CEOS LPV VI Workshop 12 Dec. 2018@Washington, D.C.

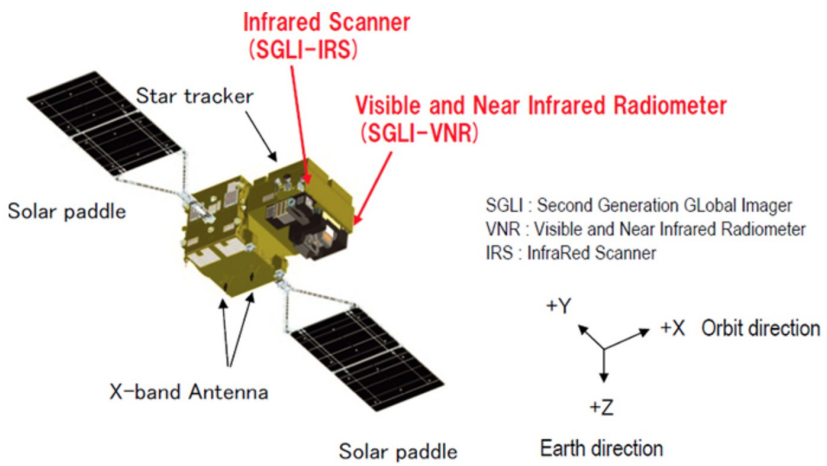
# *Collection of ground-truth data for the validation of GCOM-C Japanese new satellite*

Shin Nagai

JAMSTEC 国立研究開発法人 海洋研究開発機構
JAPAN AGENCY FOR MARINE-EARTH SCIENCE AND TECHNOLOGY

# *Global Change Observation Mission - Climate "SHIKISAI" (GCOM-C) satellite*

Orbiter: Sun-Synchronous Subrecurrent/ Recurrent
Altitude: 798km; Inclination 98.6 degrees; Period: 10:30±15min
Swath: 1150km (SGLI)/1400km (IRS);
Global observation data: every 2 or 3 days;
Launched date: 23 Dec. 2018

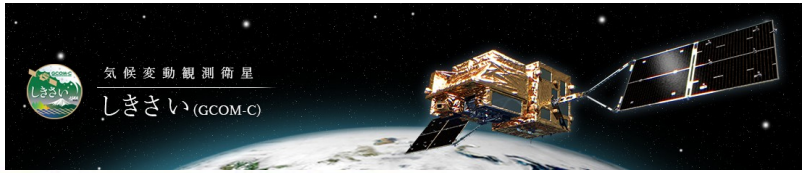



[http://global.jaxa.jp/projects/sat/gcom_c/]
[https://suzaku.eorc.jaxa.jp/GCOM_C/about/summary.html]
[https://suzaku.eorc.jaxa.jp/GCOM_C/instruments/product.html]
[http://global.jaxa.jp/activity/pr/brochure/files/sat30.pdf]

| | | Channel | Center Wavelength | Band width | IFOV |
|---|---|---|---|---|---|
| | | | VNR, SWI: nm<br>TIR: μm | | m |
| Visible and Near Infrared Radiometer (SGLI-VNR) | Non-polarization Channel | VN1 | 380 | 10 | 250*1 |
| | | VN2 | 412 | 10 | |
| | | VN3 | 443 | 10 | |
| | | VN4 | 490 | 10 | |
| | | VN5 | 530 | 20 | |
| | | VN6 | 565 | 20 | |
| | | VN7 | 673.5 | 20 | |
| | | VN8 | 673.5 | 20 | |
| | | VN9 | 763 | 12 | |
| | | VN10 | 868.5 | 20 | |
| | | VN11 | 868.5 | 20 | |
| | Polarization Channel | P1 | 673.5 | 20 | 1000 |
| | | P2 | 868.5 | 20 | |
| Infrared Scanner (SGLI-IRS) | SWI Channel | SW1 | 1050 | 20 | 1000 |
| | | SW2 | 1380 | 20 | |
| | | SW3 | 1630 | 200 | 250*1 |
| | | SW4 | 2210 | 50 | 1000 |
| | TIR Channel | T1 | 10.8*2 | 0.74*2 | 250*3 |
| | | T2 | 12.0*2 | 0.74*2 | |

*1 : Possible to be reduced to 1km resolution over both polar and ocean regions except coastal region.
*2 : Unit of TIR is micro-meter.
*3 : Possible to be reduced to 500m/1km resolution over both polar and ocean regions except coastal region.

# *Phenological observation in Japan by SGLI/GCOM-C in 2018*



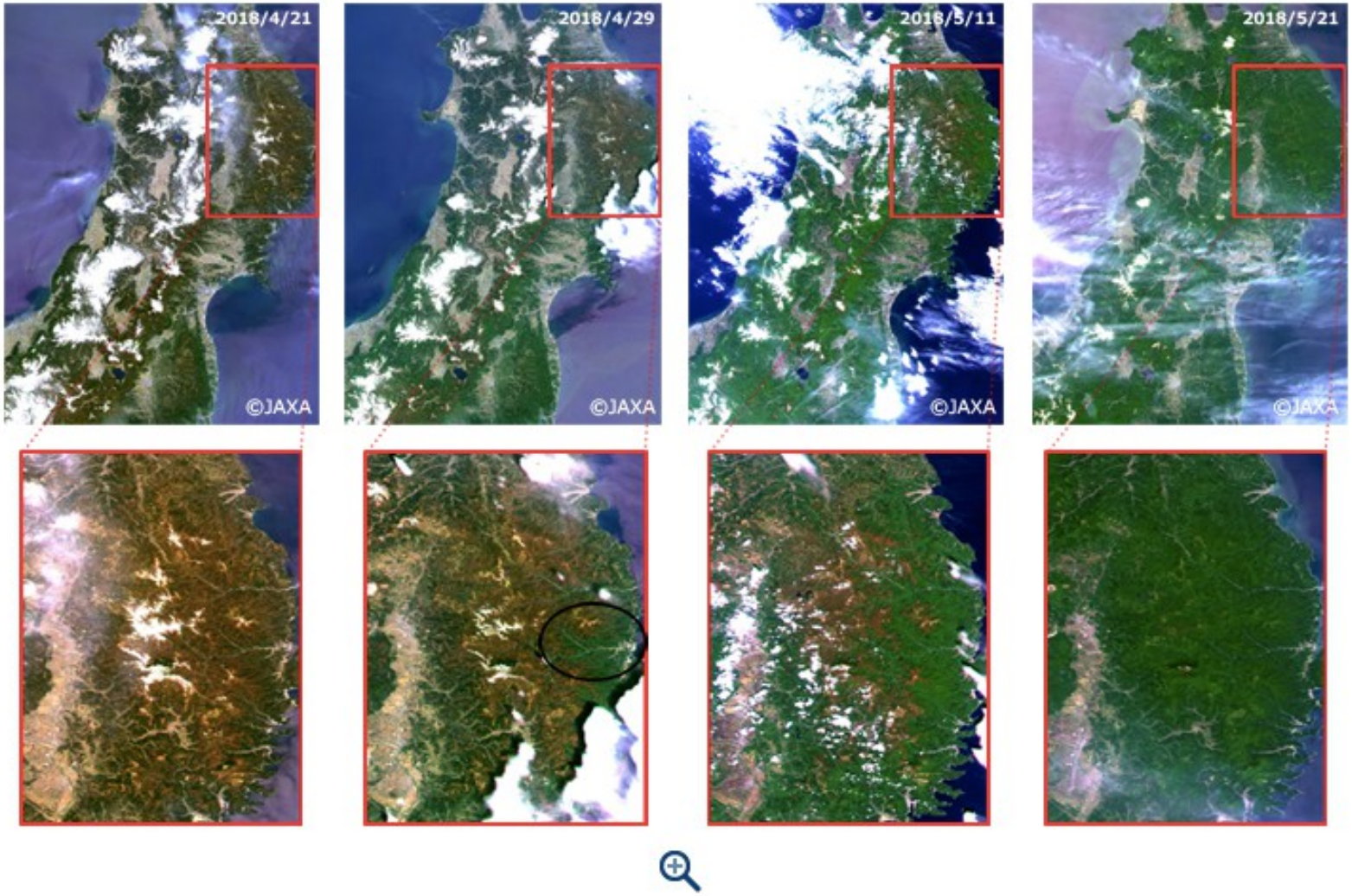




図1　「しきさい」による東北地方のカラー合成画像（上図）。SGLIの赤(VN08: 673.5nm)・緑(VN06: 565nm)・青(VN03: 443nm)のチャンネルの観測データをそれぞれR・G・Bに割り当てた。下図は北上山地付近の拡大図で、季節が進むにつれて高山域でも徐々に展葉が進んでいく様子が分かる。

[http://www.eorc.jaxa.jp/earthview/2018/tp180531.html]

# *8 million phenological and sky images from 29 ecosystems from the Arctic to the tropics: the Phenological Eyes Network*

BIGLOBE | Phenological Eyes Network

保護されていない通信 pen.jamstec.go.jp

## Phenological Eyes Network (PEN)

--- Connecting Satellite Remote Sensing to the Ground-Level Ecosystems ---

Phenological Eyes Network

*Data paper:*
Nagai et al. (2018; Ecological Research)

**ACCESSIBIL**

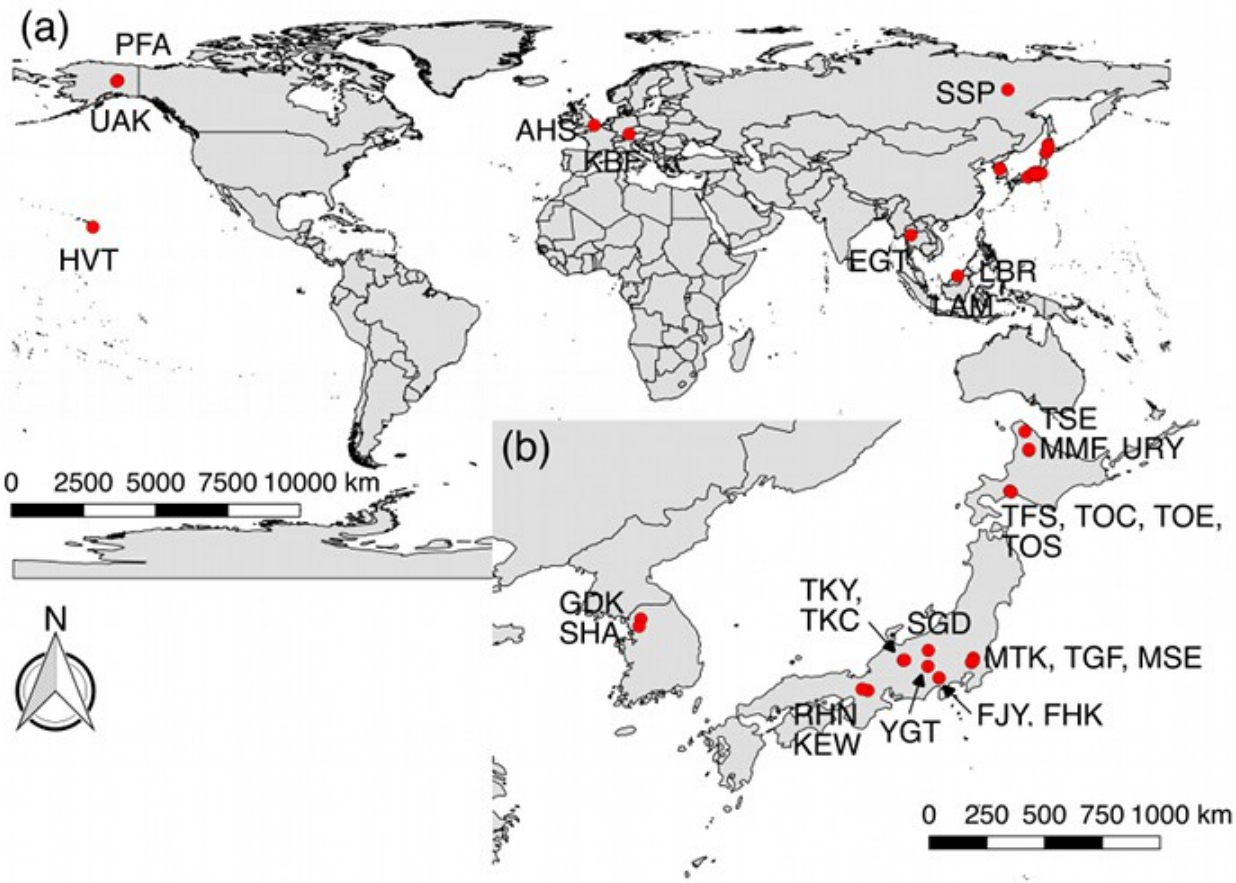
License: This data set is provided under a Creative Common
https://creativecommons.org/

**REFERENC**

Nagai S, Akitsu T, Saitoh TM, et al. 8 million phenological and sky images fror
Eyes Network. Ecological Research, https://doi

