



A continuous monitoring system of terrestrial
ecosystem for satellite validation

"Phenological Eyes Network (PEN)"

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We need ground data for validation of ecology remote sensing.

Satellite data (band reflectance, VIs)



Ground optical data



Ground ecology data
(carbon flux, LAI, phenology etc.)

Systematic error due to cloud, aerosol, sensor angle, sun angle, etc., within a single satellite sensor.

Difference in overpass-time, band setting, etc. among multiple sensor.

We need stable, long-term, multi-site ground datasets to mitigate these problems.

Because ecosystem is always changing!

A network of the ground sites for data collection of these purposes:

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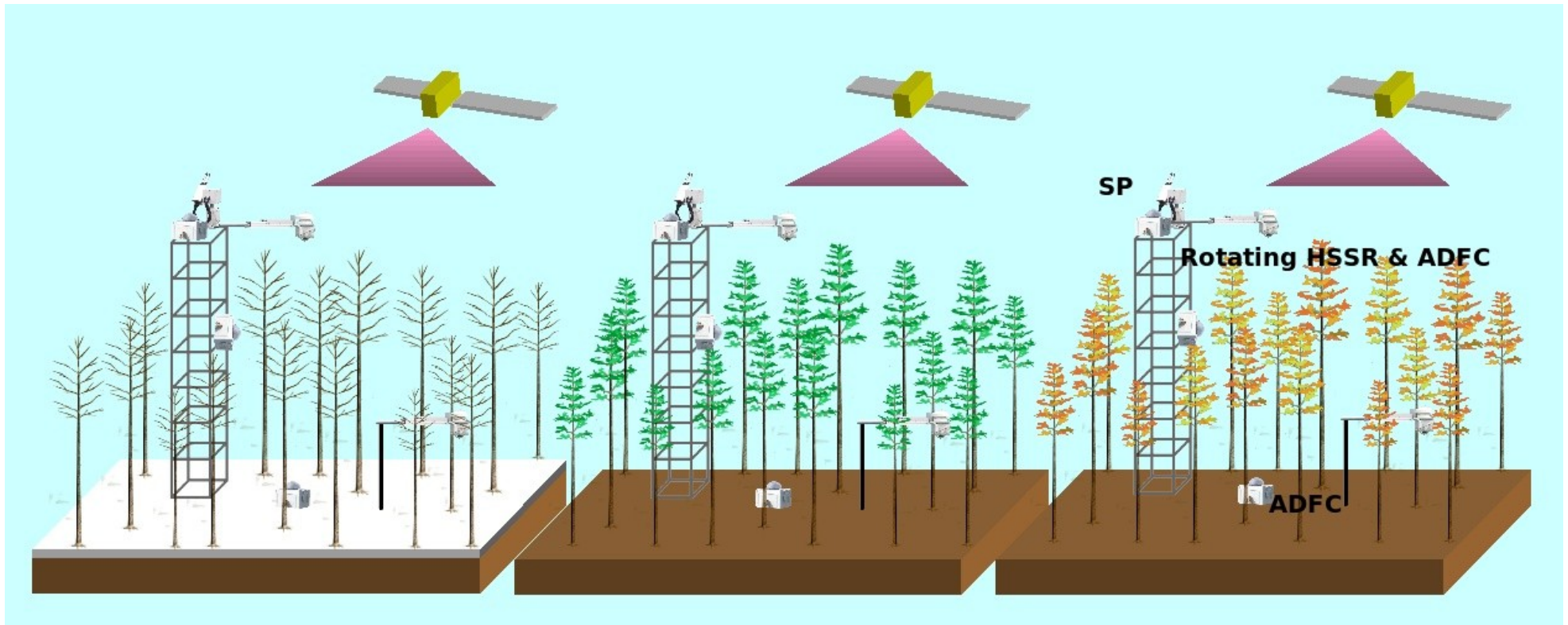
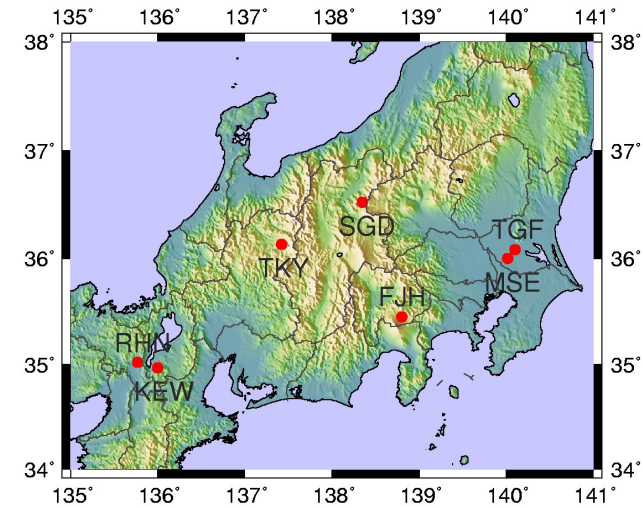
"Phenological Eyes Network (PEN)"

Phenological Eyes Network (PEN)

