from September 1947 to the present (JRA-3Q; Kosaka et al., 2024). Note that there are alternative choices of meteorological data, the ERA5 and MERRA2. The present prototype system has a spatial resolution of a quarter degree for consistency of land-use data (LUH2) and therefore the JRA-3Q data originally produced using a TL479 data assimilation system are converted into the land model grid system.

Several technical issues should be solved. First, the JRA-3Q data is provided in wgrib2 format from the DIAS and the University of Tsukuba. Alternatively, the data is also provided in NetCDF format, which is more flexible and widely used, from the U.S. National Center for Atmospheric Research. The prototype system adopts the NetCDF data and then requires a corresponding interface to directly read it. Second, to realize near-real-time analysis beginning from an arbitrary time (typically from the end of the previous analysis), a restart routine is required to be implemented. This is also necessary to avoid conducting a spin-up simulation, which demands a heavy computational cost for each analysis run. At present, it was implemented by a routine of writing and reading whole structure variables of the VISIT. The prototype system aims at conducting a land simulation within a latency of 1 month.

There remain several technical issues. First, it is challenging to obtain satellite-derived biomass burning emissions within 1 month, although several fire products (e.g., QFED, CAMS, and GFED) are available. Similarly, satellite-derived inundation products, which are used for wetland CH_4 emissions, have a latency longer than 6 months, and model-estimated inundation is still highly uncertain. Finally, the system is expected to make a contribution to the Global Greenhouse Gases Watch by the World Meteorological Organization (WMO-G3W), as well as the 2nd UNFCCC Global Stocktake.

References

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Kosaka, Y., et al. (2024), The JRA-3Q reanalysis, *Journal of the Meteorological Society of Japan*, *102*, 49–109, doi:10.2151/jmsj.2024-004.

Acknowledgments

The study was partly supported by the Digital Biosphere Project (JSPS KAKENHI Grant No. 21H05318:) and the Environmental Research Fund S-22 of the ERCA/MOE (JPMEERF24S12200).

Day 1, 16:00~16:20

Understanding the impact of high-temperature events on carbon balance in northern mid-to-high latitude regions

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Seasonal variations in the terrestrial carbon balance across northern mid-high latitude zones are closely associated with the location, timing, and duration of temperature increases. In recent years, the frequency of high-temperature events has been reported to increase due to climate change, with predictions suggesting a further rise in the future. In the spring and summer of 2020, large parts of middle to northern Eurasia experienced an unprecedented temperature increase, recording nearly +6°C above the climatological average. However, its effect did not significantly contribute to changes in the net carbon balance of the region. This study compares high-temperature events that occurred in the regions of North America and Eurasia situated above 45°N latitude from 2001 to 2020 and evaluates their impact on the carbon balance. Monthly temperature from ERA5 reanalysis data and precipitation data from MSWEP were employed to assess high-temperature events, while FLUXCOM-RS data on gross primary production (GPP) and terrestrial ecosystem respiration (TER) were utilized to analyze the carbon cycle. Despite widespread increases in temperatures, no substantial impact on the carbon balance was identified in northern Eurasia during January-April of 2002, 2007 and 2020, because temperature increases were insufficient to activate carbon cycles in boreal regions. Although appearing less extensive, noticeable changes in carbon balance were found in a high-temperature event that occurred from May to August 2010 in western Eurasia. The high-temperature event coincided with a reduction in precipitation and a decline in the vegetation index, causing a significant reduction in GPP. The results of this study suggest that the magnitude of high-temperature events does not necessarily directly affect the carbon balance but varies greatly depending on the location, timing, and duration of events.

Day 1, 16:20~16:40

Seeming weakening of land CO_2 uptake due to climate and land-use changes

Masayuki Kondo[1]

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The rate of CO_2 uptake by land has increased since the 1960s. The “top-down” atmospheric inversions and “bottom-up” biogeochemical models that calculate the land CO_2 exchange agree that its sink strength has increased until the end of the 2000s but weakened for 2000−2022. Integrating multiple model and observational estimates, here we provide evidence that the recent weakening of global land CO_2 uptake is a spurious phenomenon, caused by decadal changes in anthropogenic forest disturbances and natural climate that coincidentally occurred during the 2000s. We find that activities of land-use, land cover changes, and forestry (LULUCF) were largely reduced for tropical ecosystems in Amazon and Southeast Asia between the 1990s and 2000s owing to national regulations but slightly increased in the 2010s. In the past 100 years of the El Niño-Southern Oscillation (ENSO) cycle, there have been two long periods without strong El Niño events, one of which was in the 2000s. The coincidental and simultaneous changes in these different processes made the 2000s a favorable environment for land CO_2 uptake. These results indicate that it only appears that land CO_2 uptake since th2000s has weakened due to a coincidental large increase in CO_2 uptake in the 2000s. Similar to the case of the land, we found that an increased ocean CO_2 uptake in the 2000s due to reduced CO2 outgassing from the ocean surface due to weakened ocean circulation is found caused by the decadal variability in ENSO. These results suggest that an over-focus on the anthropogenic impact on the carbon cycle has led to an underestimation of the impact of natural variability on land and ocean CO_2 uptake.