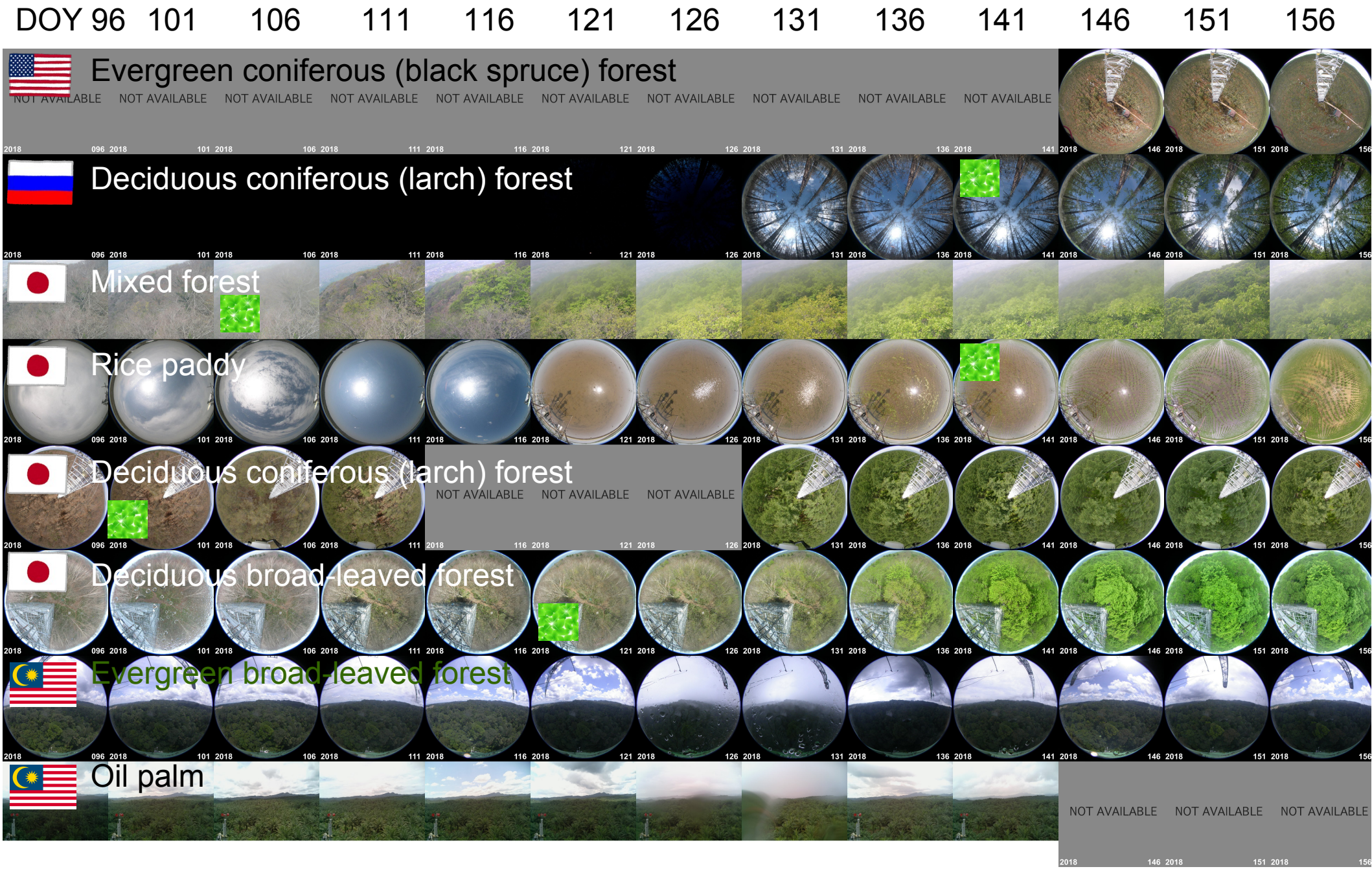
**Data of PE**

dc_2017_244_1200+....jpg | 2018survey-201809....zip



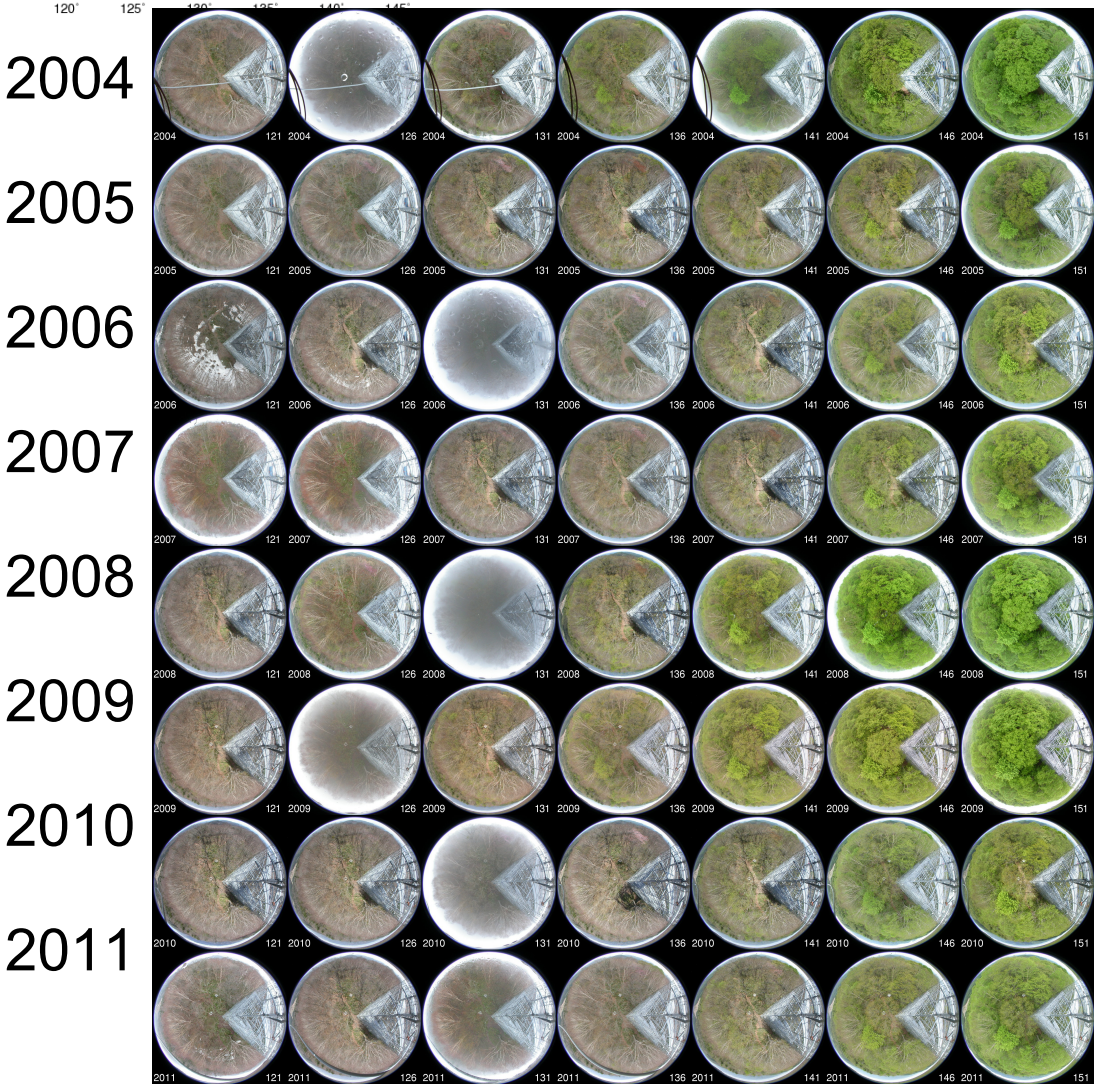

*Get data:* я я я я я я
http://pen.jamstec.go.jp

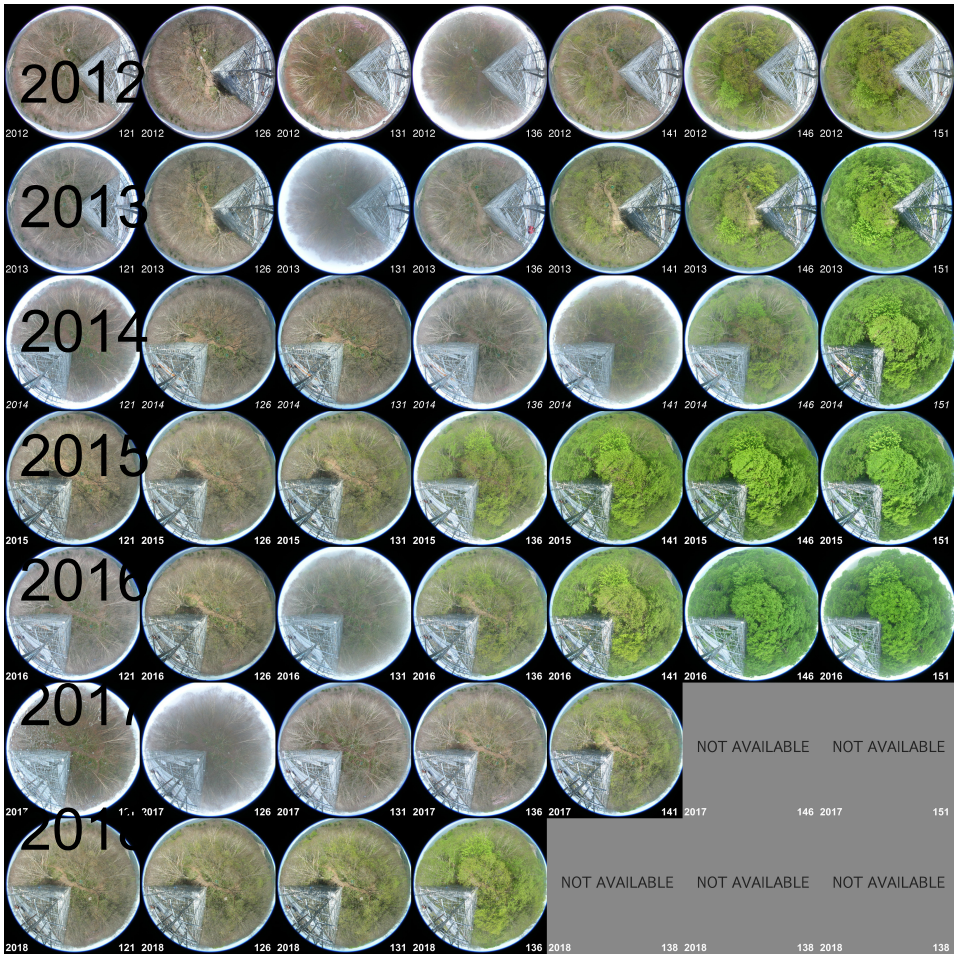
# *Spring phenology in 2018 from the Arctic to the tropics*



# *Daily phenology images at Takayama decidous broad-leaved forest*

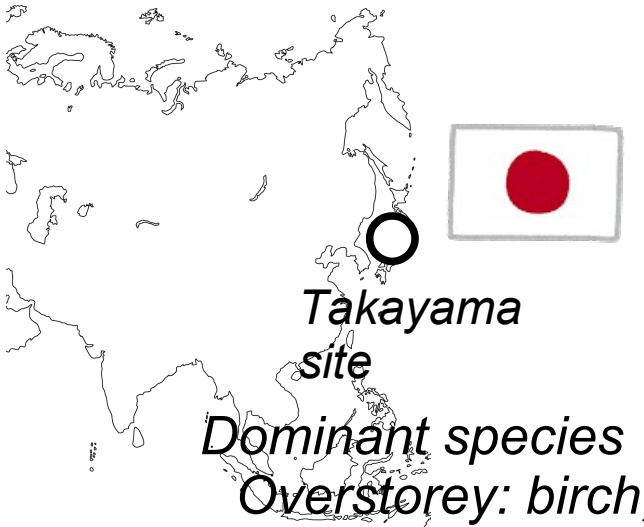
1420 m a.s.l.



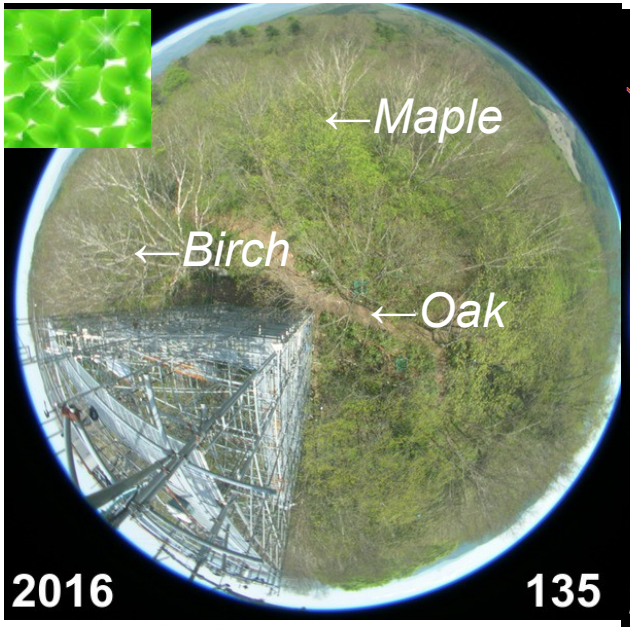



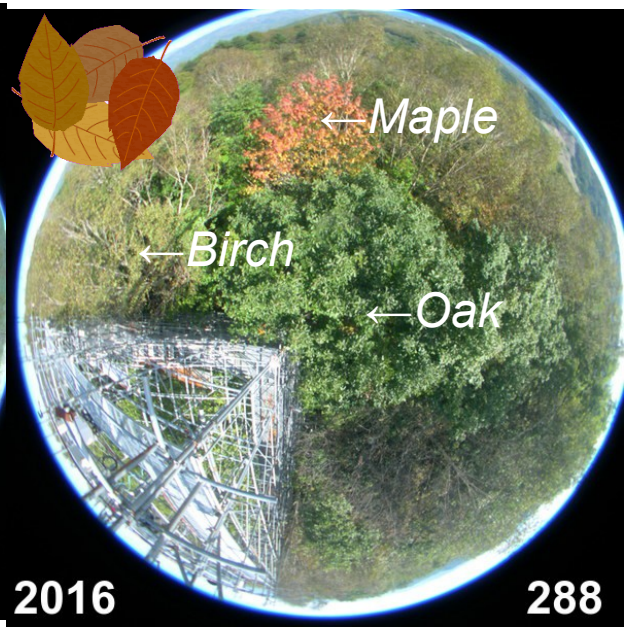

[Nagai et al., 2018, Eco Res]