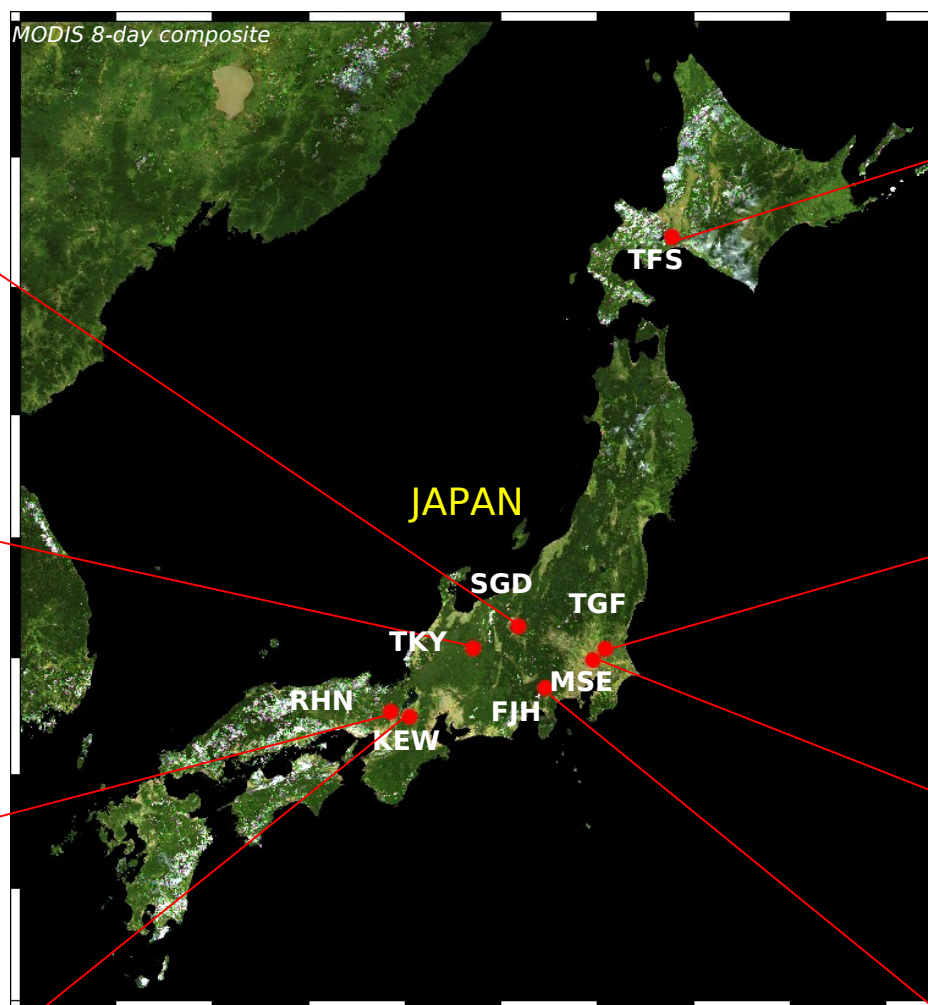
PEN

Phenological Eyes Network

Phenology, carbon & water flux, aerosol (yellow sands etc.), spectral reflectance, leaf area (LAI), PAR, FPAR, etc.



PEN Sites



Most of the PEN sites are located at the AsiaFlux sites. AsiaFlux is a monitoring network of carbon, water and energy fluxes between ecosystems and the atmosphere.

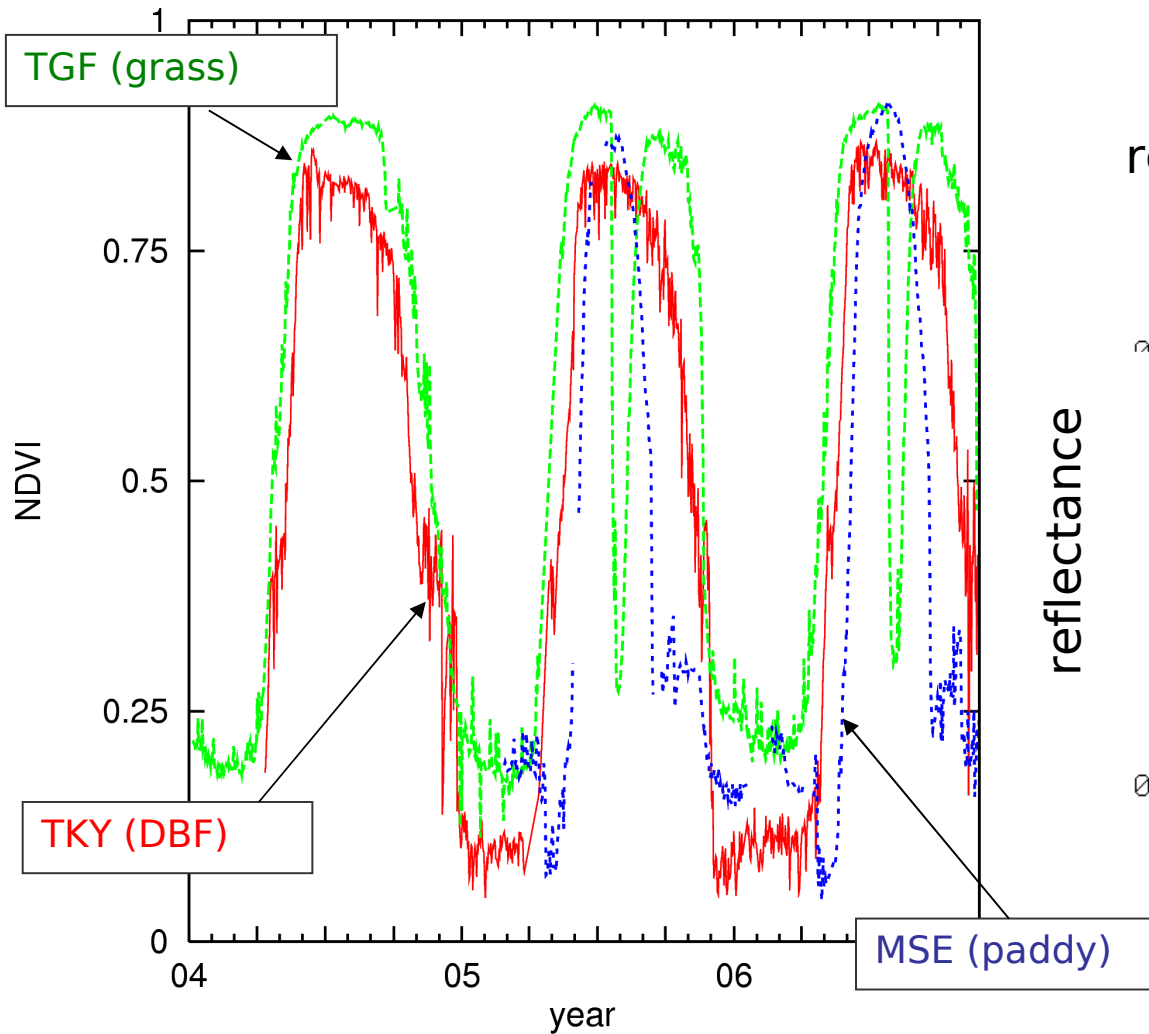
* TFS and RHN stopped operation in September, 2004 and February 2006, respectively.

