

Phenological Eyes Network (PEN): A Ground Network for Satellite Ecological Data Validation



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This study was supported by the S-1 program: “Integrated Study for Terrestrial Carbon Management of Asia in the 21 Century Based on Scientific Advancements” funded by the Global Environmental Research Fund of the Ministry of the Environment of Japan.

What is PEN (Phenological Eyes Network) ?

It is a network of ground observation sites for long-term continuous validation of terrestrial ecological remote-sensing. It started in 2003 in Japan. Most sites are located at Asia-Flux network sites (with carbon and water flux observations).

Why long-term and continuous?

We want to capture the seasonal and inter-annual change pattern of ecosystem by satellites. Because ecosystem is continuously changing, validation of the satellite data should be also continuous.

Automatic observations

ADFC (Automatic Digital Fisheye Camera)

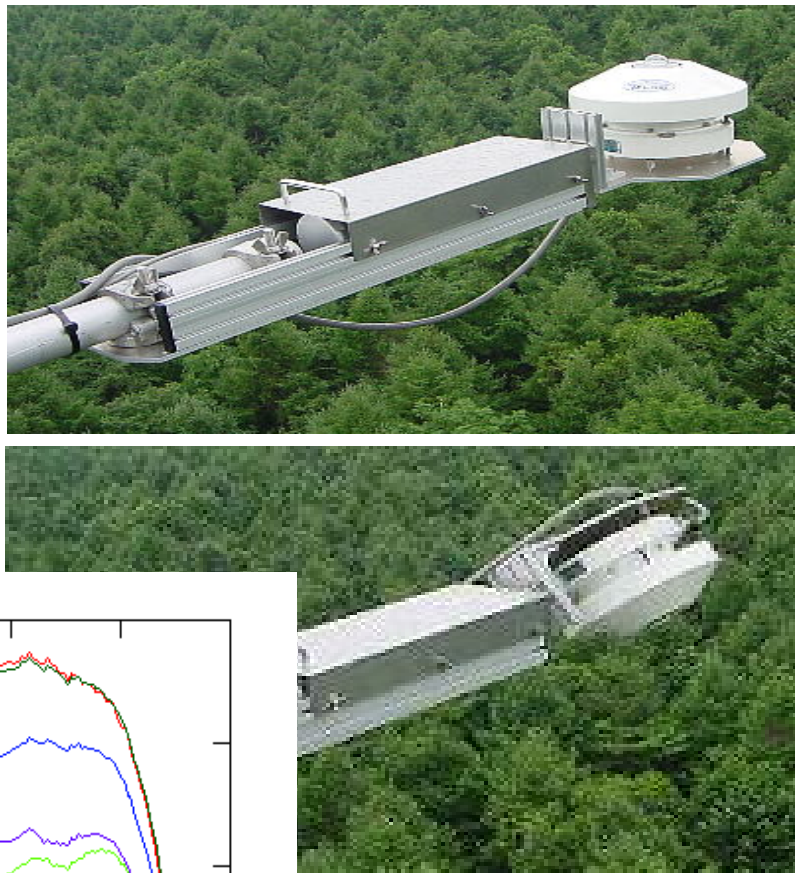
Device: Nikon Coolpix 4300/4500 + FC-E8 converter
Target: sky image ... validation of cloud flags
canopy image ... phenology and LAI