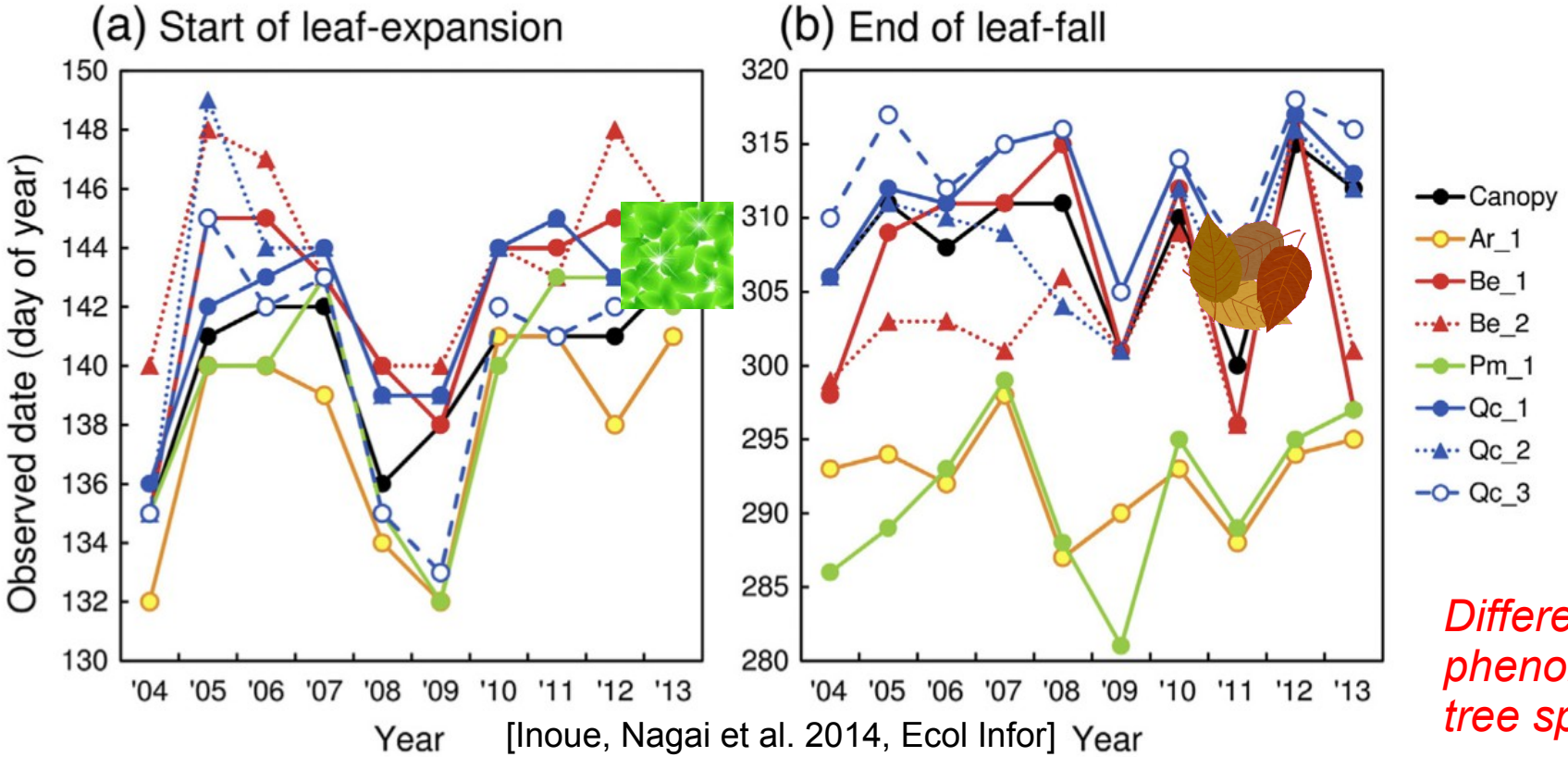
# Detection of year-to-year variability of leaf-flush and -fall phenology




Dominant species
Overstorey: birch, oak
Understorey: maple



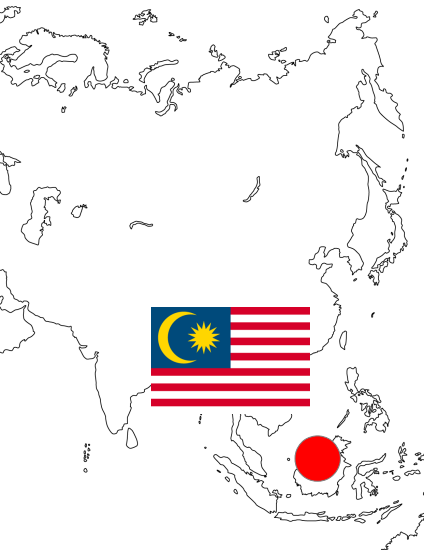



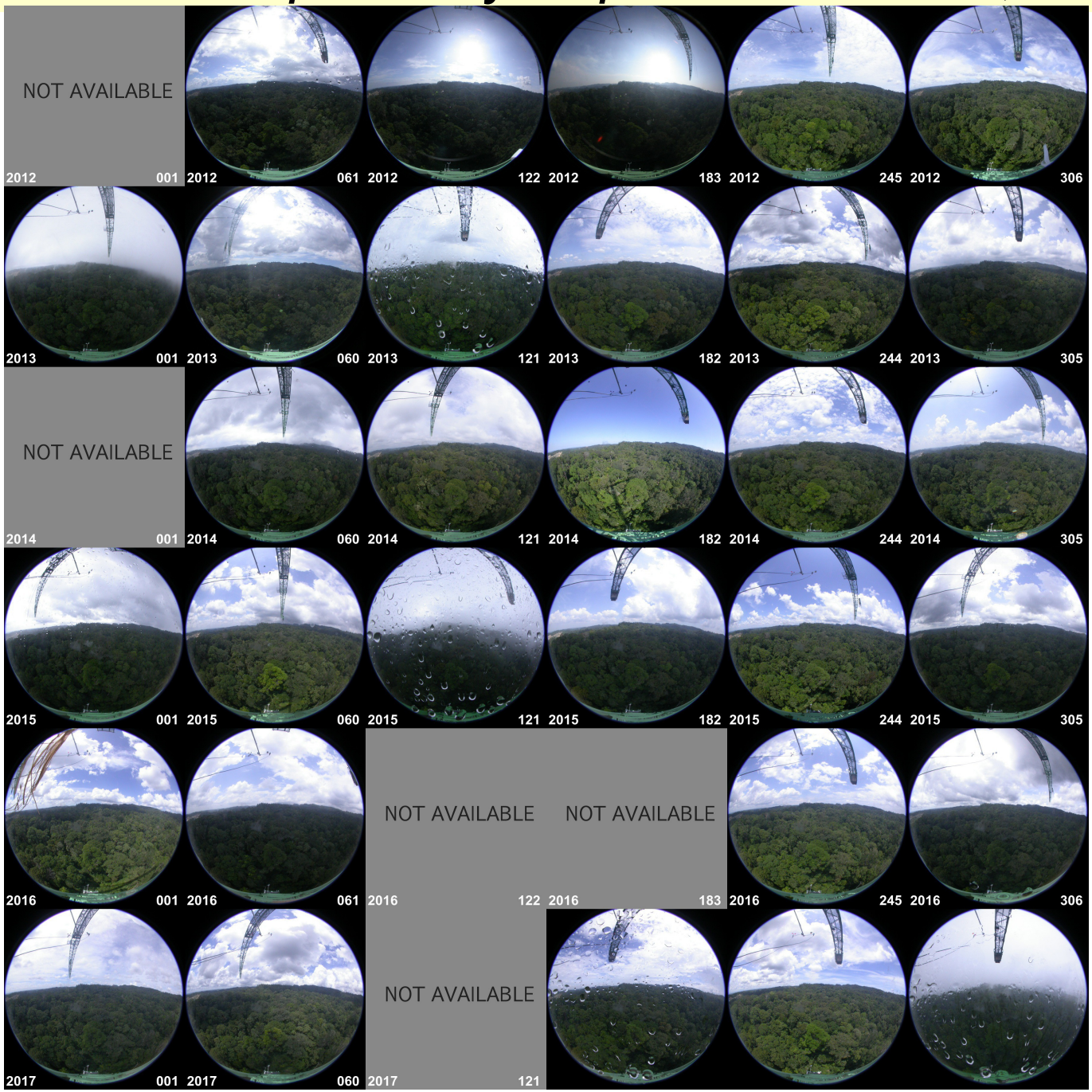




[Inoue, Nagai et al. 2014, Ecol Infor]

*Different autumn phenology among tree species*

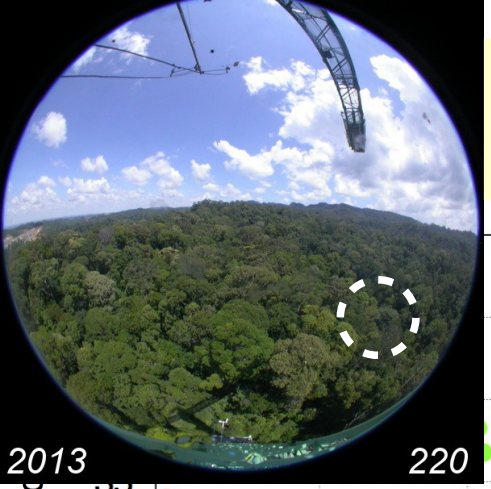
# *Phenology observation in a primarily tropical rain forest, Borneo*

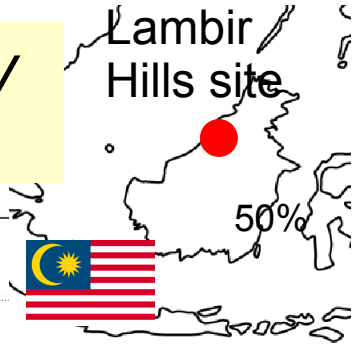


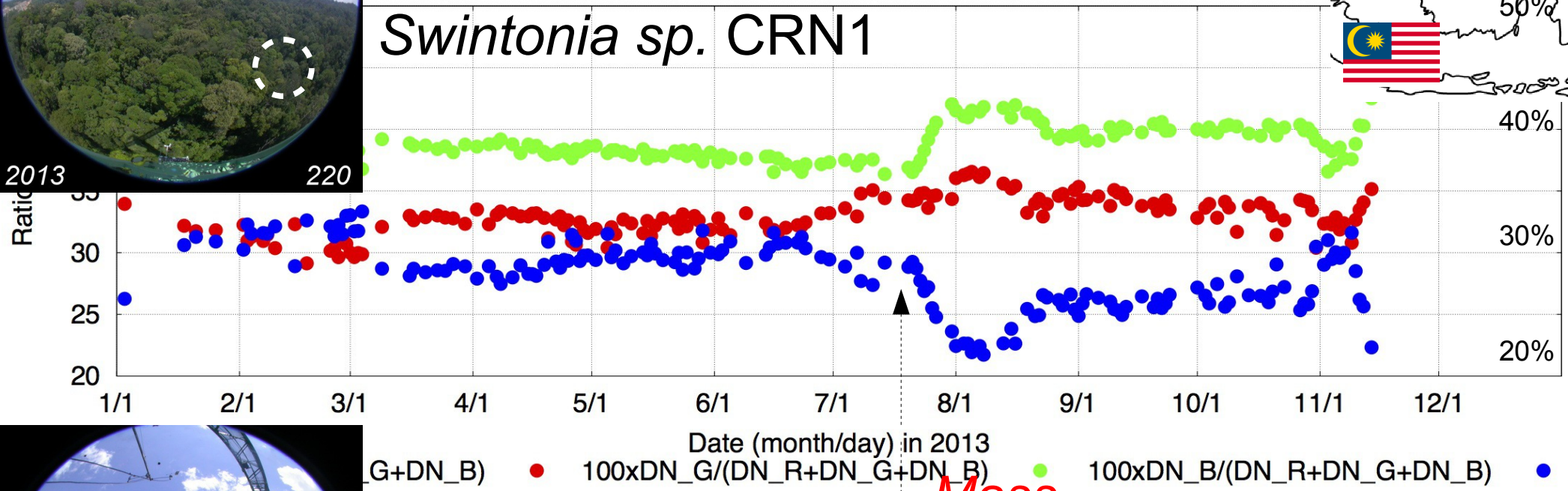


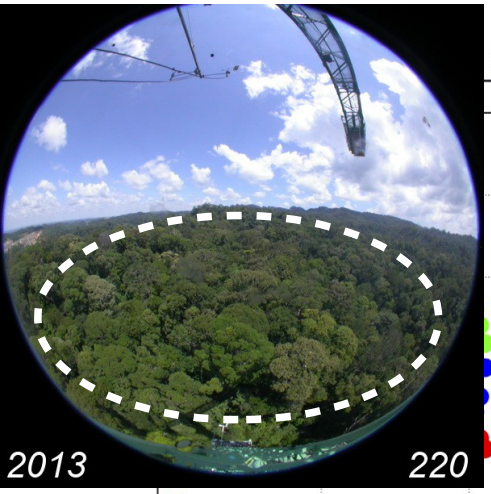

[Nagai et al., 2018; Ecol Res]