Phenological Eyes Network (PEN)

HSSR (hemispherical spectro-radiometer)



Ground measured NDVI at PEN site

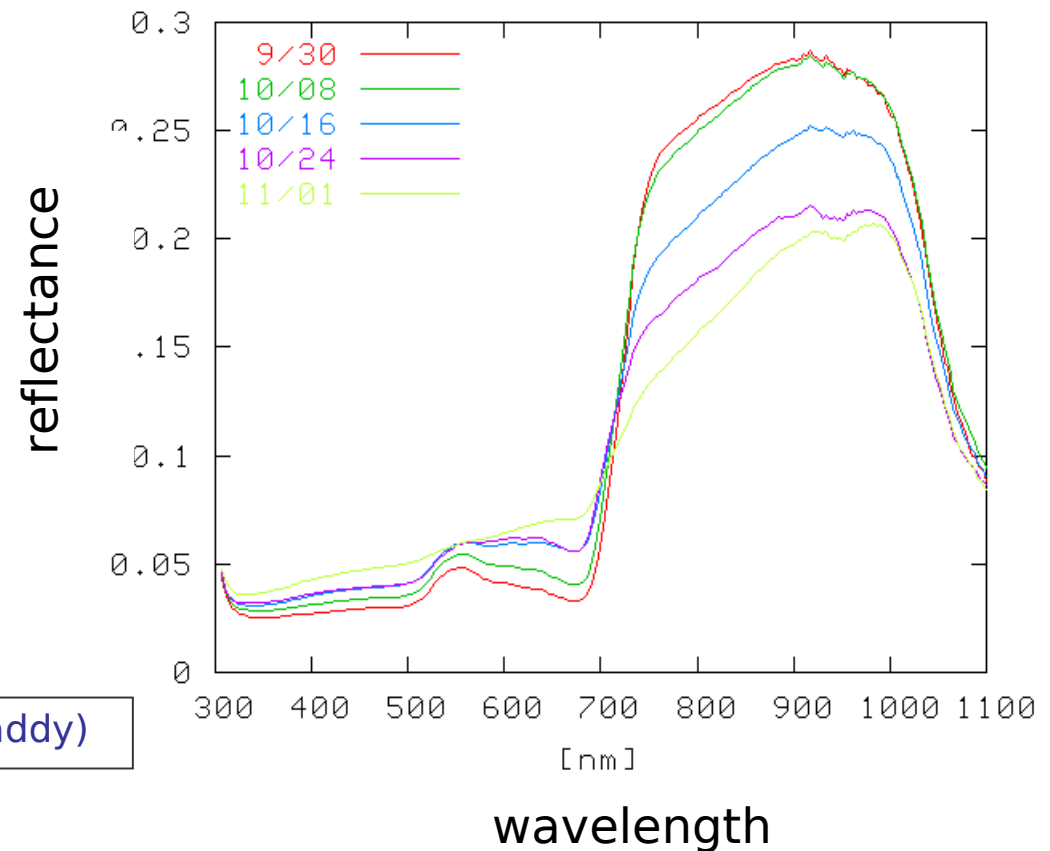


Takayama 18m

TERC

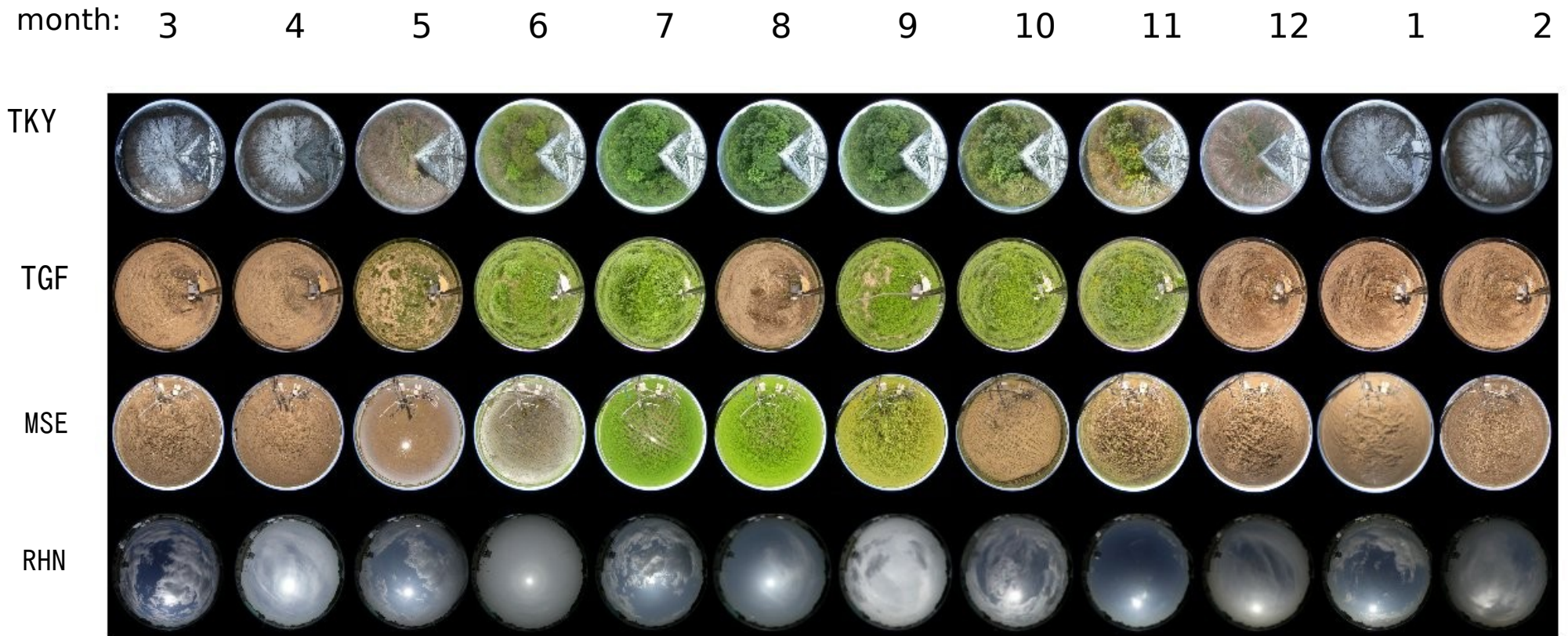
Mase

reflectance spectrum (Takayama site)



Phenological Eyes Network (PEN)