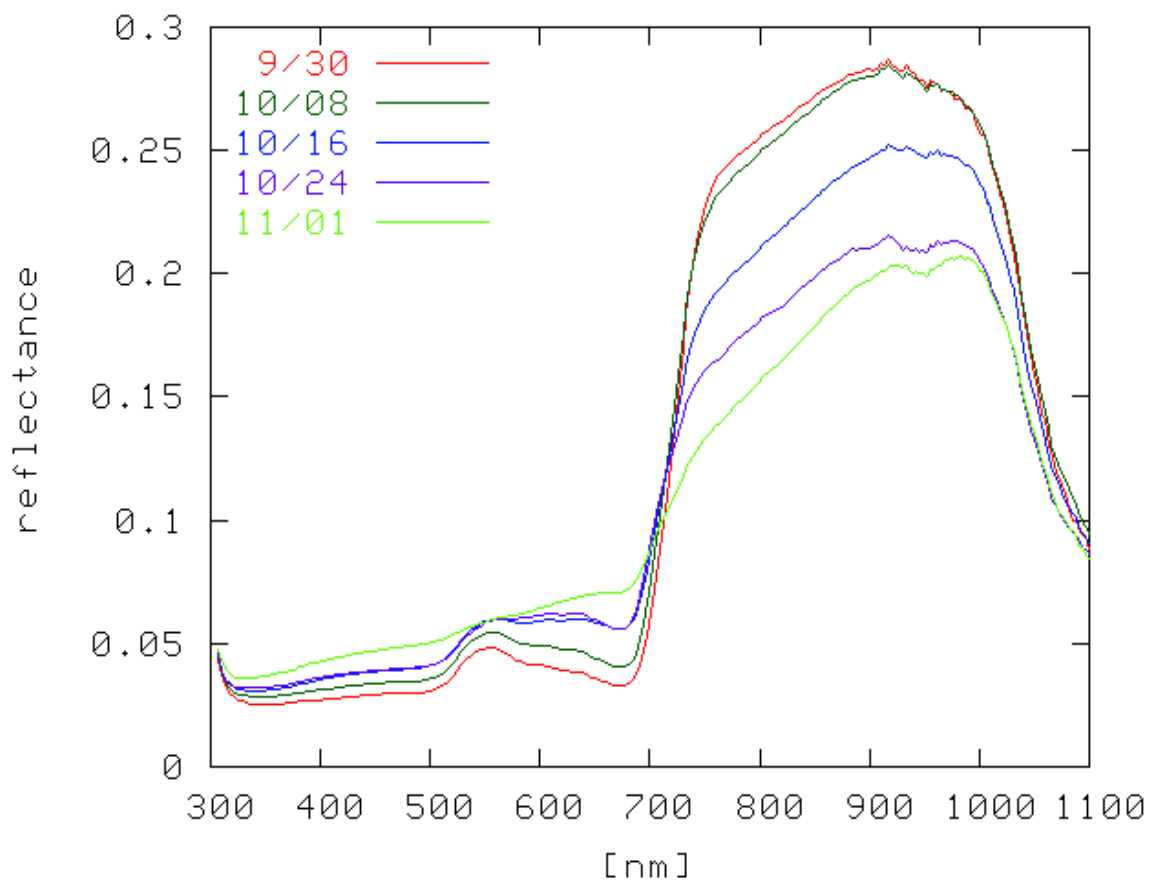