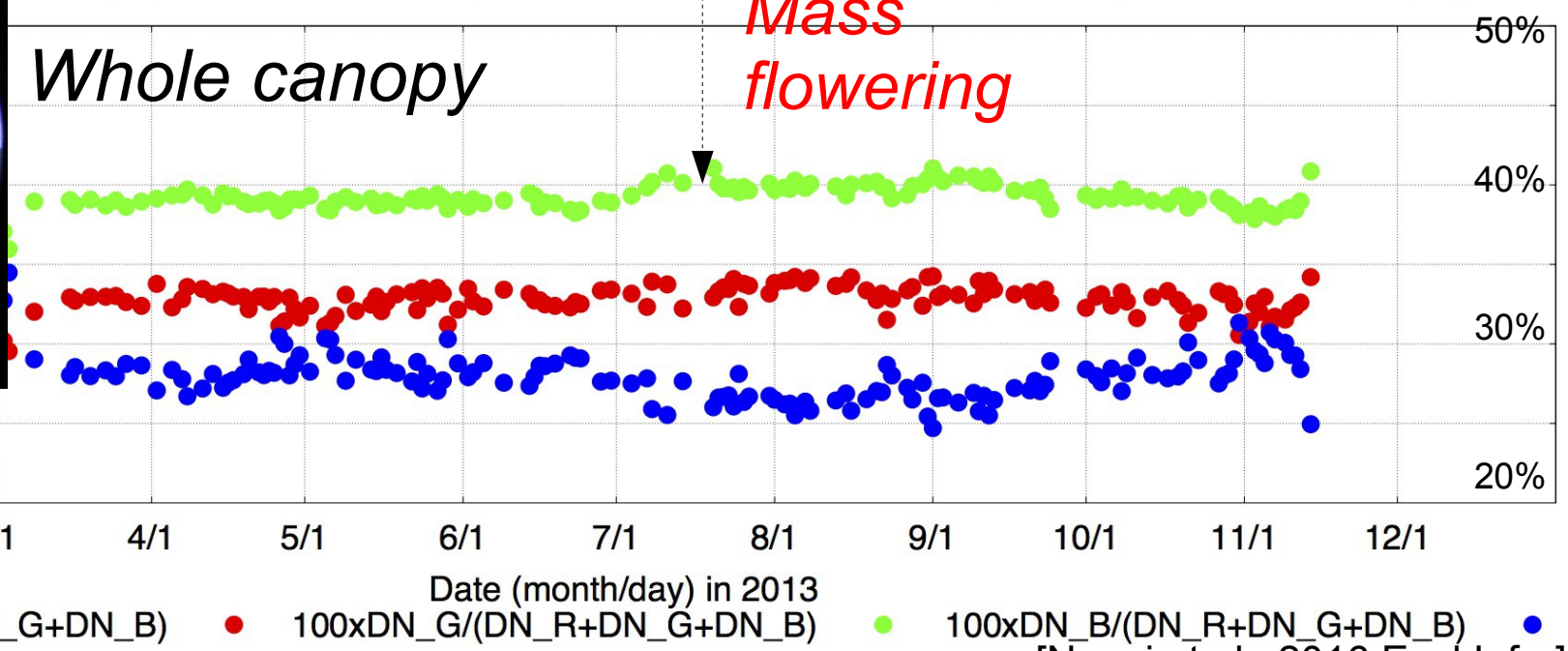
# *Detection of characteristics of tree phenology by analysing the RGB digital numbers*



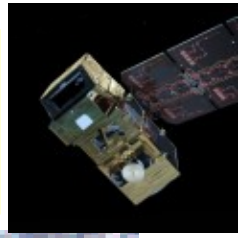



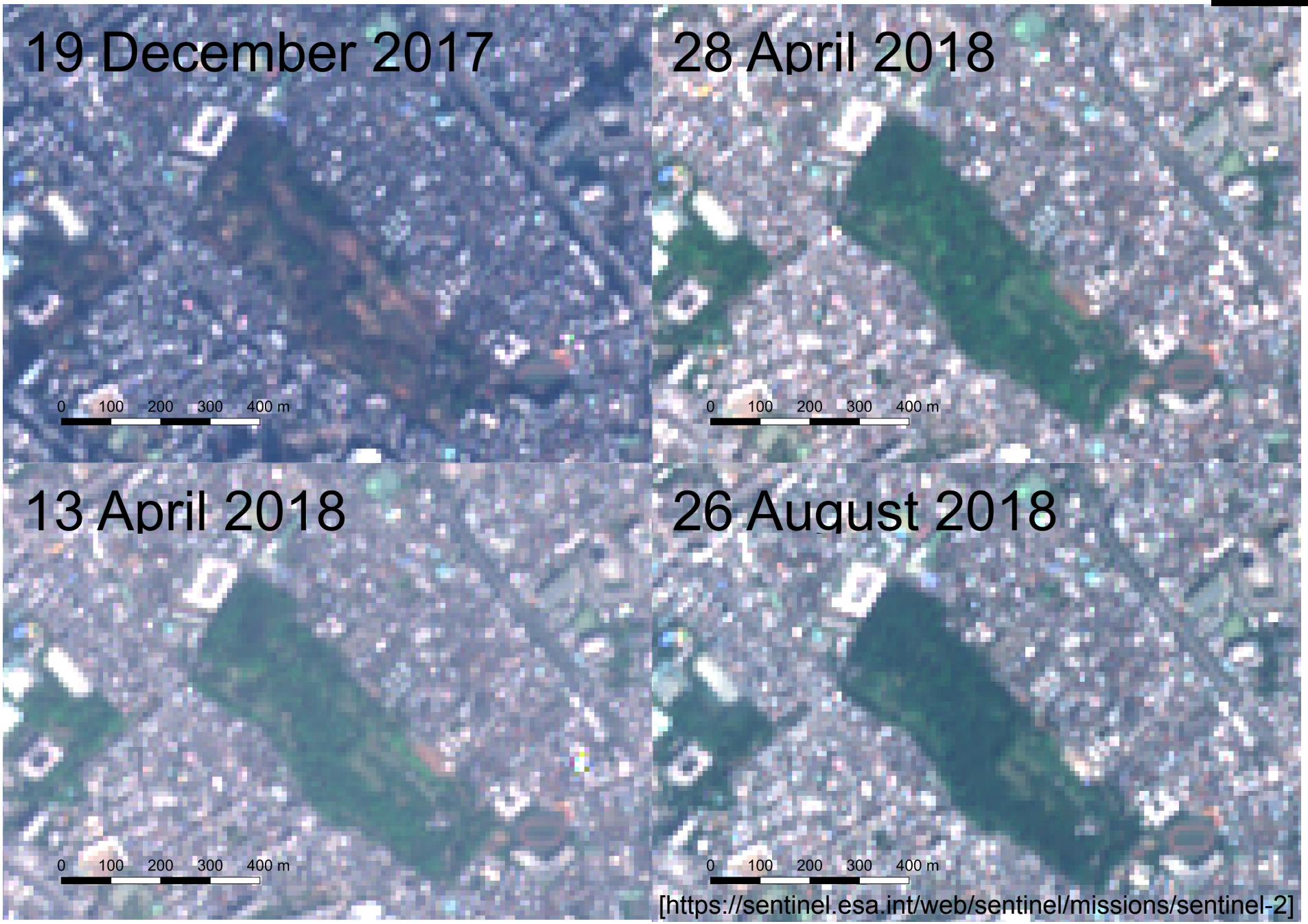




[Nagai et al., 2016 Ecol Infor]

# *Seasonal RGB images observed by SENTINEL-2 at Koishikawa Botanical Garden in Tokyo (10m res.)*





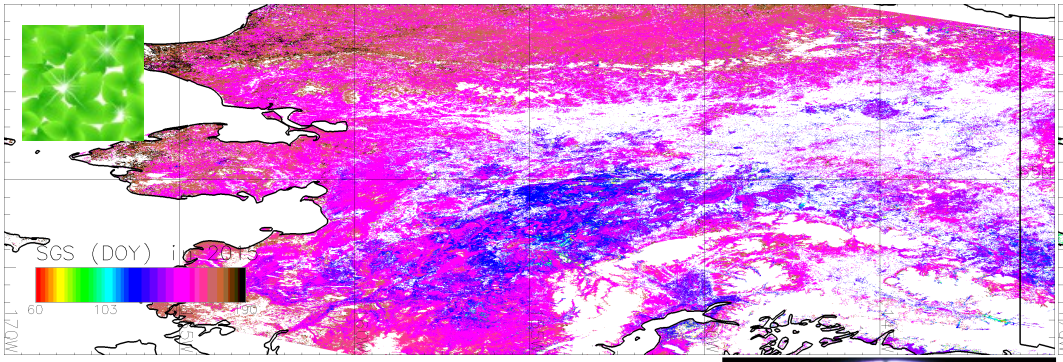

[https://sentinel.esa.int/web/sentinel/missions/sentinel-2]

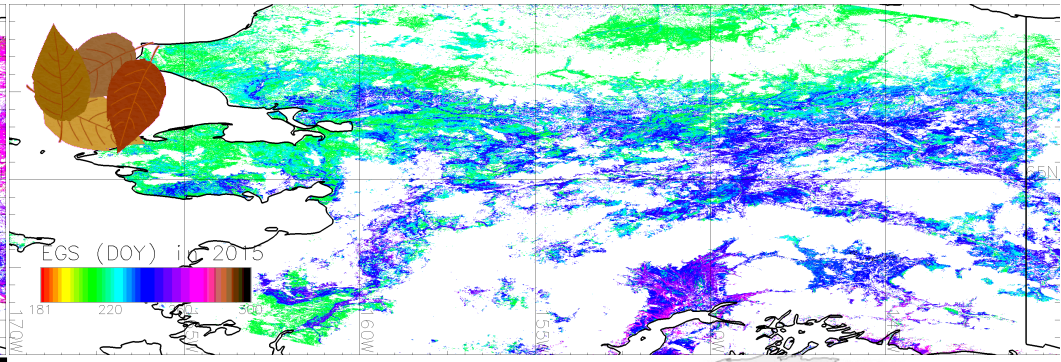
# *Discrimination of tree species by analysing seasonal change of canopy surface colour caused by blooming and leaf-flush*

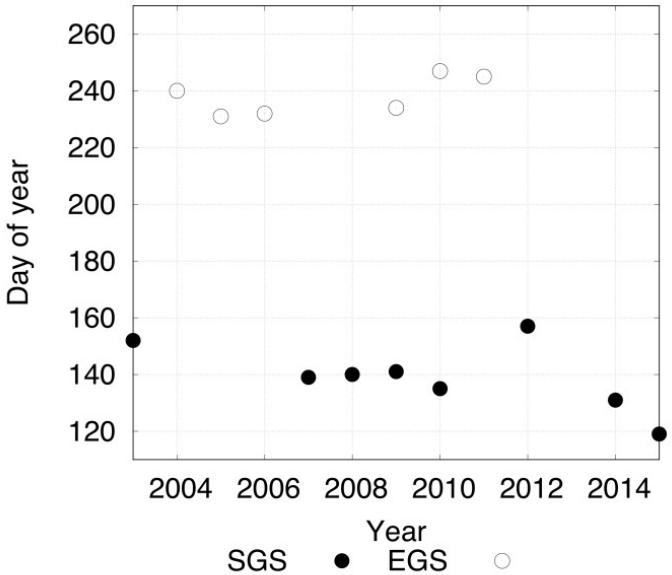
# *Daily phenology images in an evergreen coniferous forest in Alaska*

Not so clear the year-to-year variability in autumn

# *Ground-truth for spatio-temporal variability of the timing of start and end of growing season by analysing MODIS-observed daily GRVI*