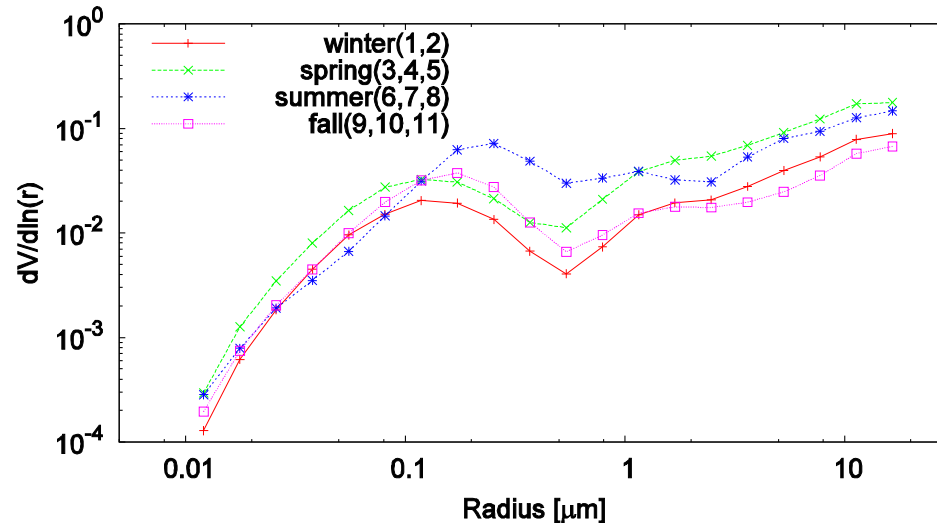
ADFC (automatic digital fish-eye camera)



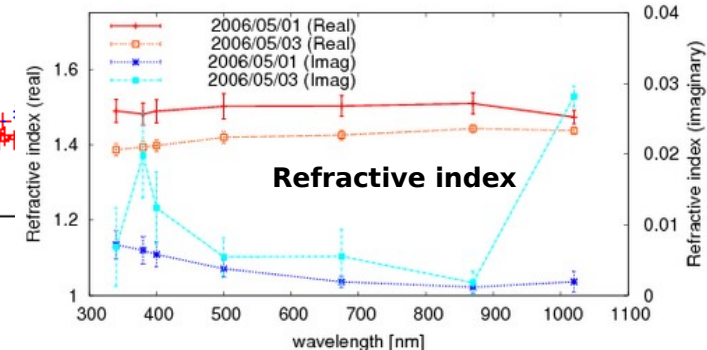
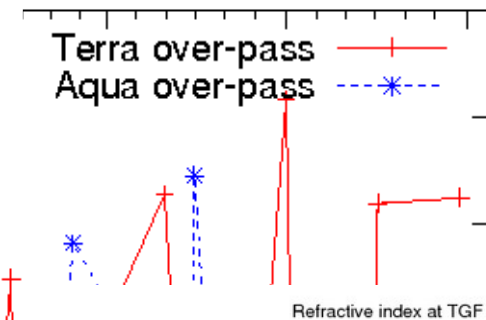
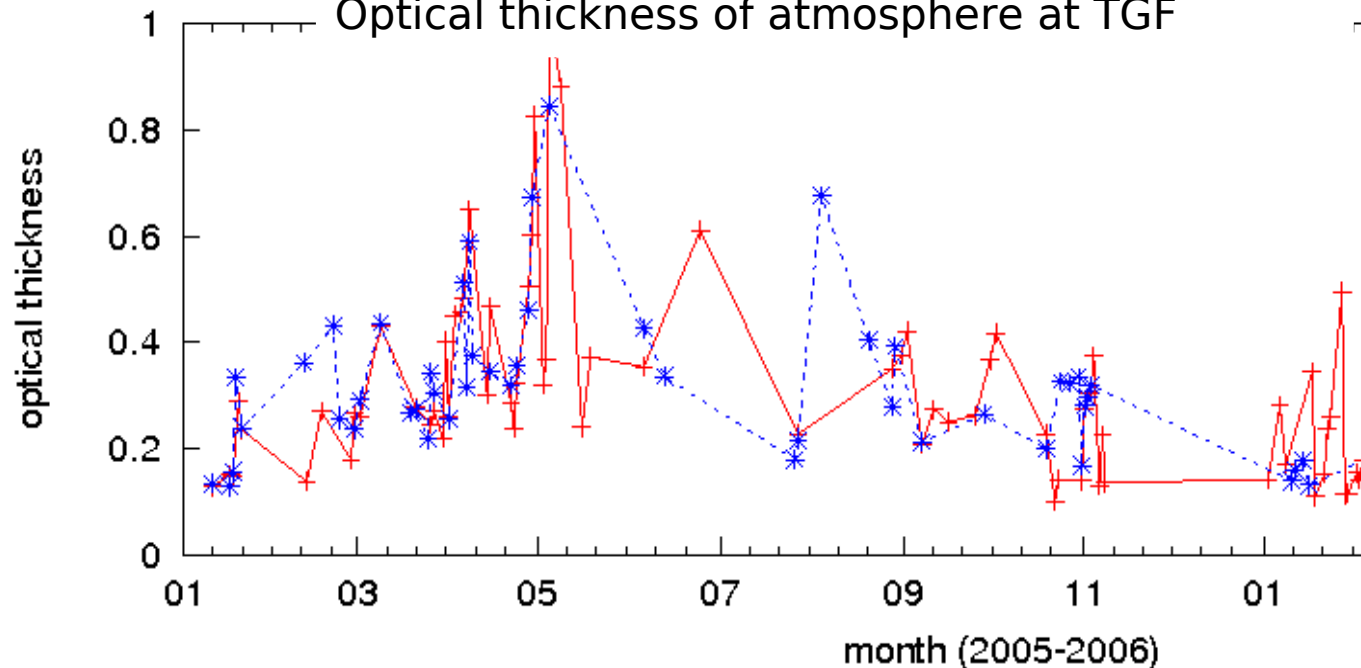
Phenological Eyes Network (PEN)

Skyradiometer (sunphotometer)

aerosol particle size
at TGF (2005)