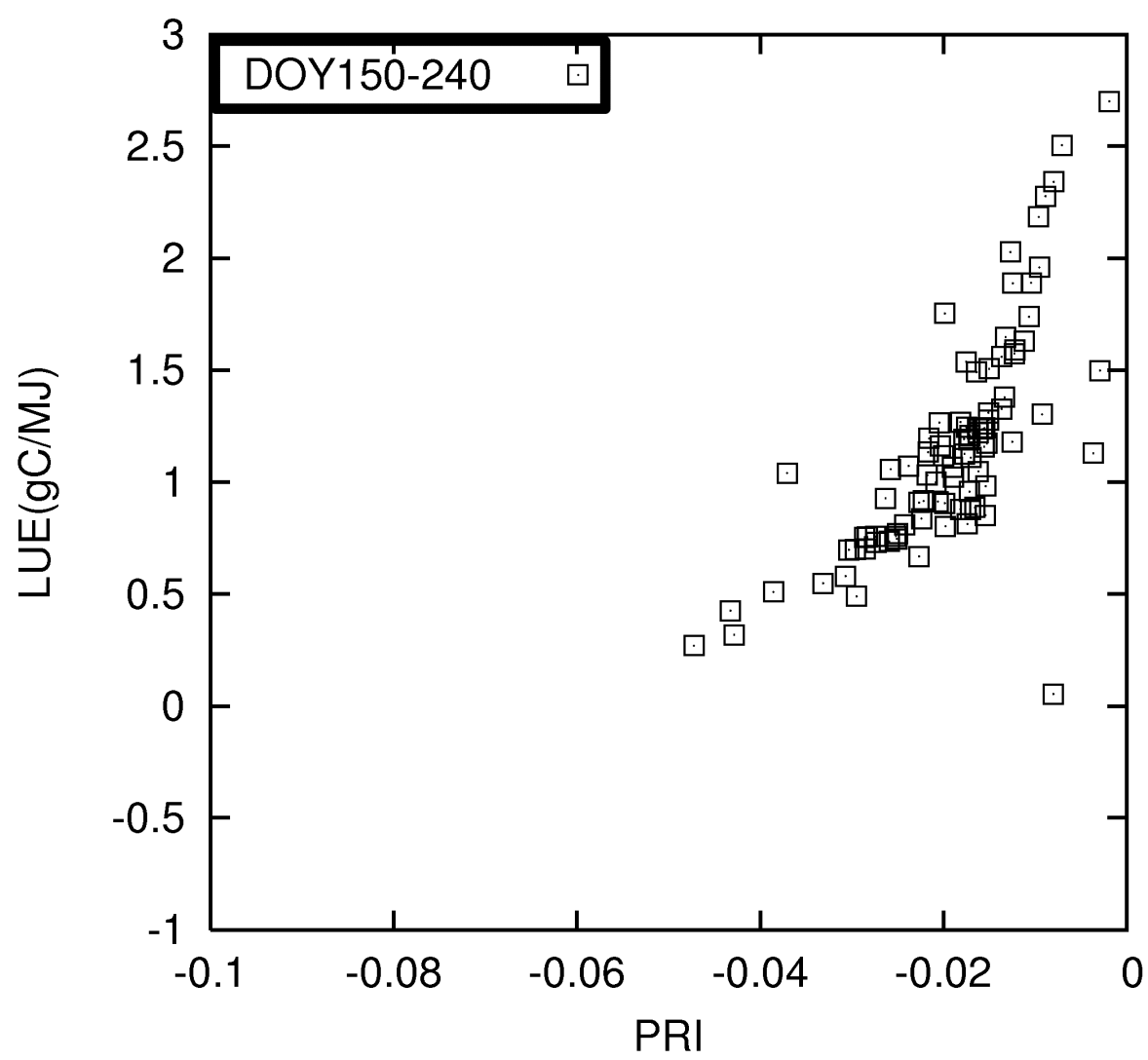
every 2 minutes