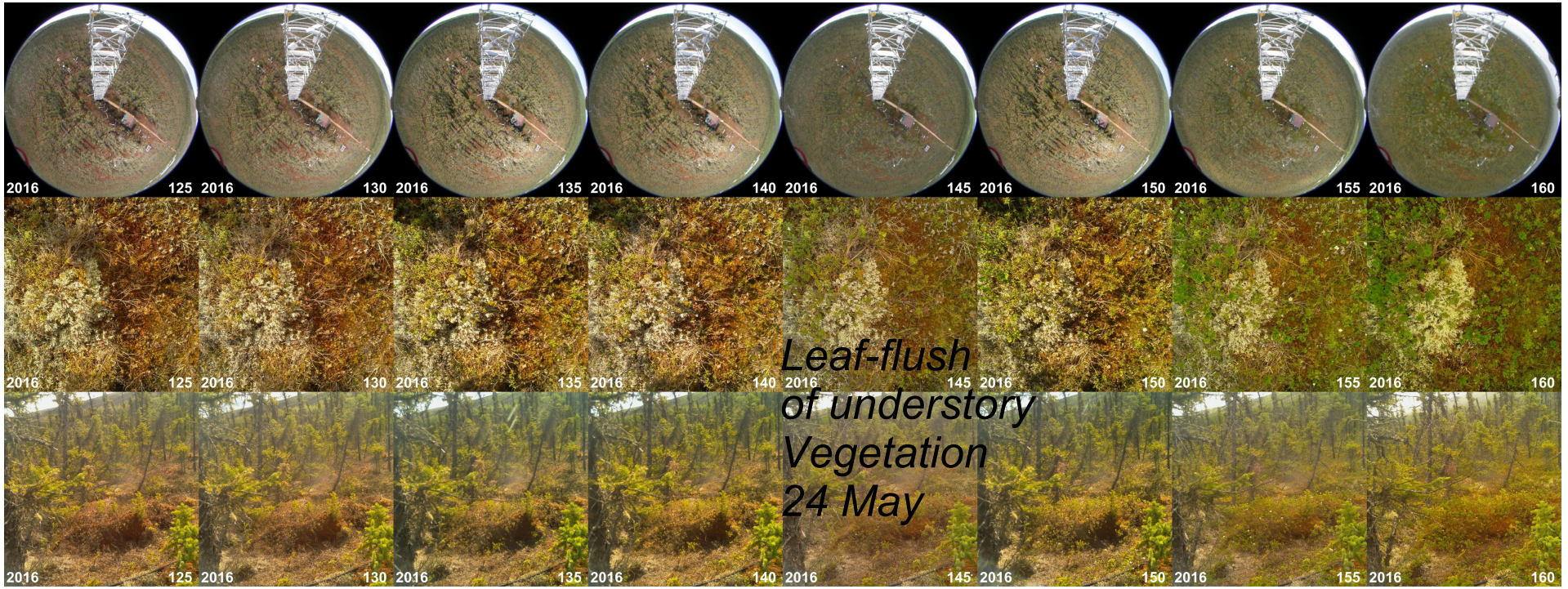





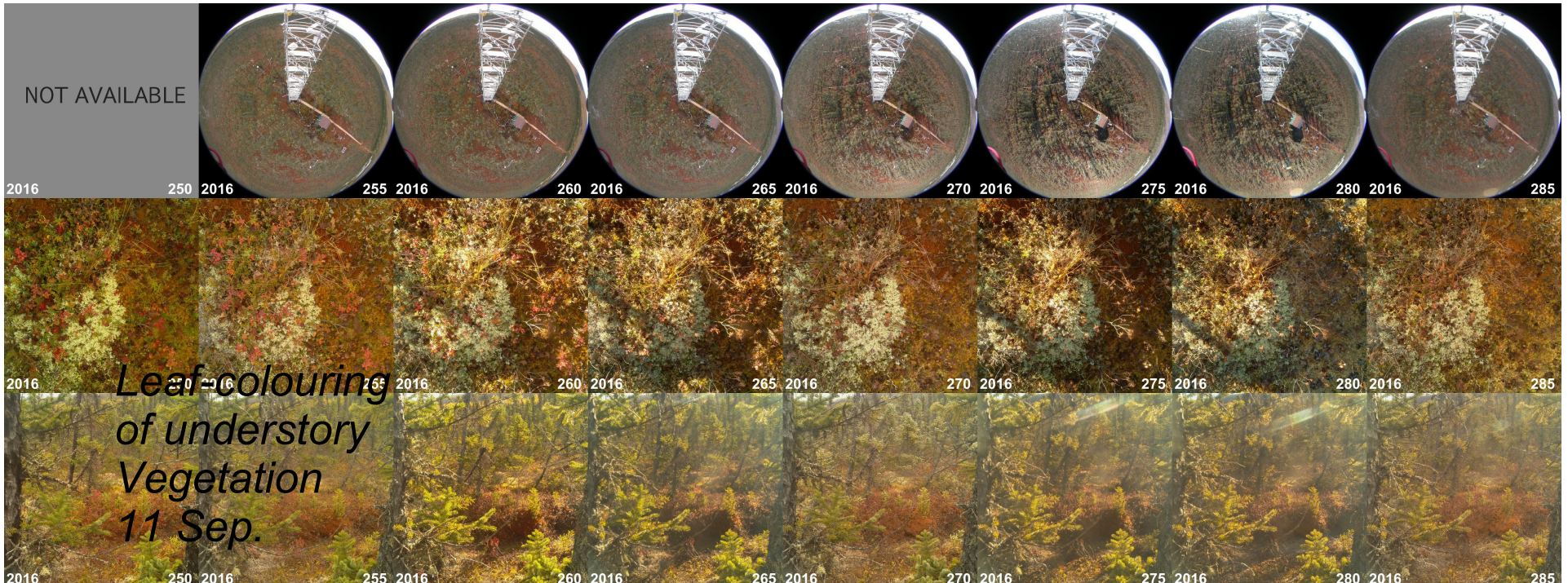
[Nagai et al., accepted, AGU books]

# *Relationship between canopy surface and forest floor images*

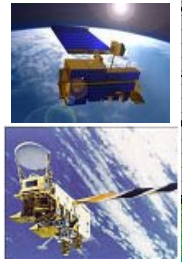
2016



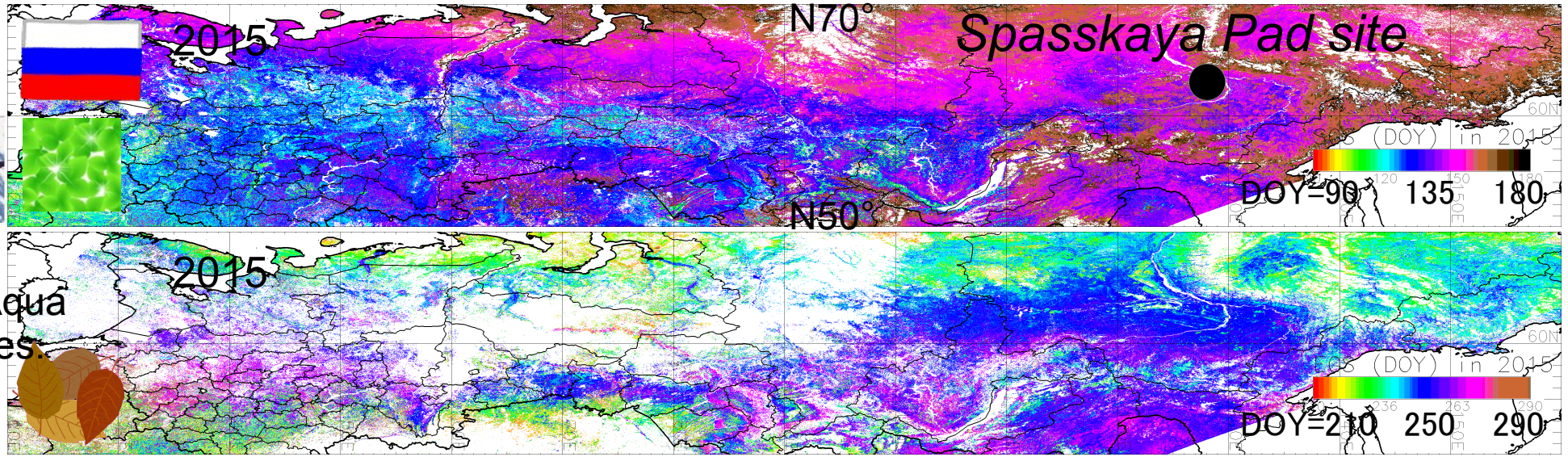
2016

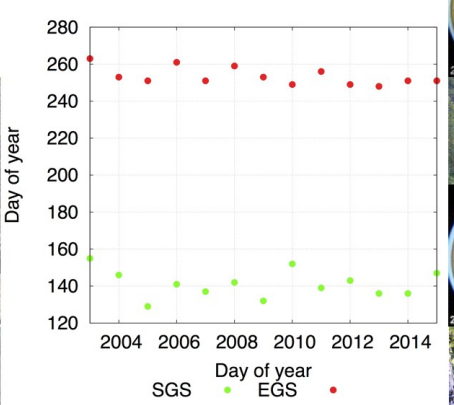


# *Ground-truth for spatio-temporal variability of the timing of start and end of growing season by analysing MODIS-observed daily GRVI*



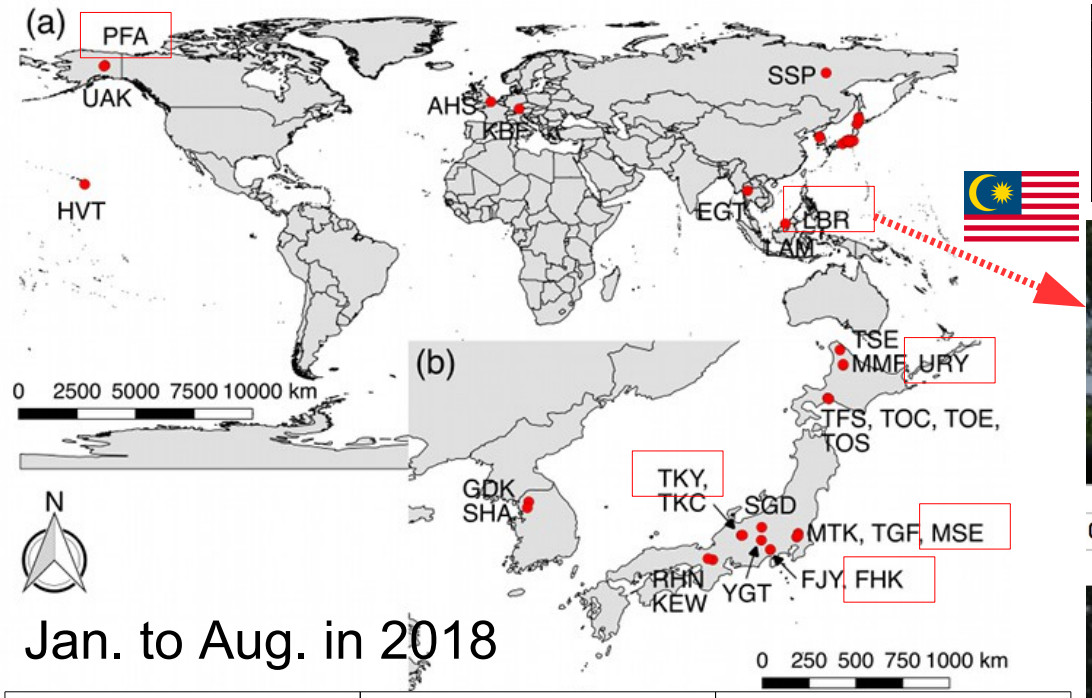
MODIS
Terra/Aqua
500m res.

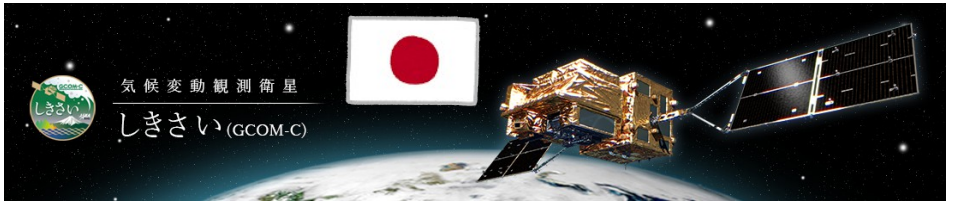





[Nagai et al., accepted, AGU books]

# *Ground-truth for cloud contamination at the time of GCOM-C satellite overpass (10:30 LT)*



Jan. to Aug. in 2018

| Site | Number days of observation | Clear sky |
|---|---|---|
| PFA (Alaska) | 14 | 2 |
| URY (Japan) | 139 | 21 |
| FHK (Japan) | 127 | 25 |
| TKY (Japan) | 141 | 25 |
| MSE (Japan) | 134 | 35 |
| LBR (Borneo) | 34 | 0 |

*Visually inspected by M. Takeuchi

# Global phenology observation networks by using time-lapse cameras

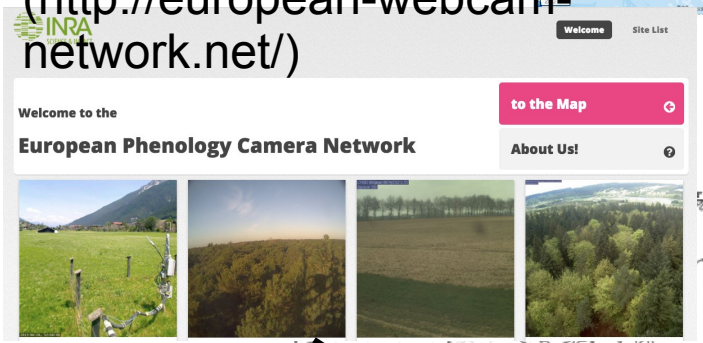
## Web Camera Images of National Parks and Wildlife in Japan

http://www.sizenken.biodic.go.jp/index.php

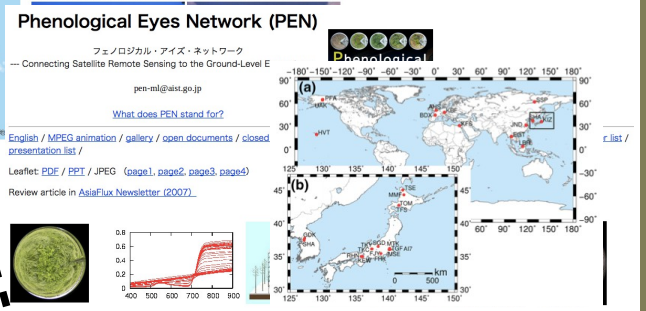
http://www.pheno-eye.org

## European Phenology Camera Network

(http://european-webcam-network.net/)