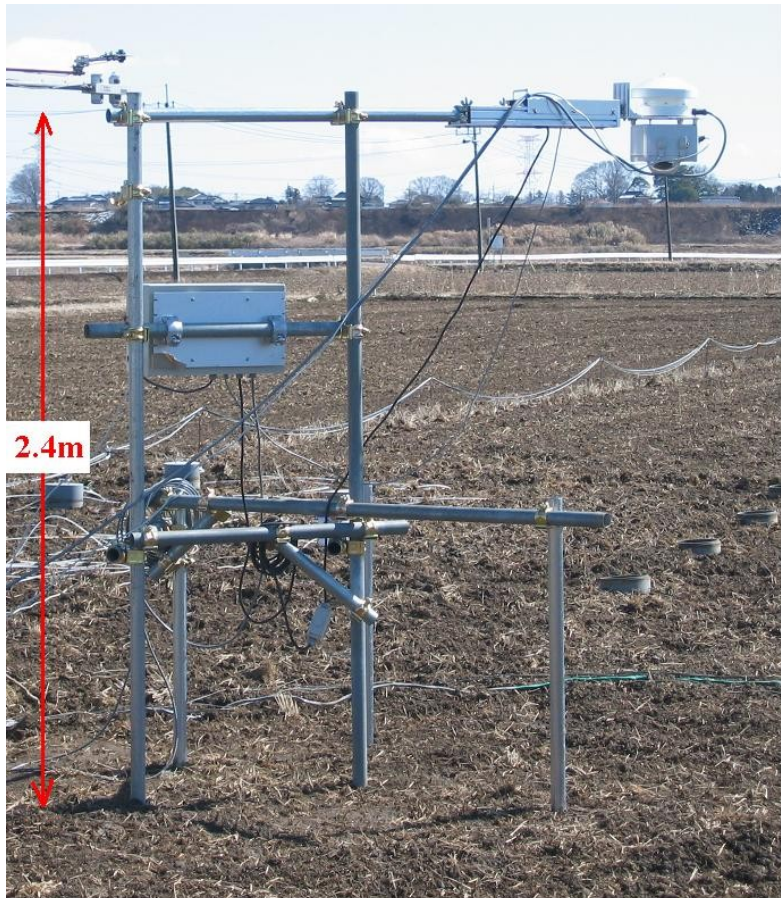


Optical thickness of atmosphere at TGF



Phenological Eyes Network (PEN)

Installation in MSE



Automatic-capturing Digital Fish-eye Camera (ADFC)

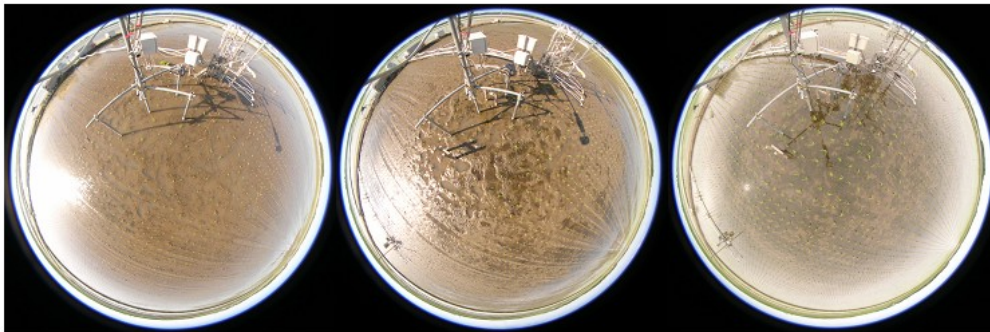
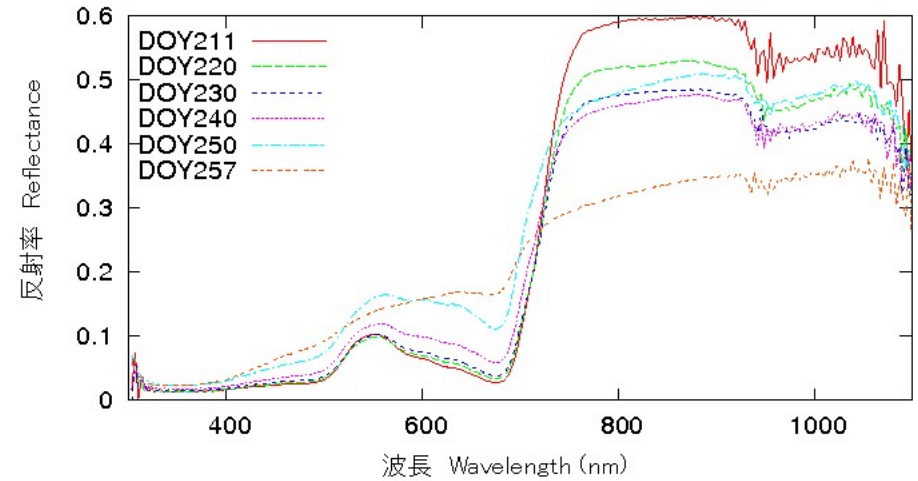
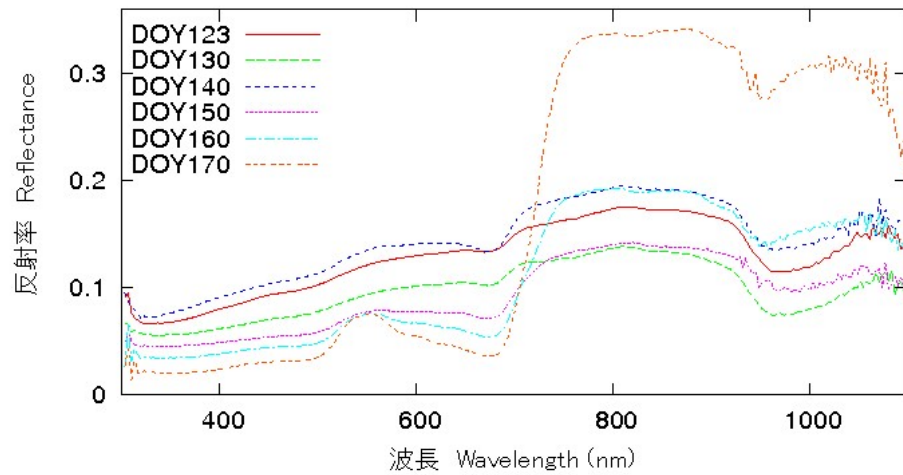
(NIKON Coolpix4300 + FC-8 Fisheye Converter)



Hemispherical Spectro-radiometer (HSSR)

(Eko MS-700; 350nm-1100nm; 256bands)