HSSR (Hemi-Spherical Spectral Radiometer)

Device: Eko MS700 + automatic rotating system
Target: sky ... PAR, PAR/shortwave ratio
canopy ... spectrum, NDVI, EVI, PRI, etc.

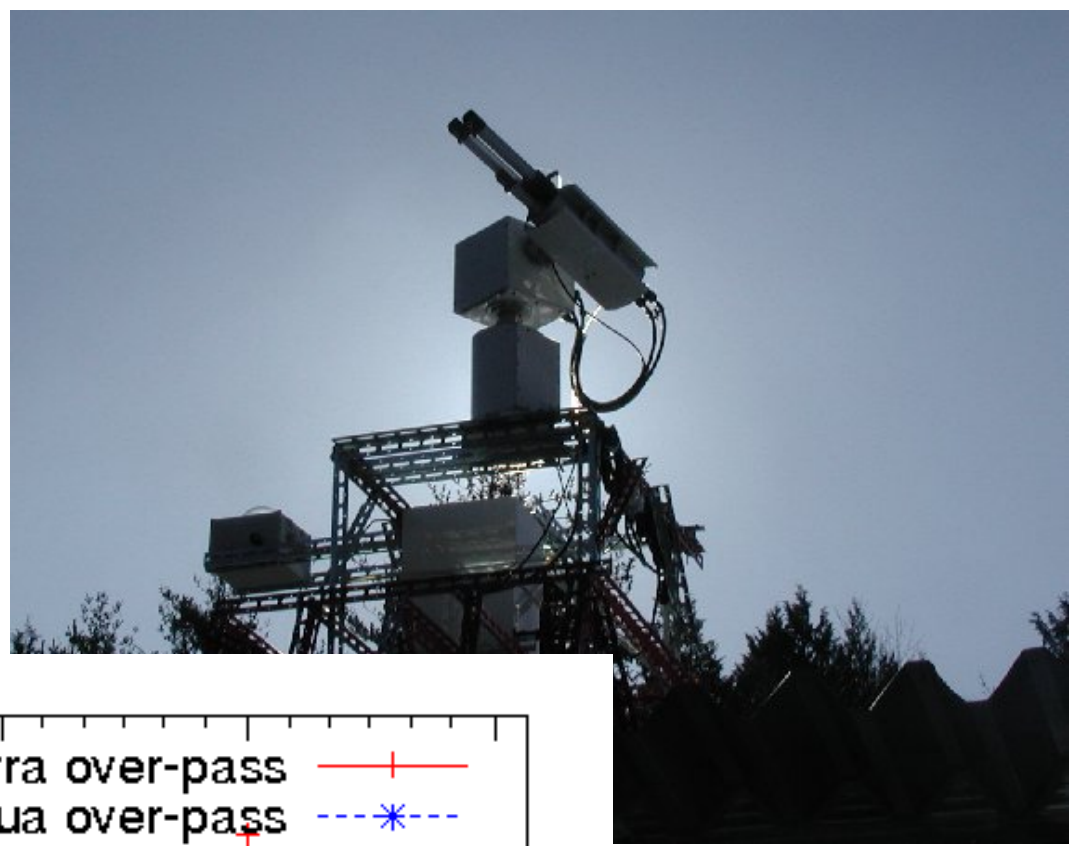


every 10 minutes

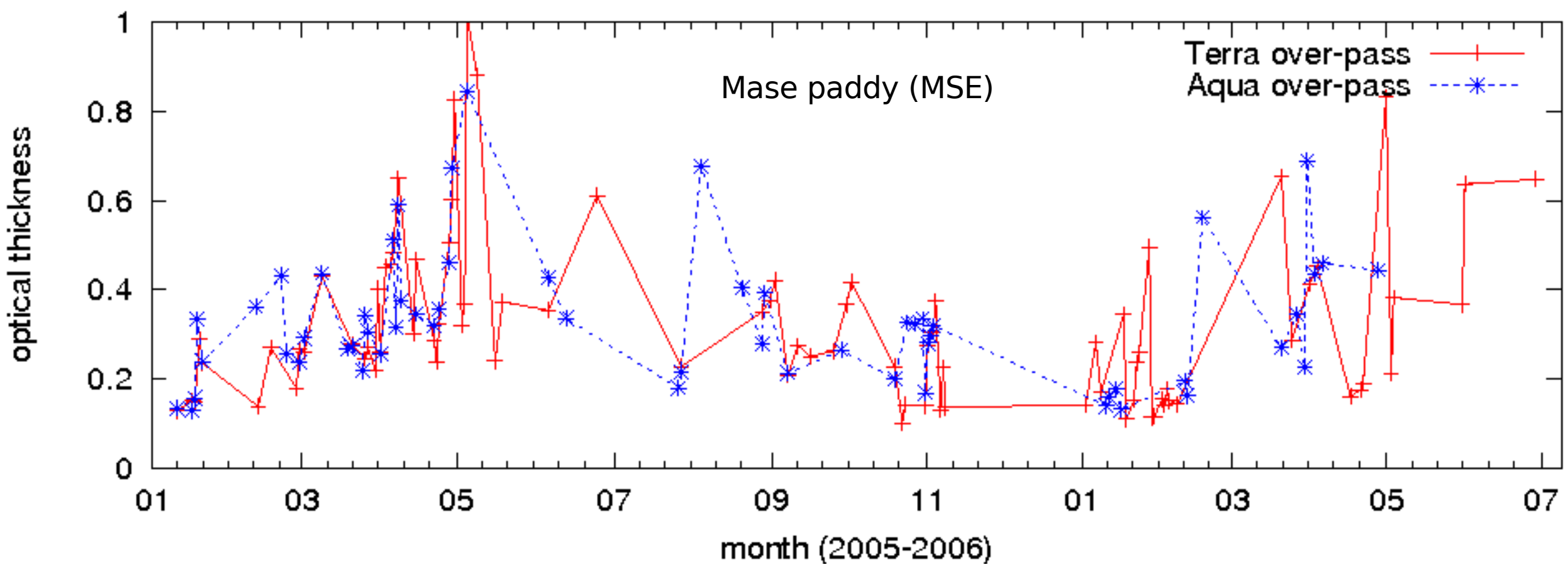


Skyradiometer (sunphotometer)

Device: PPEDE POM-01
Target: direct sunlight ... optical thickness
diffuse sunlight ... aerosol etc.
canopy directional radiance ... BRDF