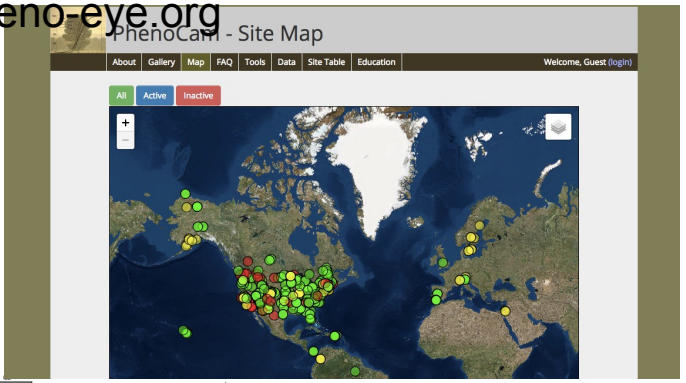


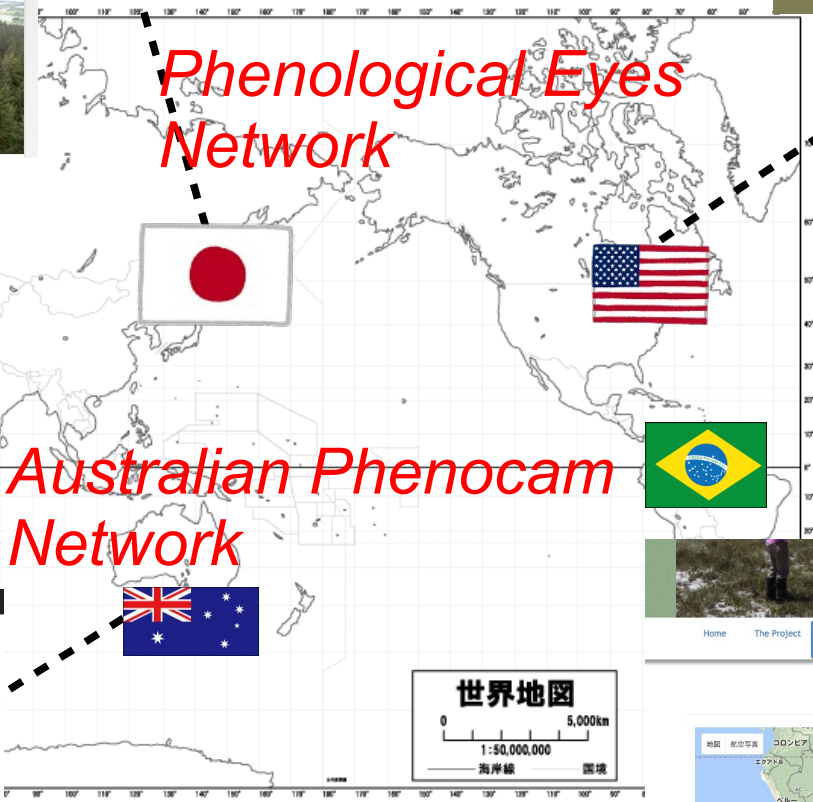

## Phenological Eyes Network



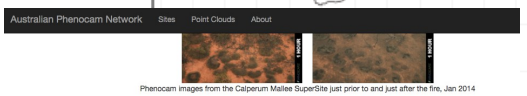

## PhenoCam

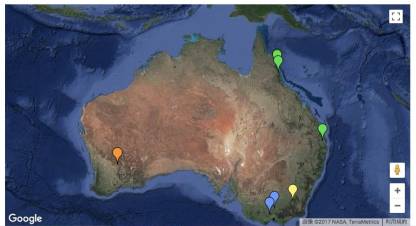
https://phenocam.sr.unh.edu/webcam/



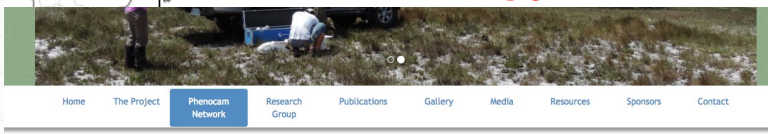




## Australian Phenocam Network



## e-phenology



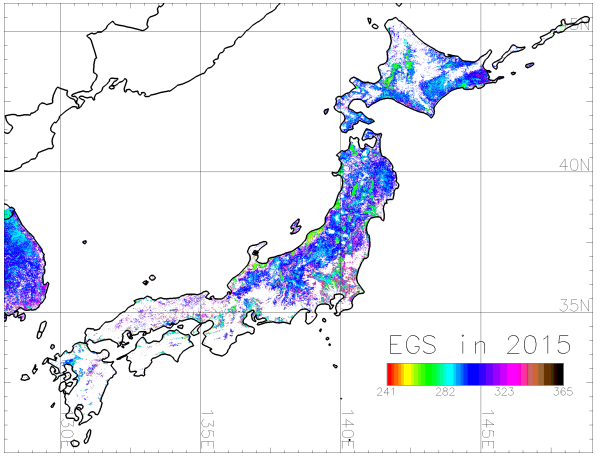
Phenocam Network Gallery

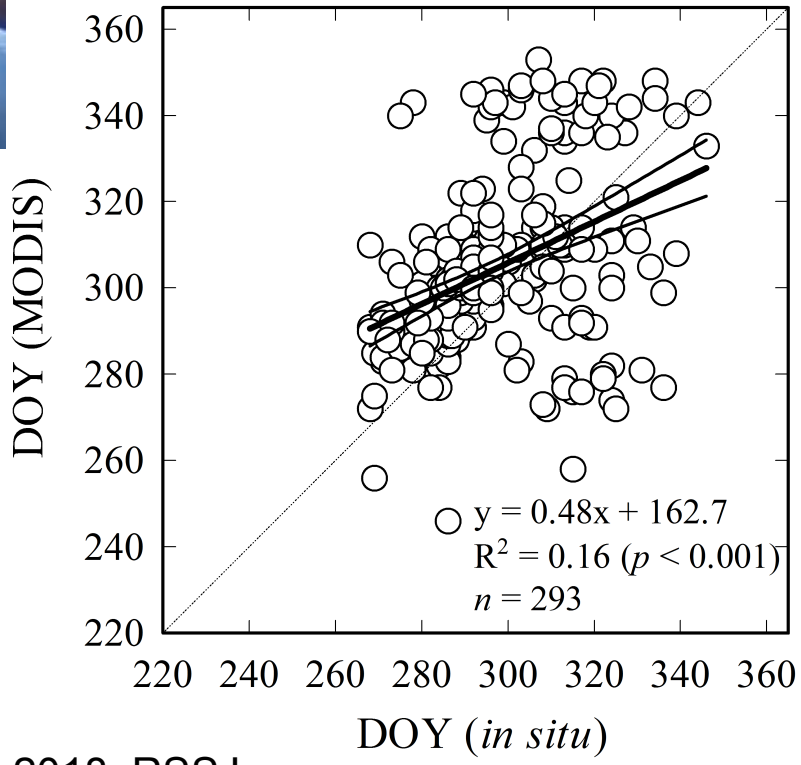
The e-phenology project has several towers arranged in different regions of Brazil in order to analyse the different biomes and phenology of the plants present in these regions.
In this section we present the location of each tower.
As some towers are in nearby regions, you need to zoom in on the map. However, it can be observed in the map of Brazil that the towers are located in different regions and arranged over great distances.
The towers of the project are: Cerrado Core, Atlantic Rain Forest, Cerrado PEG, Amazon Forest, Caatinga, EE Itirapina and Serra Cipó. It is important to mention that the Serra Cipó presents a set of towers arranged in different areas of this region.
You can click on each location's mark of the map to open tower details, or simply click on the images below to perform this action.

←https://phenocam.org.au/

→http://www.recod.ic.unicamp.br/ephenology/client/index.html#/

# *Relationship between satellite-observed timing of growing season and leaf-colouring information*

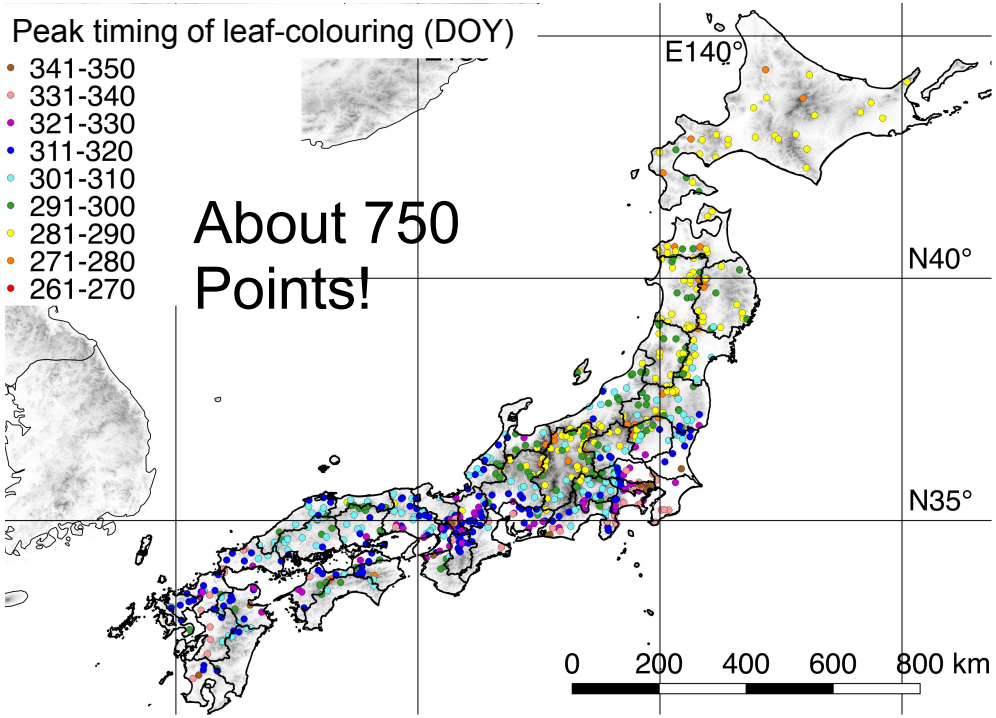





[Nagai et al. 2018, RSSJ; AGU books]

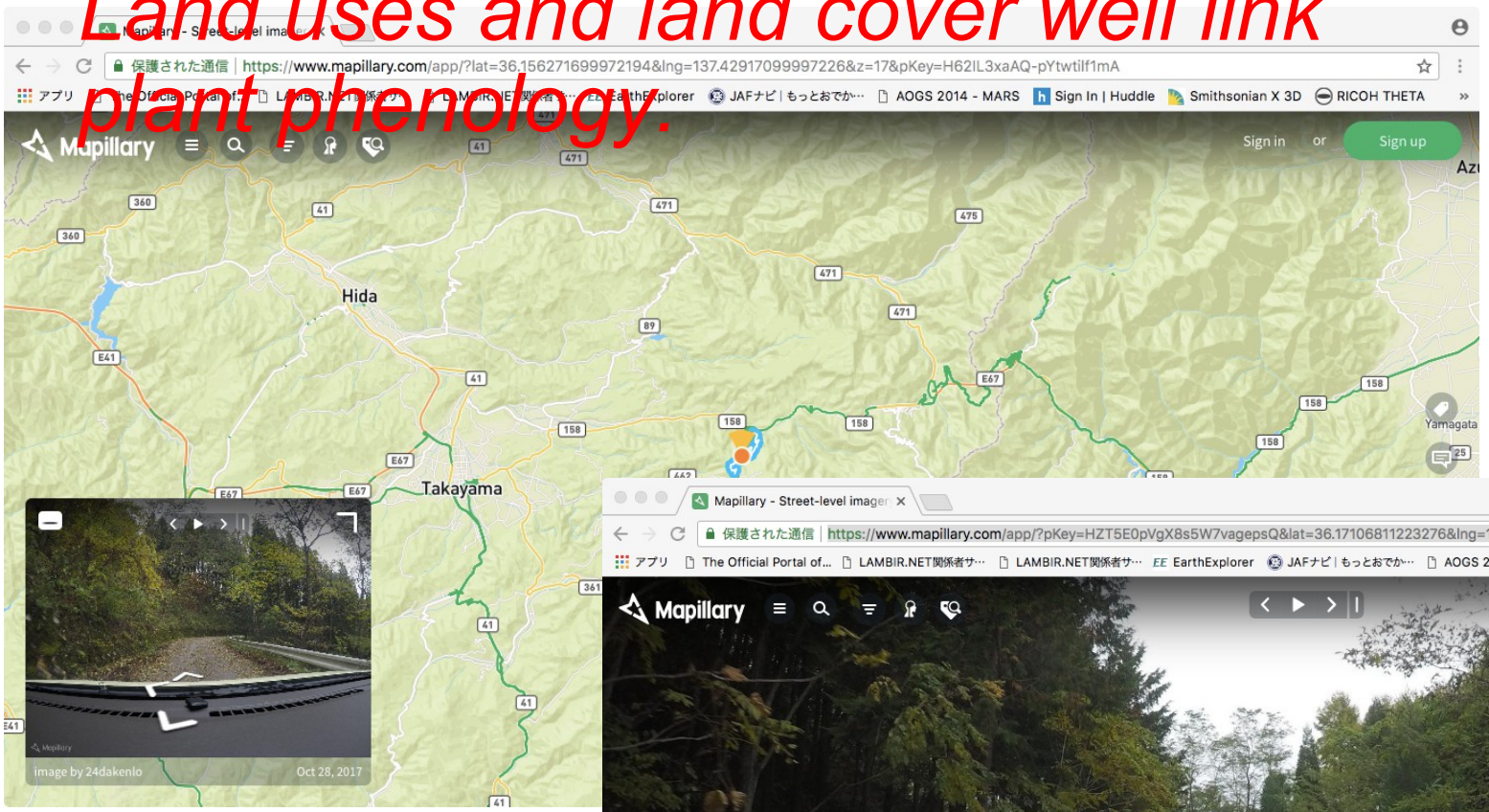
*Big data (tenki.jp)*

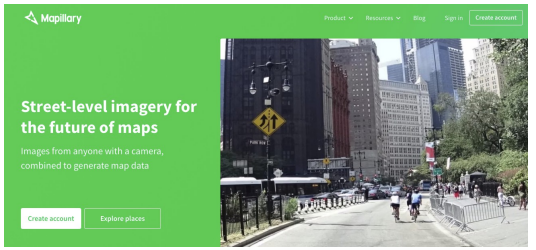
[http://www.tenki.jp]