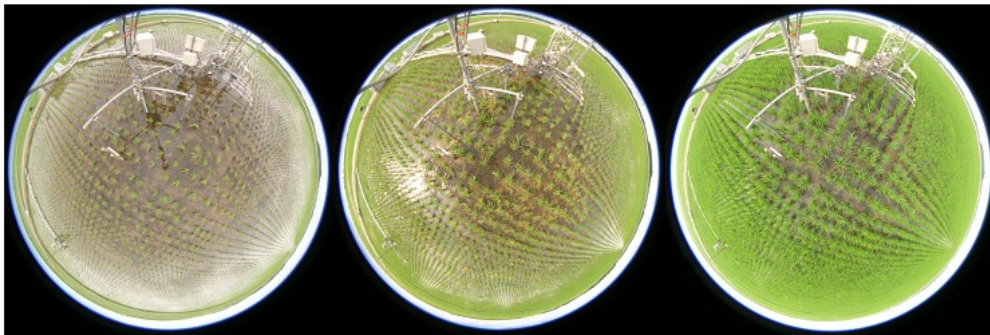
Example: Mase site (paddy), 2005



DOY123

DOY130

DOY140



DOY150

DOY160

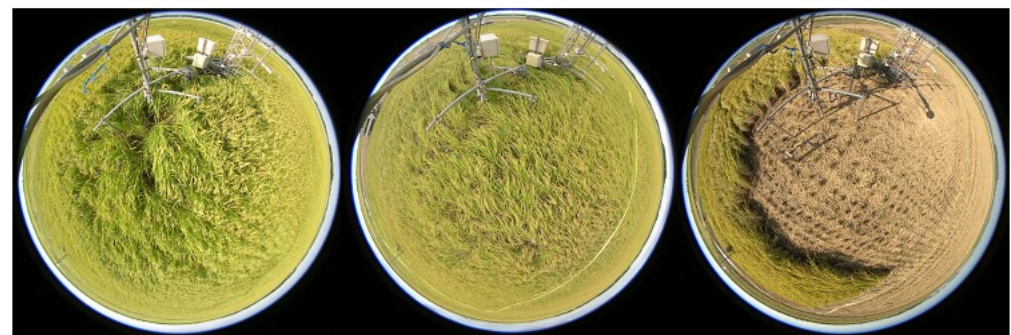
DOY170



DOY211

DOY220

DOY230

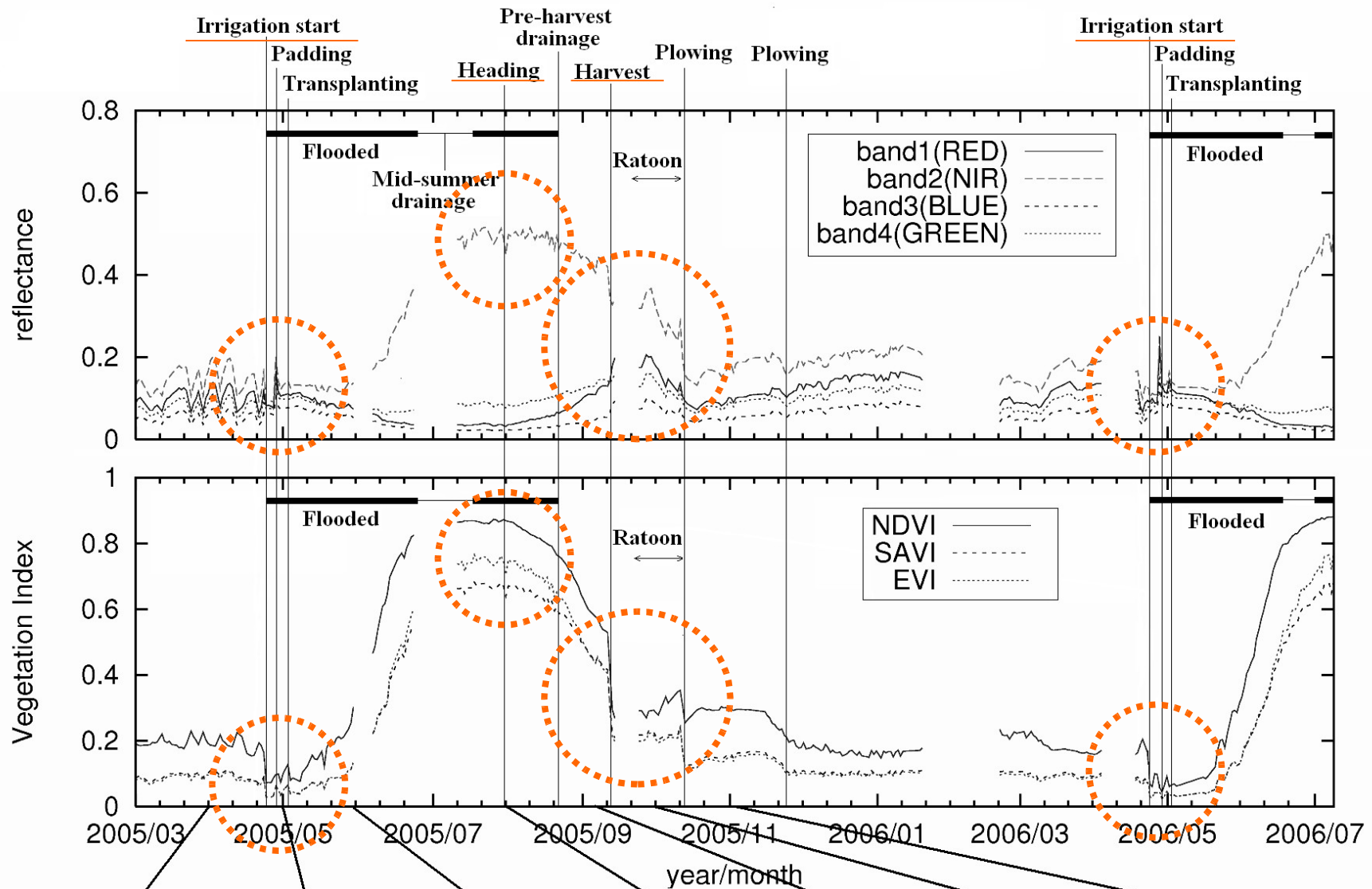


DOY240