Detecting satellite SIF time series change as resilience metrics over 20 years in Malaysia and Indonesia

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Introduction

Palm oil is globally used in various products and industries, mostly produced in Malaysia and Indonesia across millions of hectares. However, climate change is projected to impact oil palms due to water stress negatively. Therefore, it is important to identify vulnerable areas to prioritize adaptation actions across the countries. Vulnerability can be generally described by measuring resilience. Particularly, ecological resilience refers to the ability of an ecosystem to persist to disturbances, which can be observed as the change in the trend and stochastic fluctuations of time series data[1]. This study aims to measure the resilience of vegetation including oil palm areas in Malaysia and Indonesia using resilience indicators analyzed from 20-year satellite vegetation products.

Methodology

Global dataset of solar-induced chlorophyll fluorescence (GOSIF)[2] was selected as vegetation productivity data for its high spatial and temporal resolutions. GOSIF was resampled to a 0.1° grid, and the monthly sum from 2002 to 2022 was used. The resilience metrics in this study included changes in the mean values of SIF, seasonal standard deviation representing fluctuation, and spectral signal. For changes in standard deviation, the study period was divided at the midpoint of the entire study period, then the standard deviation was calculated from seasonal data, which was derived from the decomposing of the original time series data into trend and seasonality. For changes in SIF mean value and seasonal spectral, change points were identified in the 20-year SIF time series using the Pruned Exact Linear Time (PELT)[3] method. The mean values were calculated if a significant trend existed in the time segments. Seasonal spectral analysis was conducted using Fourier Transforms to obtain amplitude and frequency domains. These changes in mean, standard deviation, and spectral properties were compared between the first and later periods.

Results

Change points were mostly observed in the Malay Peninsula, Borneo, and Sumatra islands, indicating that vegetation in these regions has been changing its response to climate. An increase in standard deviation was observed in these regions. In contrast, amplitude changes were more pronounced in other areas, suggesting that the response of seasonal signals varied among regions. Negative changes in mean SIF values were seen in the Malay Peninsula, Sumatra islands, and the northeast of Borneo islands, while positive changes were present in other regions. These results suggest that the Malay Peninsula and Sumatra islands may be less resilient at present. However, differences in vegetation types might lead to varying responses to climate disturbances and time series data.

Conclusion and Future Work

The analysis of changes in trend and seasonal fluctuation suggested that the Malay Peninsula and Sumatra may be less resilient in this study. In future studies, other resilience metrics such as recovery capacity and autocorrelation will be investigated. Additionally, focusing on areas specific to oil palm cultivation areas may provide detailed insights into oil palm resilience. Furthermore, validation of the analysis, particularly concerning palm yield, is needed.

References

[1] M. Scheffer, S. R. Carpenter, V. Dakos, and E. H. van Nes, 'Generic Indicators of Ecological Resilience: Inferring the Chance of a Critical Transition', Annual Review of Ecology, Evolution, and Systematics, vol. 46, no. Volume 46, 2015, pp. 145–167, Dec. 2015.

[2] X. Li and J. Xiao, 'A Global, 0.05-Degree Product of Solar-Induced Chlorophyll Fluorescence Derived from OCO-2, MODIS, and Reanalysis Data', Remote Sensing, vol. 11, no. 5, Art. no. 5, Jan. 2019.

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Day 2, 9:20~ 9:40

Characteristics of the Fluorescence of Water-Soluble Organic Matter in Atmospheric Aerosols in Wakayama

Chenran Wei[1], Sonia Afsana[1], Yange Deng[1], Hikari Yai[1], Hiroaki Fujinari[1], Yuzo Miyazaki[3], Eri Tachibana[3], Michihiro Mochida[1,2*]

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[3] Institute of Low Temperature Science, Hokkaido University
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The fluorescence properties of atmospheric aerosols show variability according to their chemical composition such as oxygenation state. Excitation-emission matrix (EEM) fluorescence spectroscopy is becoming an important method for analyzing the chromophores of water-soluble organic aerosol. The fluorescence characteristics of the chromophores were reported widely in recent years; however, how environmental conditions (e.g., humidity and temperature) affect the fluorescence properties of water-soluble organic aerosol are not yet fully understood. In this study, the fluorescence of water-soluble components in forest aerosol samples is studied to understand their characteristics and their temporal variations, and to infer the underlying processes.