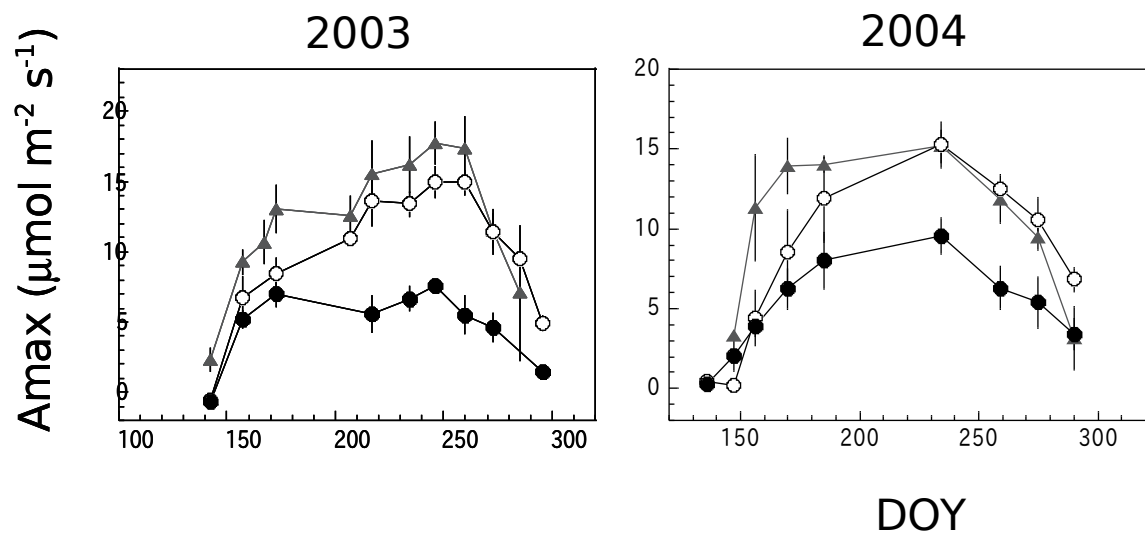
every 20 minutes



Manual observation

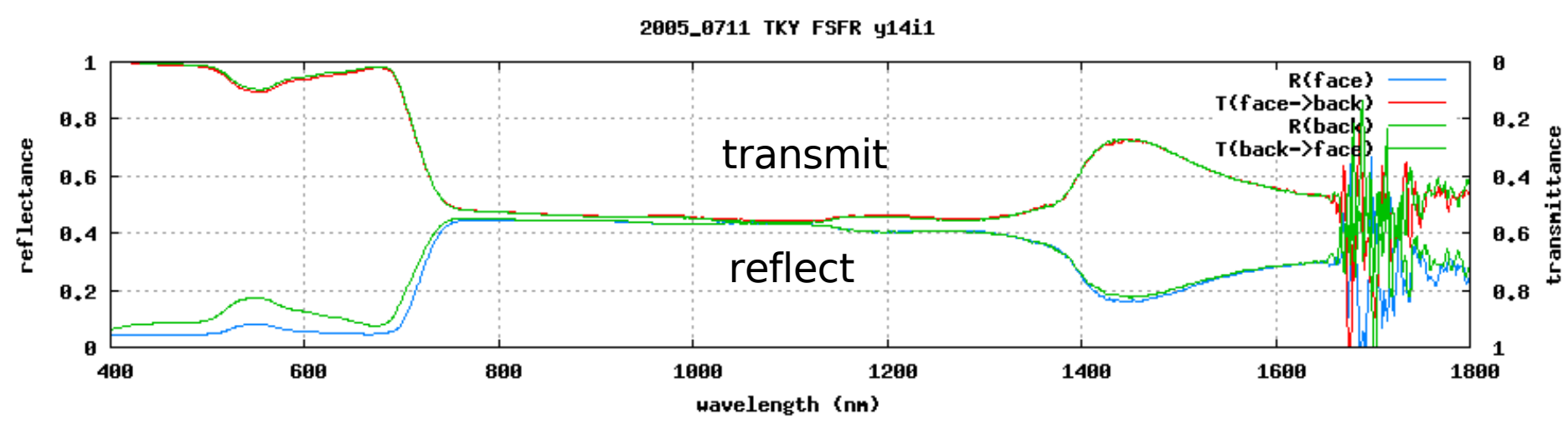
Leaf gas exchange

Device: LI6400
Target: physiological phenology