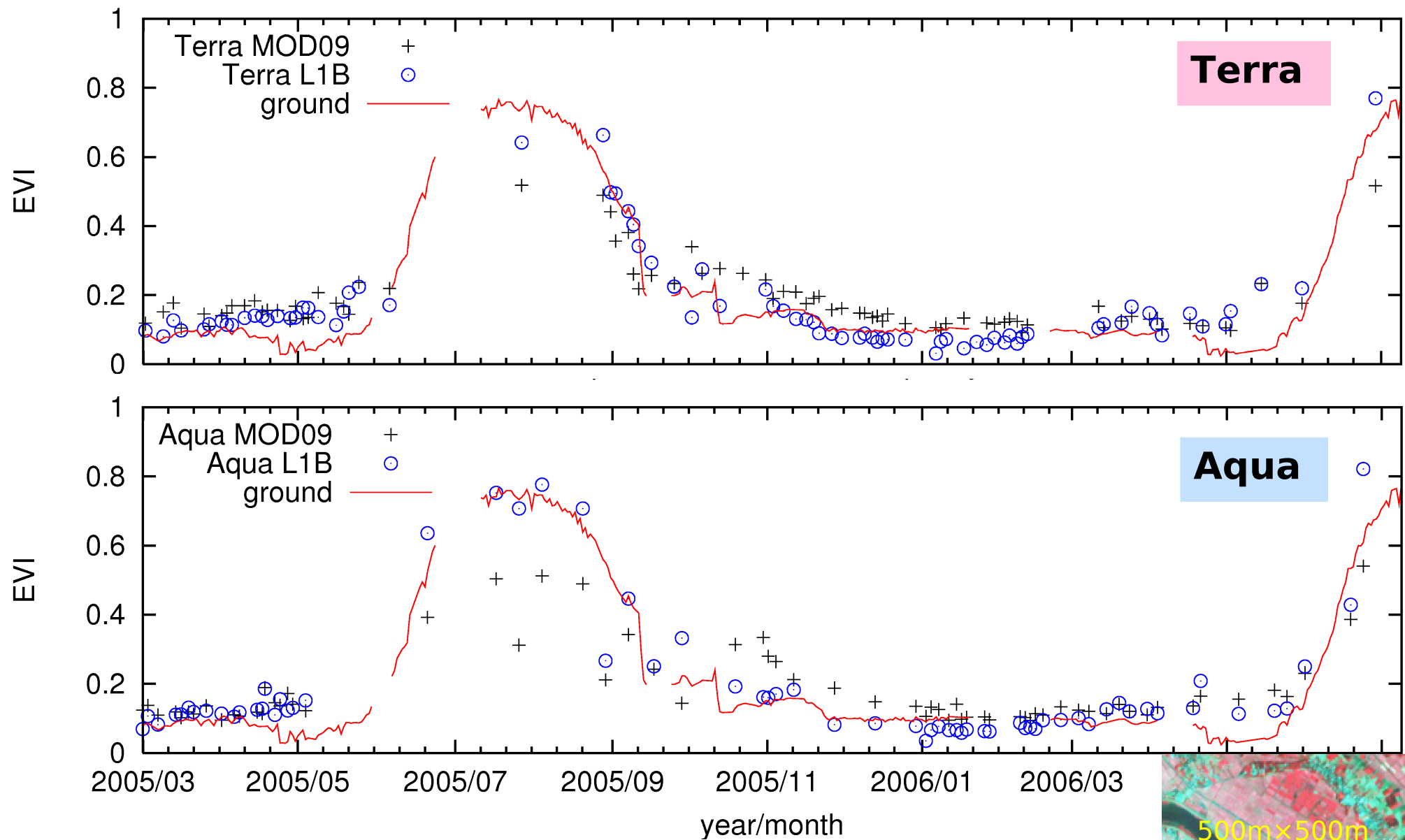
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DOY257

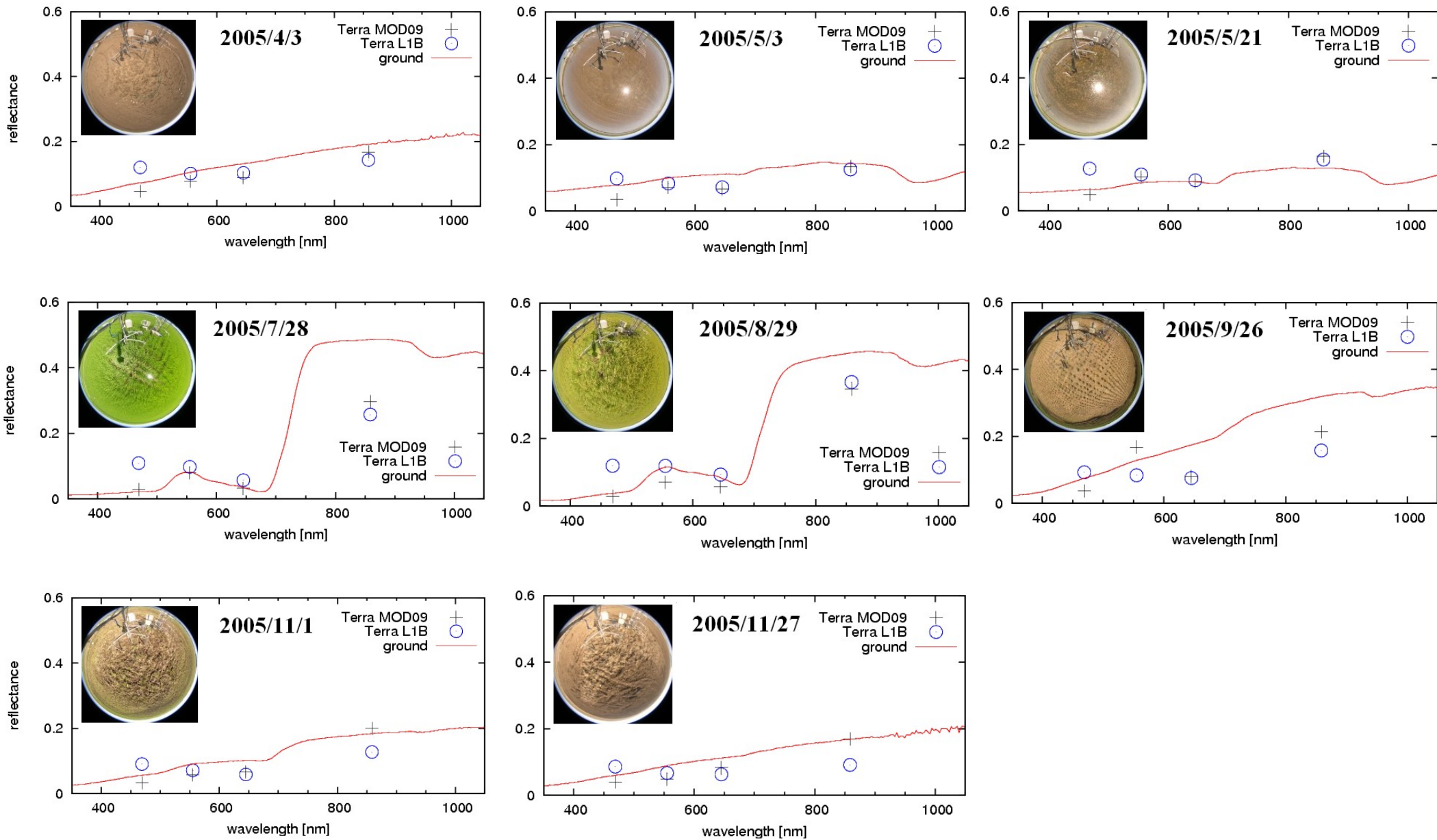
Example: Mase site (paddy), 2005-2006



Example: check of satellite index at Mase site (paddy)