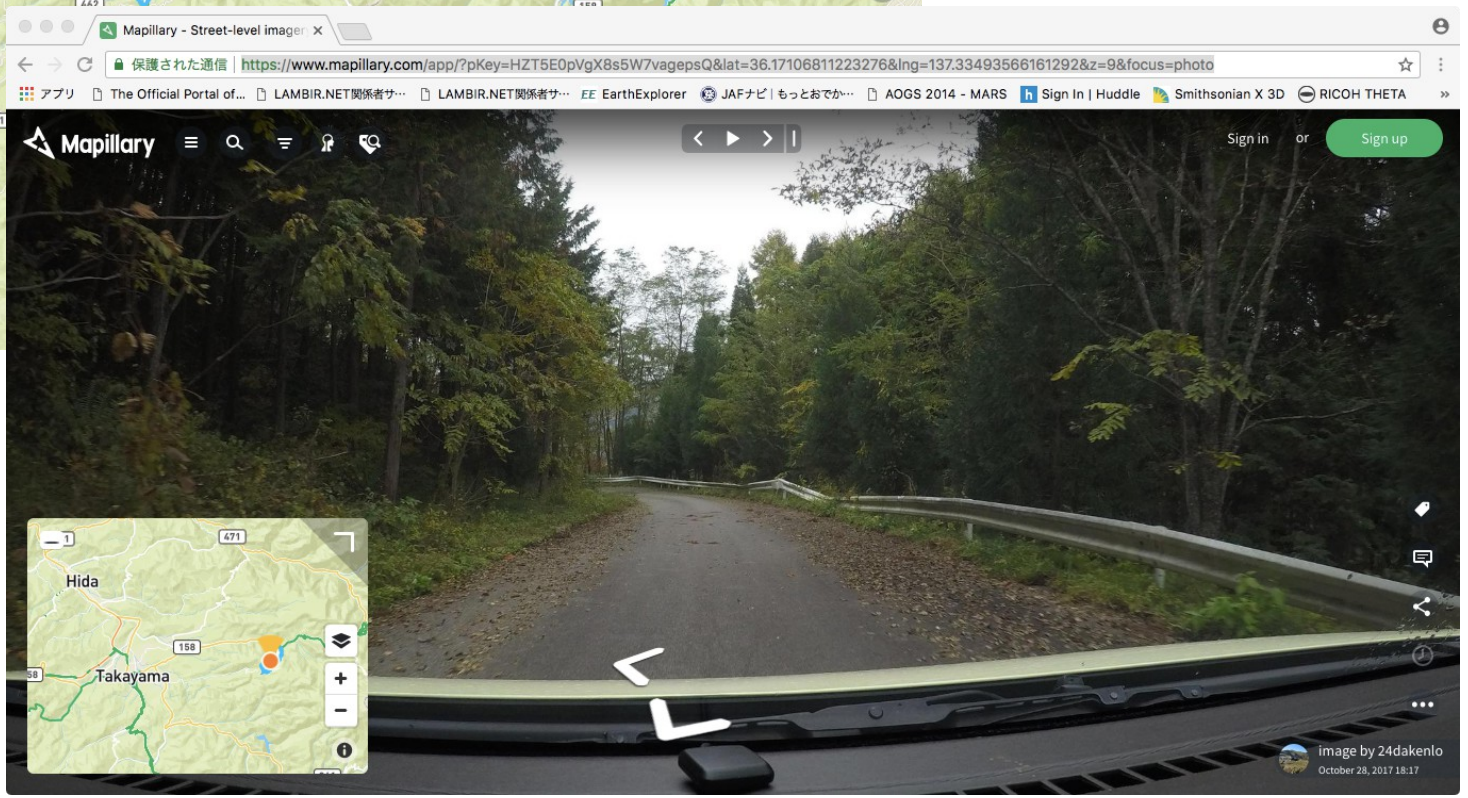


# *Usefulness of field survey images published on "**Mapillary**" [https://www.mapillary.com/]*

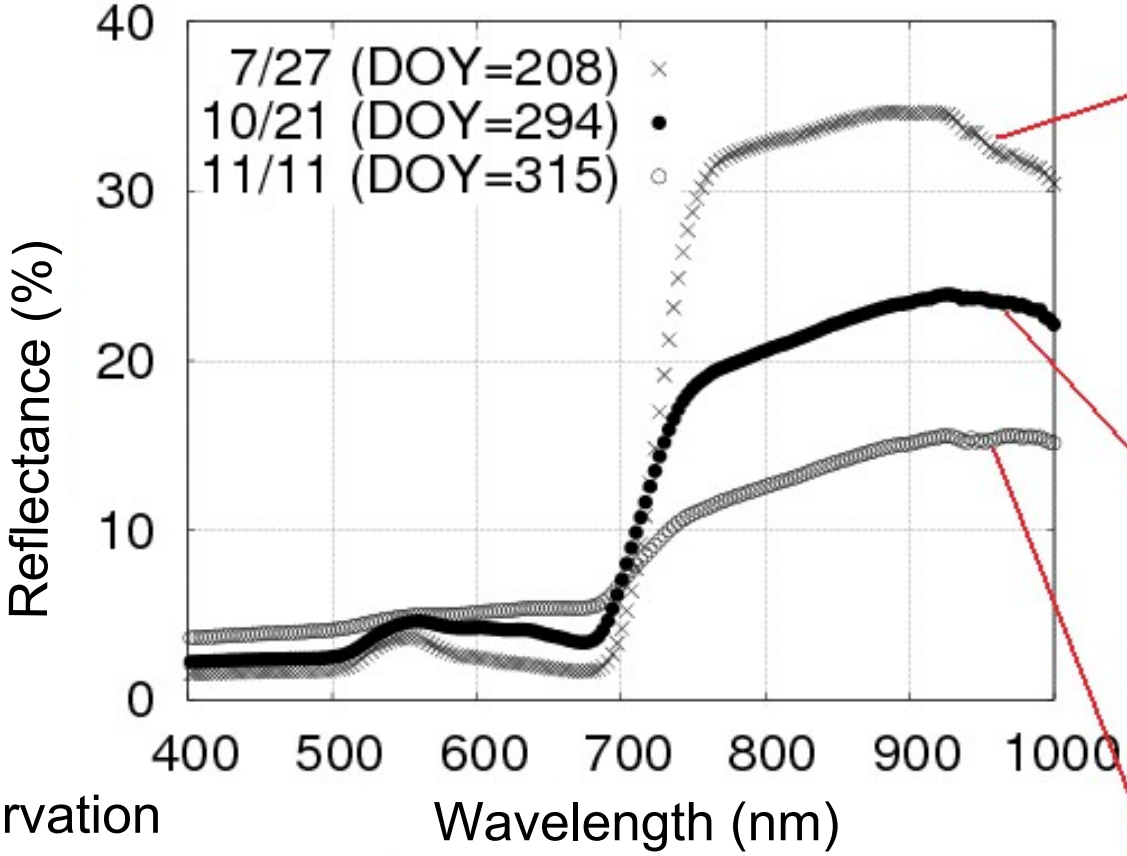
*Land uses and land cover well link plant phenology.*

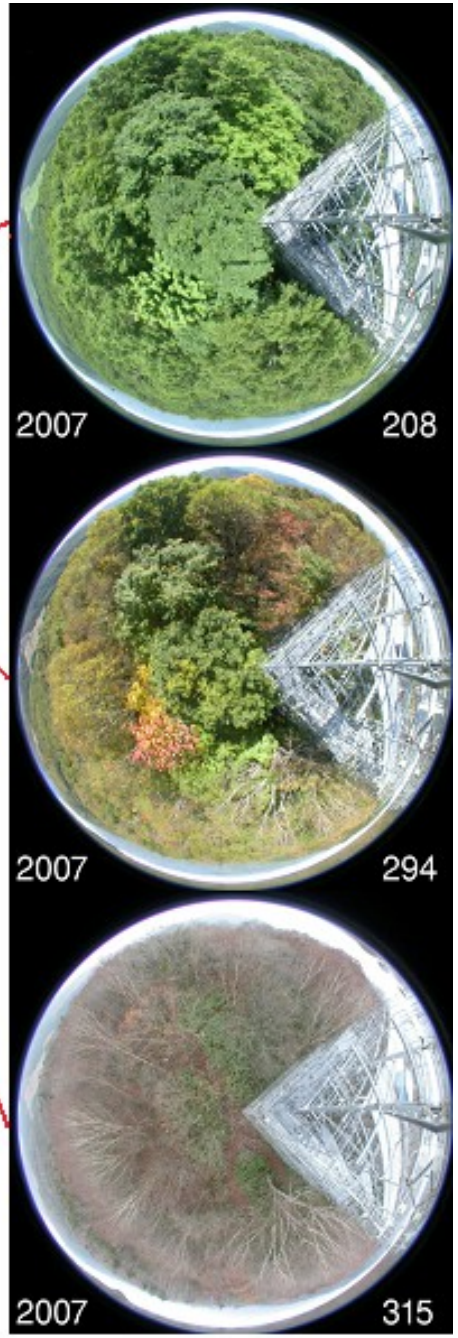


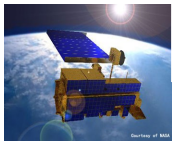



# *Relationship between plant phenology and spectral characteristics in a desciduous broad-leaved forest*




Observation band



[NASA]

MODIS

3 4 1 2

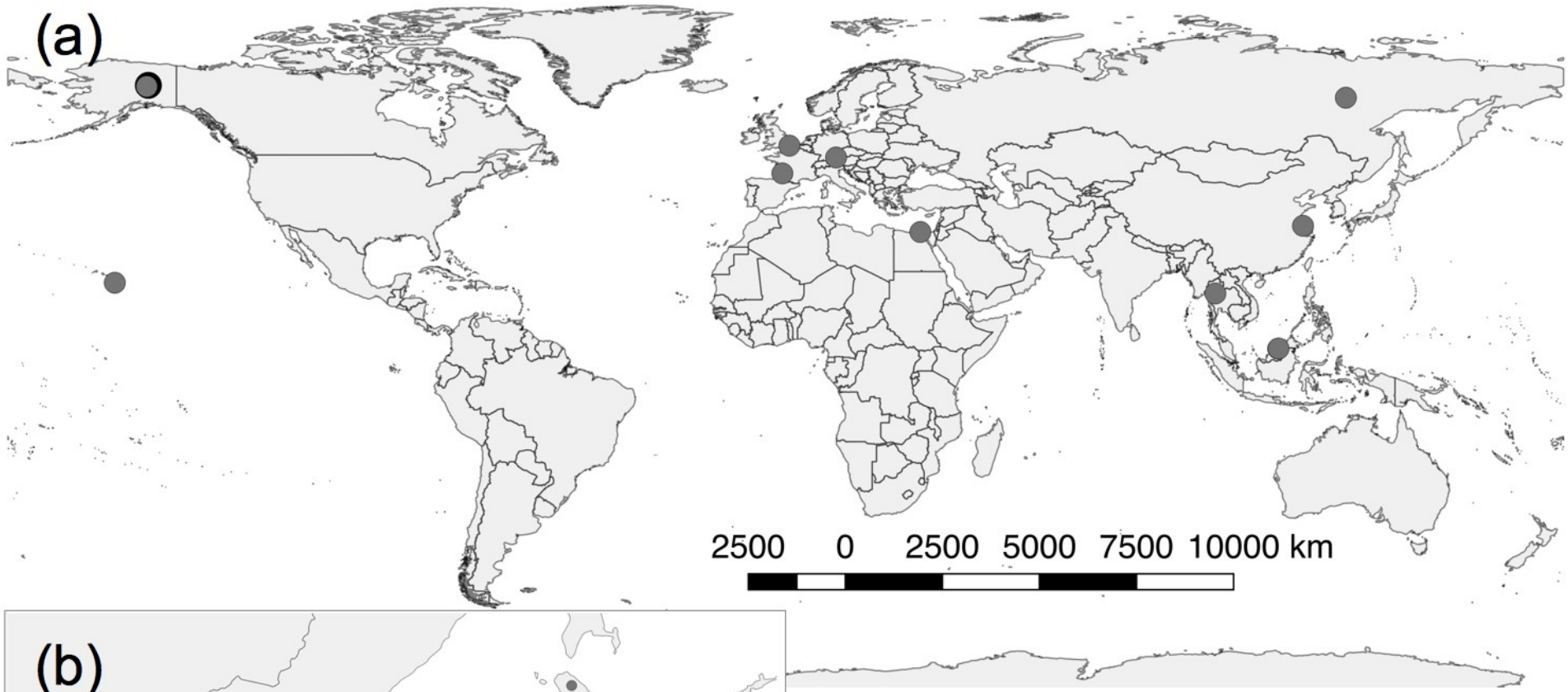
Blue Green Red Near-infrared

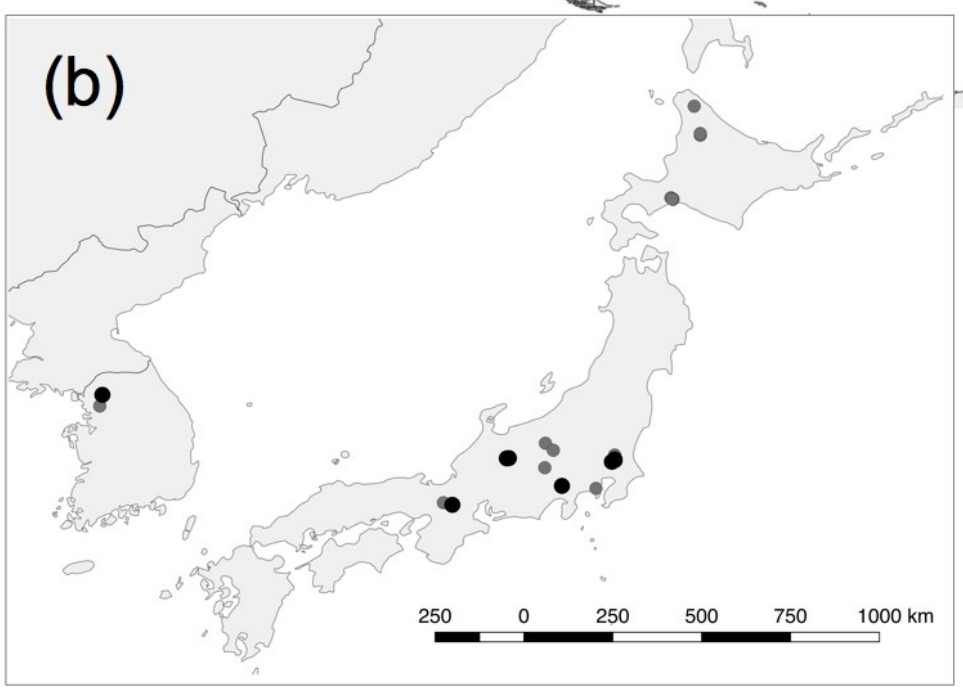
[NASA]