Forest aerosol samples collected in Wakayama during 2015 summer were subjected to the analysis of EEM for water-soluble extracts. Parallel factor analysis (PARAFAC) was used to identify fluorescence characteristics. The result shows that water-soluble organic aerosol in this study was consist with low-oxygenated species (LOS), highly-oxygenated species (HOS), and protein-like substances (PRLIS). The relative contribution of the fluorescence of LOS showed significant positive correlation with SO42- ($r=0.78$; $p<0.001$) and NH4+ ($r=0.80$; $p<0.001$), while PRLIS showed strong negative correlation with them ($r=-0.72$ and $p<0.001$ for both). A possible explanation is that LOS may have been influenced by regional/long-range transport, while the influence is smaller on PRLIS. Nine meteorological variables including temperature, solar radiation, relative humidity, wind speed, and precipitation, were used for the comparison with fluorescence characteristics. The relative contribution of PRLIS showed a positive correlation with relative humidity ($r=0.36$; $p<0.001$), which may be explained by the humidity-dependent emission of bioaerosol.

The temporal variation of the fluorescence within a day was also analyzed. The fluorescence volume was relatively high in the daytime, especially in the afternoon (around 12-18 LT). The fluorescence of LOS showed a similar variation pattern with the minimum between around 0-6 LT and the maximum during around 12-18 LT. A possible explanation is that biogenic emissions were high during midday because of high temperature and strong solar radiation and contributed to the increased LOS. Comparison between inorganic ions and total fluorescence volume showed that the increase in the chromophores from nighttime to daytime was more prominent, which may relate to photochemical reactions.

Day 2, 9:40~10:00

Process-based modeling of BVOC emissions from forest ecosystem with validation at two observation sites for monoterpene

Zhanzhuo Chen (1, 2), Tomomichi Kato (3), Akihiko Ito (4, 5), Tatsuya Miyauchi (3), Yoshiyuki Takahashi (4), Jing Tang (2), Zhiyang Zhang (2), Riikka Rinnan (2), Ross Petersen (6), Cheng Wu (7)

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Abstract. Globally, the emission of biogenic volatile organic compounds (BVOC) by plants represents the dominant source of volatile organic compounds emitted to the atmosphere. Monoterpene (MT), as one of the major BVOCs, can contribute significantly to the formation of secondary organic aerosols and thus influence cloud properties. In this study, first, we developed a process-based MT module in the Vegetation Integrative Simulator for Trace Gases (VISIT) model, considering the production, storage, and emission of MT as three main processes. We evaluated the modeled MT emissions against ecosystem-level observation data at a half-hour scale from a Japanese larch (Larix kaempferi) forest site on Mt. Fuji, Japan. The VISIT model demonstrated relatively high accuracy, with Willmott's index of agreement of 0.61, a mean bias error (MBE) of 0.29, and a root mean squared error (RMSE) of 0.43. These results were comparable to those of the Model of Emissions of Gases and Aerosols from Nature (MEGAN) model, which had Willmott's index of agreement of 0.63, an MBE of 0.40, and an RMSE of 0.54. In a long-term simulation under high CO2 emission scenarios, the ratio of MT emission to gross primary production exhibited a stronger correlation with CO2 concentration than with temperature. Second, after completing vegetation-based BVOC simulations for the FHK site, we applied laboratory-based litter emission capacity data to simulate MT emissions at the Swedish Norunda site, dominated by Scots pine (Pinus sylvestris L.) and Norway spruce (Picea abies L.), using the Lund-Potsdam-Jena General Ecosystem Simulator (LPJ-GUESS) model. By comparing Norunda BVOC validation data with the simulation incorporating litter MT emissions, we found that including this process enhanced the model's accuracy. Our study provides a process-based modeling approach for more accurately simulating MT emissions from Japanese larch and highlights the importance of including a process-based scheme of litter BVOC emissions for improved model performance.

Detecting graminoids in wetlands: a method with UAV and deep learning

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極域の陸上生態系は、気候変動の影響が特に大きくなると懸念されている。極域に広がる永久凍土は、気候変動によって大規模な融解が生じる恐れがある。永久凍土の融解により、それまでは森林が成立していた場所の地表面が陥没し、地下水位が上昇する。これは、森林から fen（低層湿原）への変化であり、植生は木本中心から草本中心へと大きく変わることとなる。Fen の草本は特に graminoids（本研究ではイネ科型草本と呼ぶ。イネ科にくわえ、カヤツリグサ科など形態の似た草本を含む）に特徴づけられる。

広大な極域で生じるこのような変化を効果的に見つけ出すため、本研究では UAV とディープラーニングを用いて graminoids の検出を行う。将来の極域での実用化を目指し、今回は日本国内の湿原における研究結果を示す。画像識別 AI の一種であるこま切れ画像法（Chopped Picture Method: CPM）は、クラス分類（classification）を応用したモデル作成の高速化が特徴であり、湿原内における graminoids の検出を行うことに成功した。