MODIS data vs. ground data: spectrum



Manual observations

Leaf area index (LAI):



litter traps



LAI-2000



TRAC

Monitoring of shoots and leaves



phenology



leaf spectrum



leaf physiology

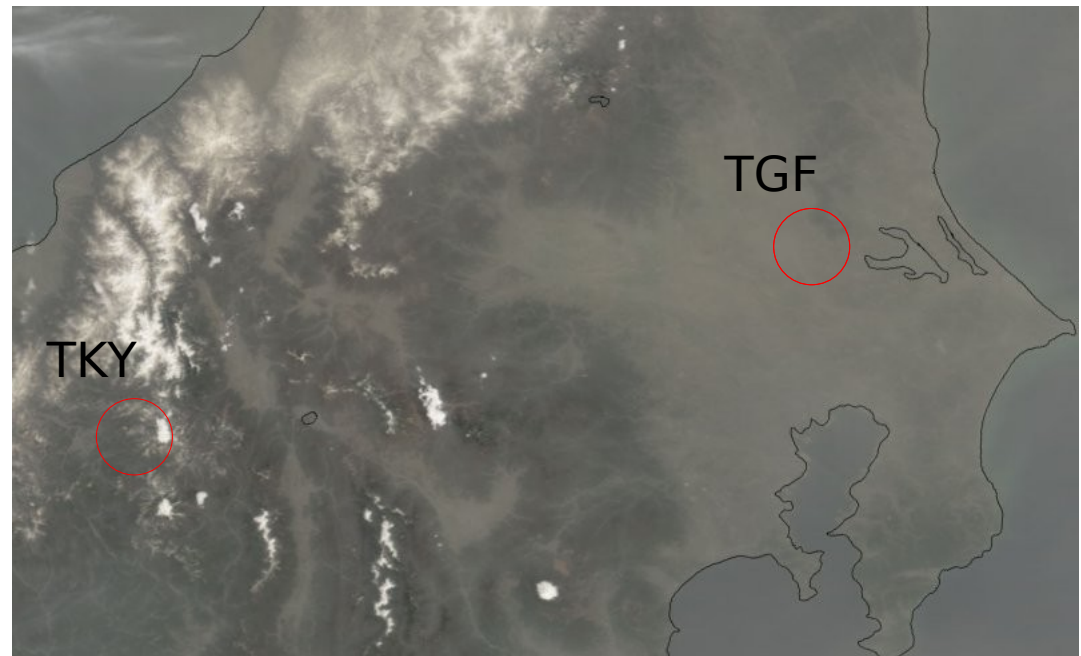
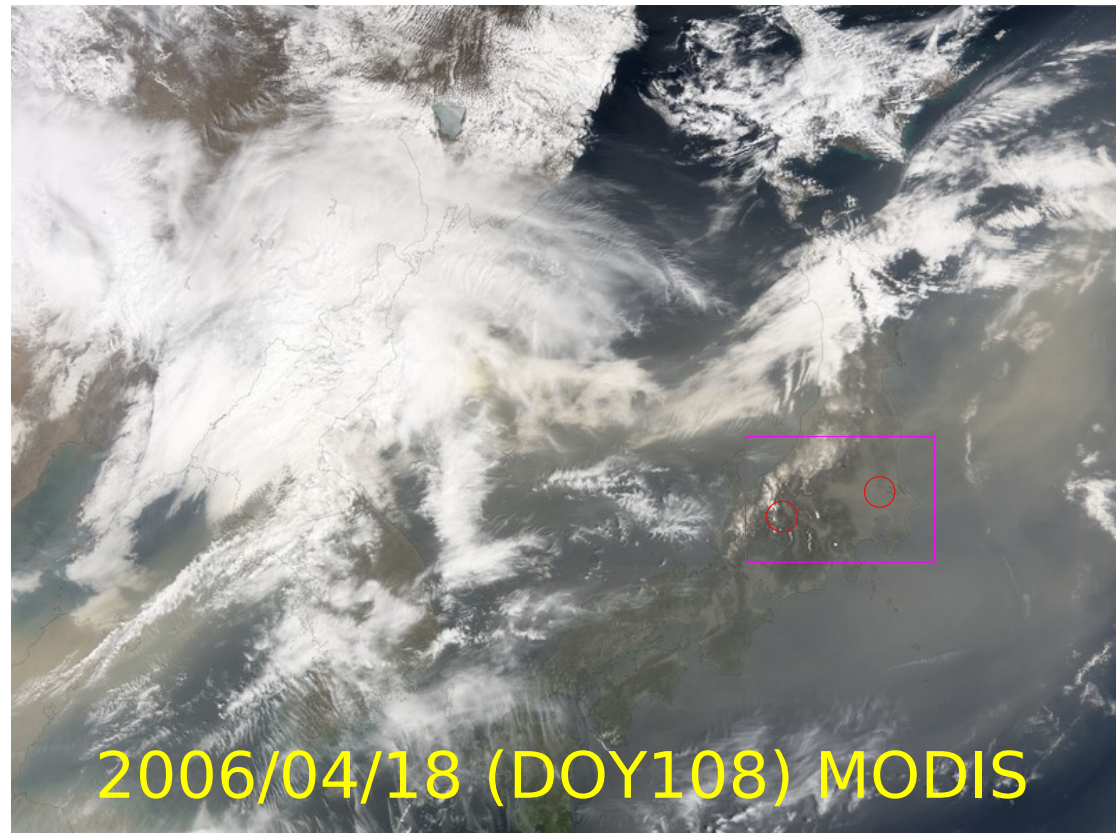
Yellow sands captured by PEN

TKY

TGF

2006/04/17 10:30AM

2006/04/18 10:30AM



From 4/17 to 4/18, visibility decreased suddenly. Influence was bigger in TKY than TGF, because TKY is closer to the Chinese continent.