AVHRR

1 2

# *Maps of Phenological Eyes Network (PEN) sites*



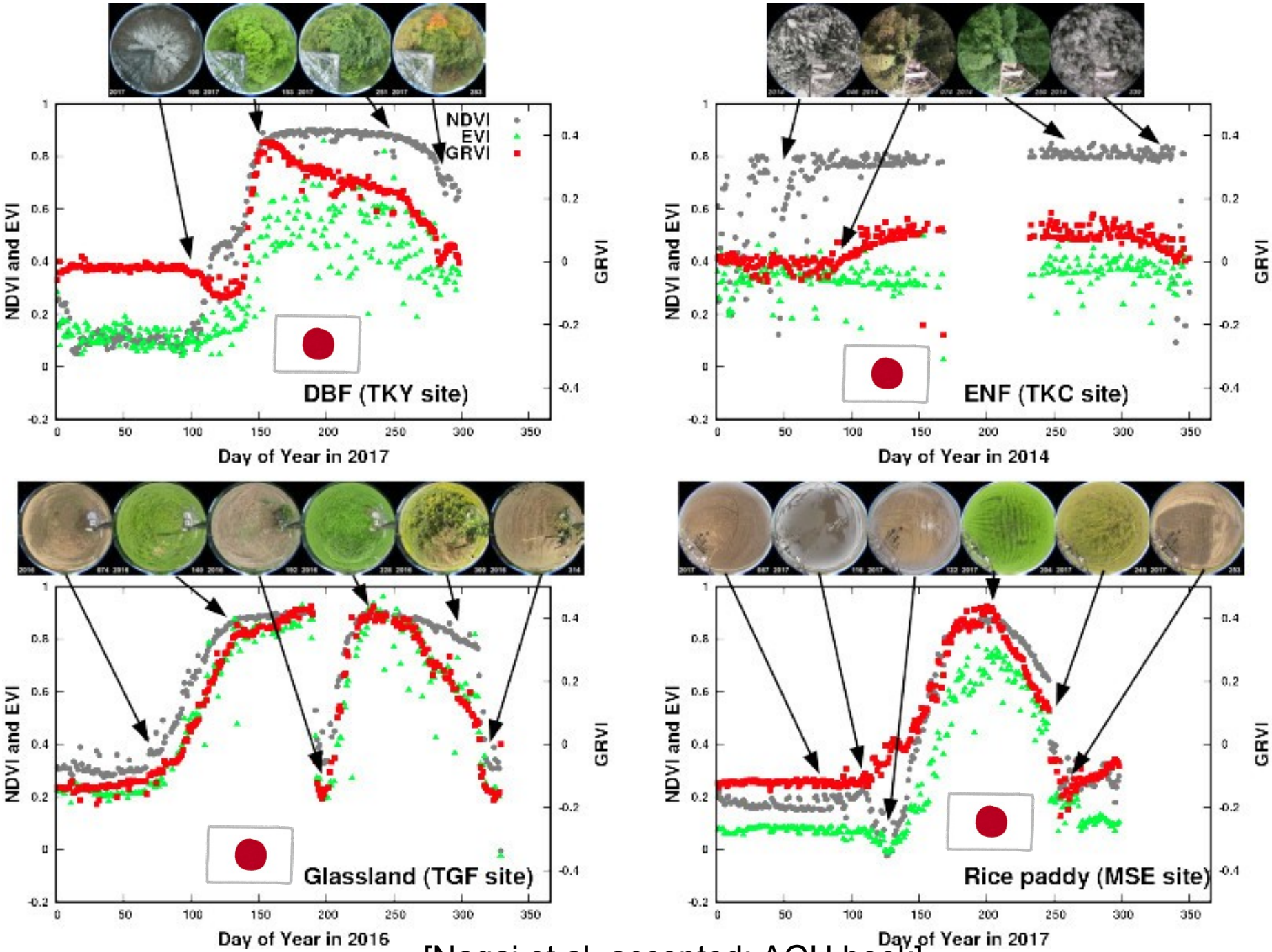

●: time-lapse digital camera

●: time-lapse digital camera
+ spectral radiometer

MS720
Eko Ltd.
Japan

[Nagai et al. accepted; AGU book]

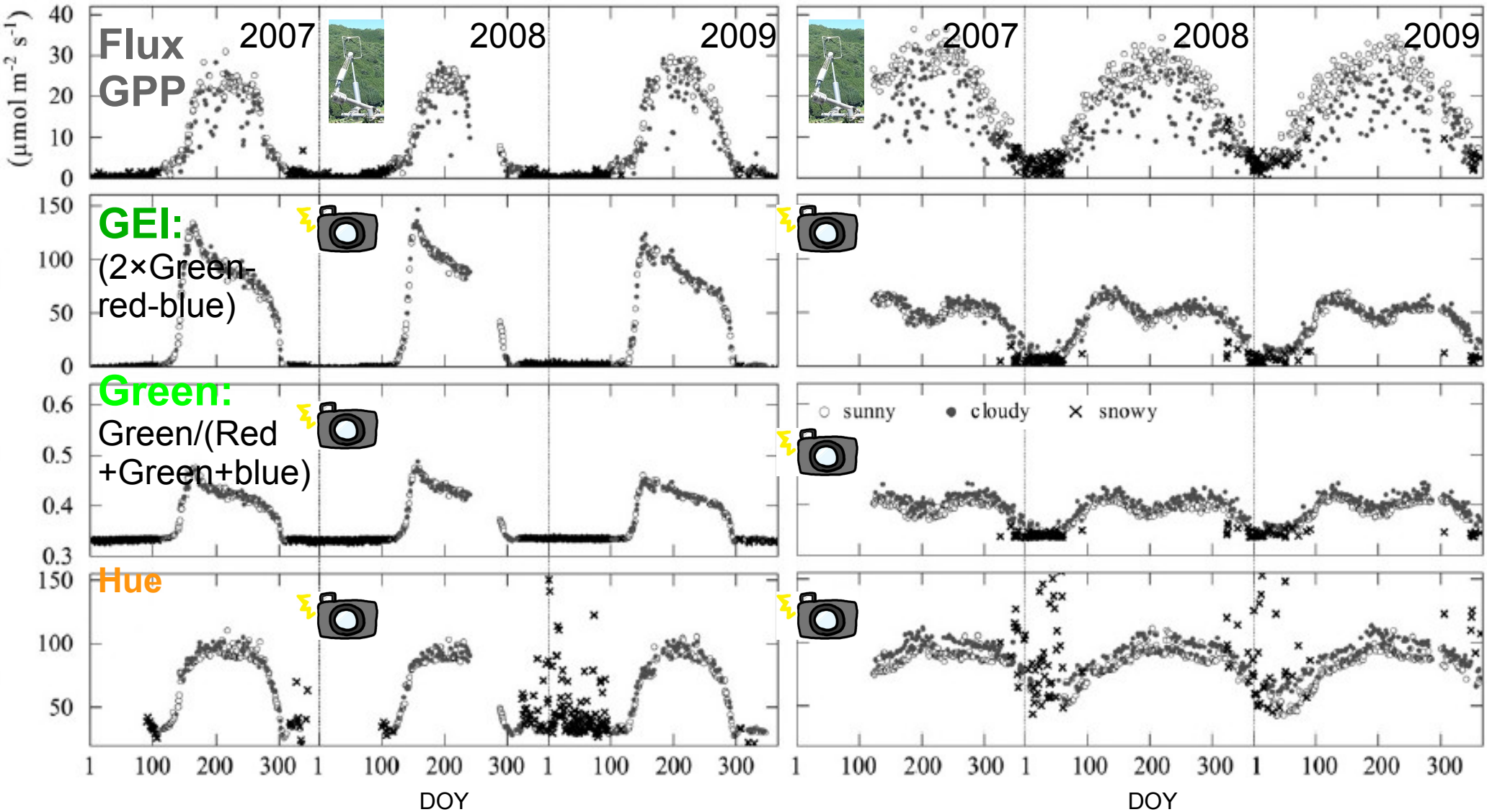
# *Various vegetation index observed by near-surface remote sensing*




[Nagai et al. accepted; AGU book]

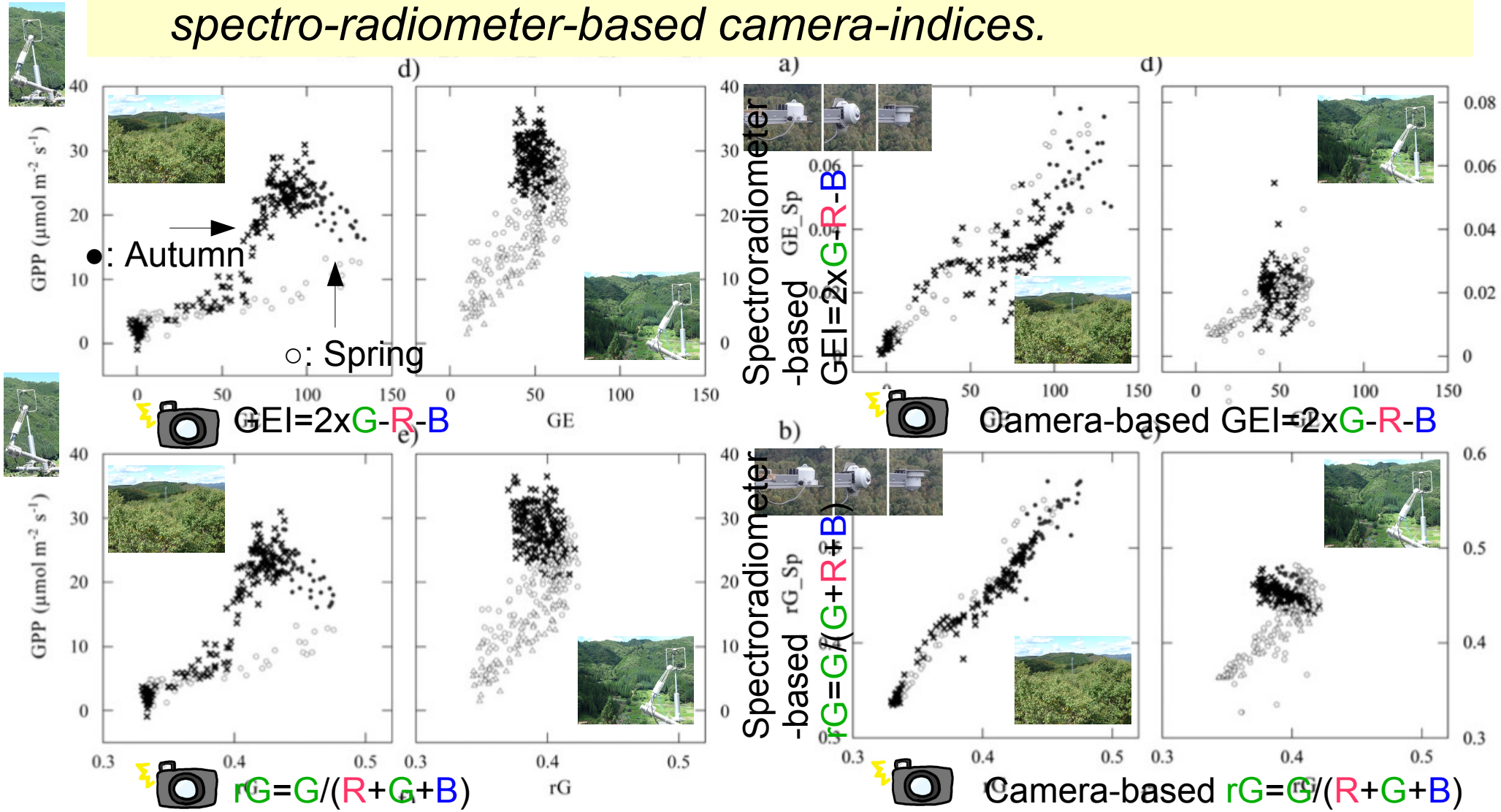
# *Relationship among flux-based GPP and camera-based indices.*

*Deciduous broad-leaved forest* *Evergreen coniferous forest*



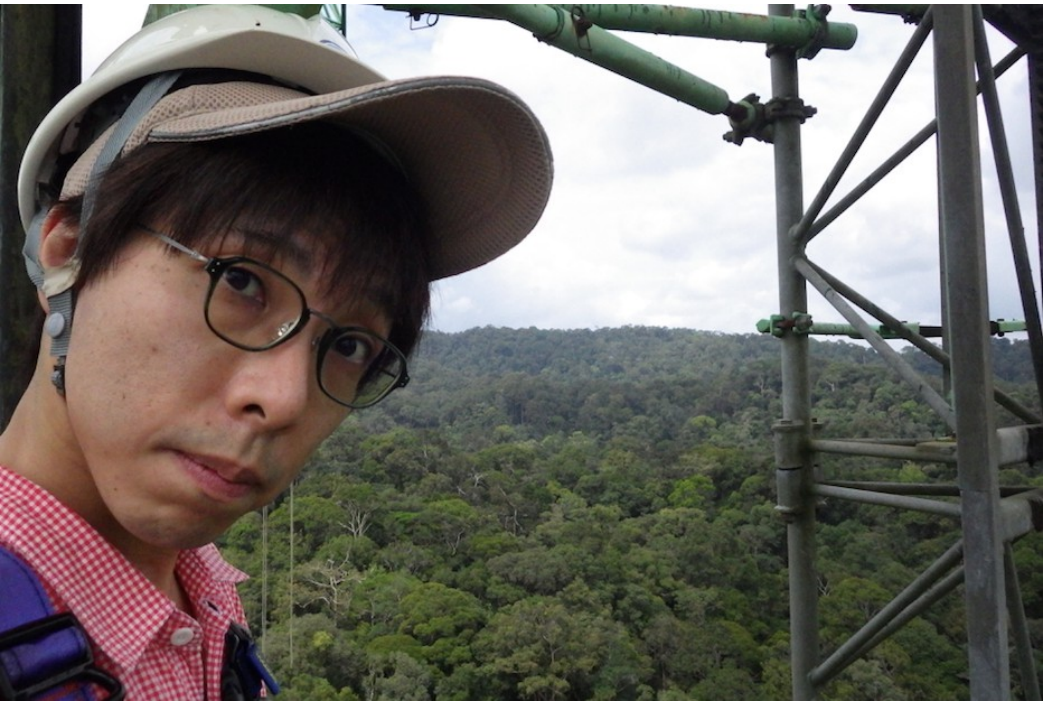

[Saitoh, Nagai et al., 2012 Ecol Informat]

# *Relationship among flux-based GPP, camera-based indices, and spectro-radiometer-based camera-indices.*




***Camera-based indices correlated with potential photosynthetic activity (GPP on sunny days).***

[Saitoh, Nagai et al., 2012 Ecol Informat]

# *Thank you for your attention and supports!*

- s ArCS (MEXT)
- s Belmont Forum (COPERA)
- s GCOM (JAXA)