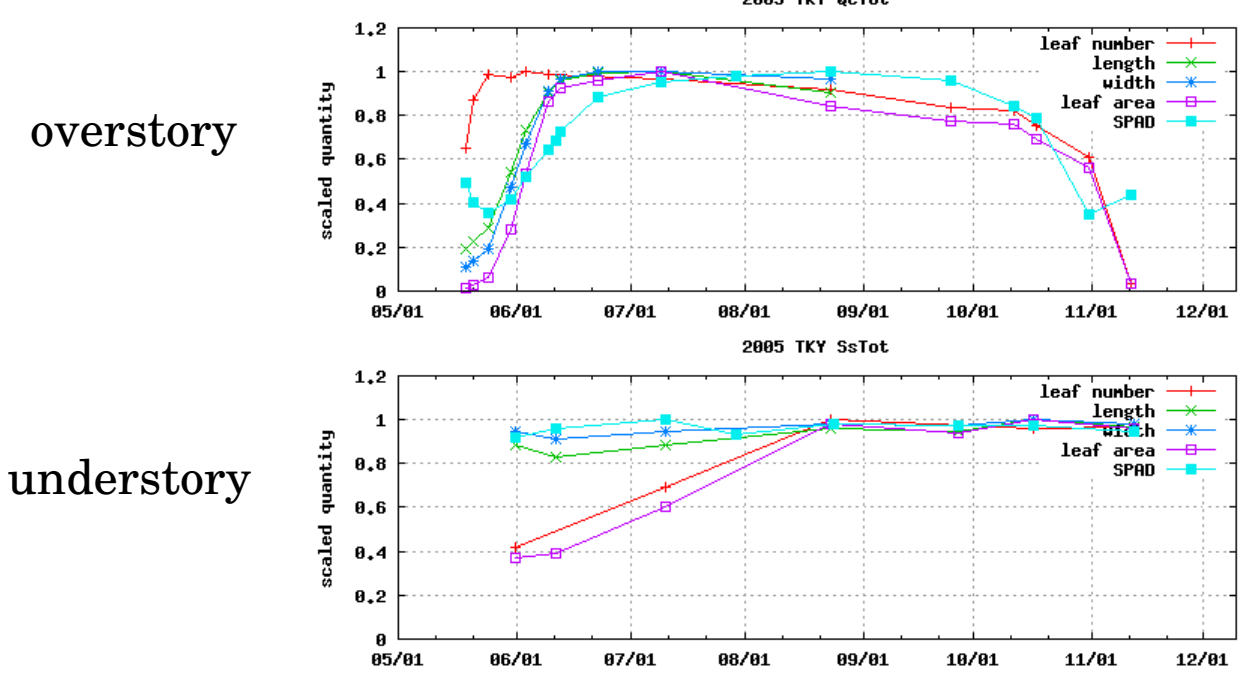
Leaf optics

Device: FieldSpec + LI1800 integrating sphere
Target: optical phenology



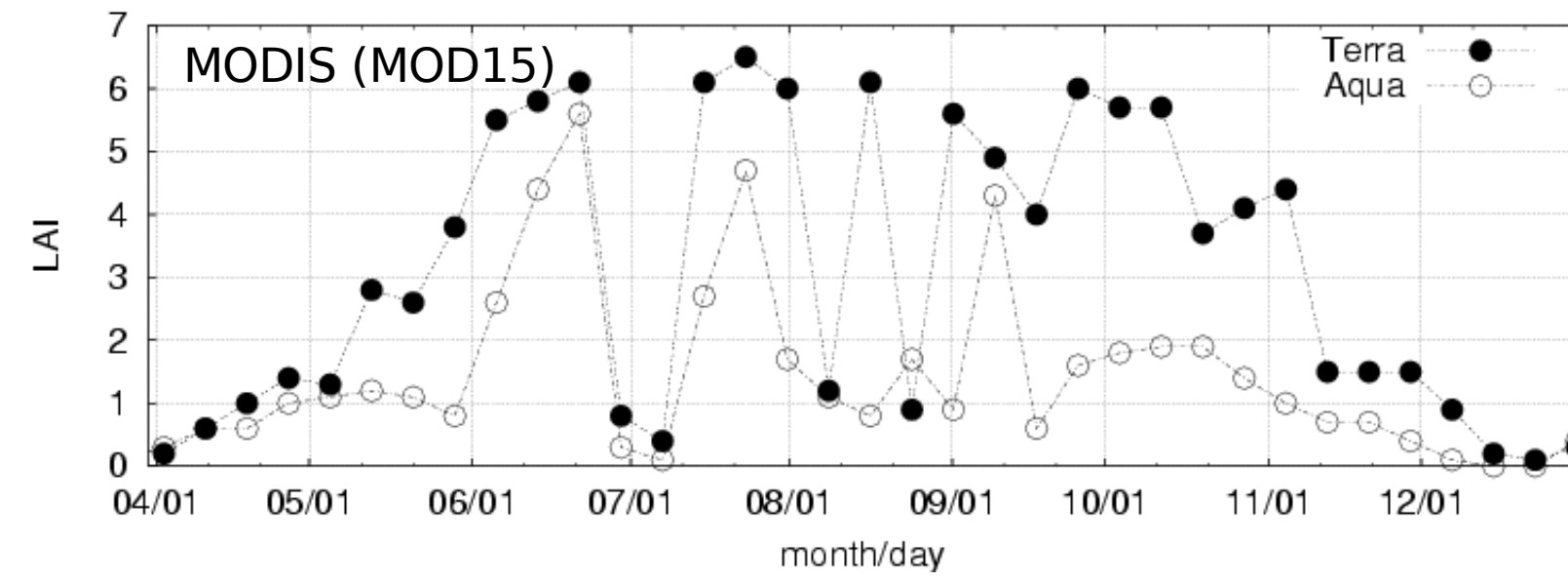
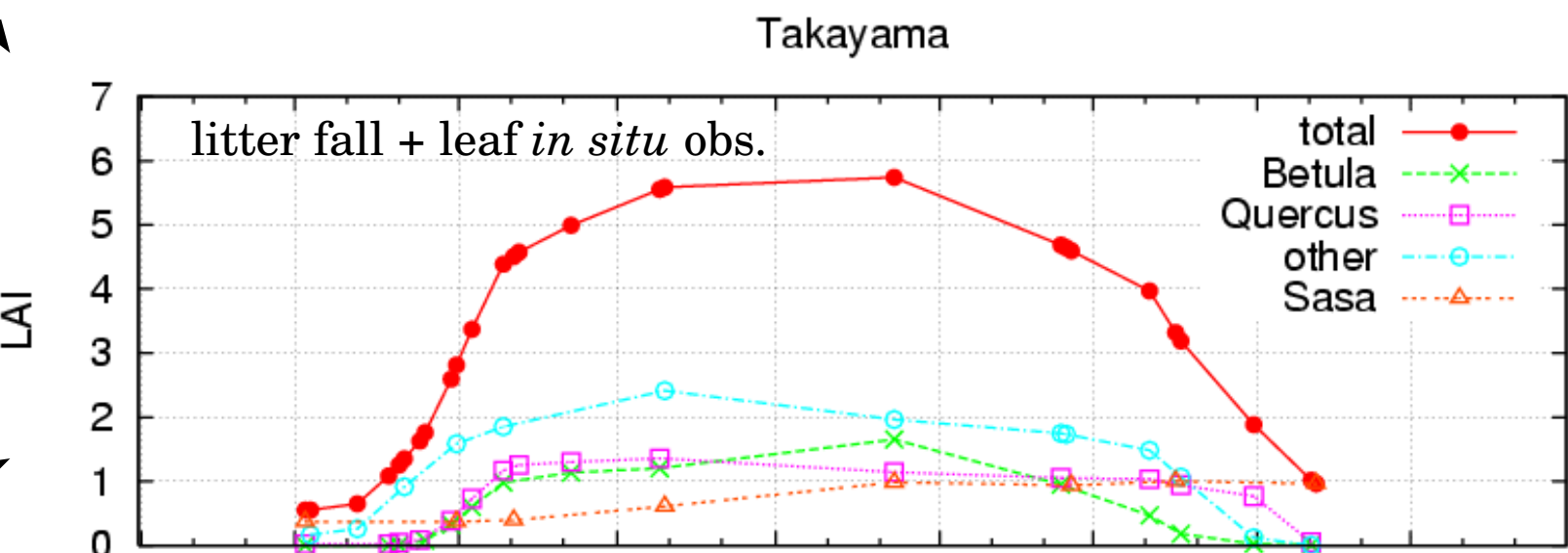
Leaf *in situ* observation / sampling

Device: SPAD, ruler, etc.
Target: leaf number, size, angle, pigment, LMA



Litter fall

Device: litter trap
Target: species composition
annual maximum LAI



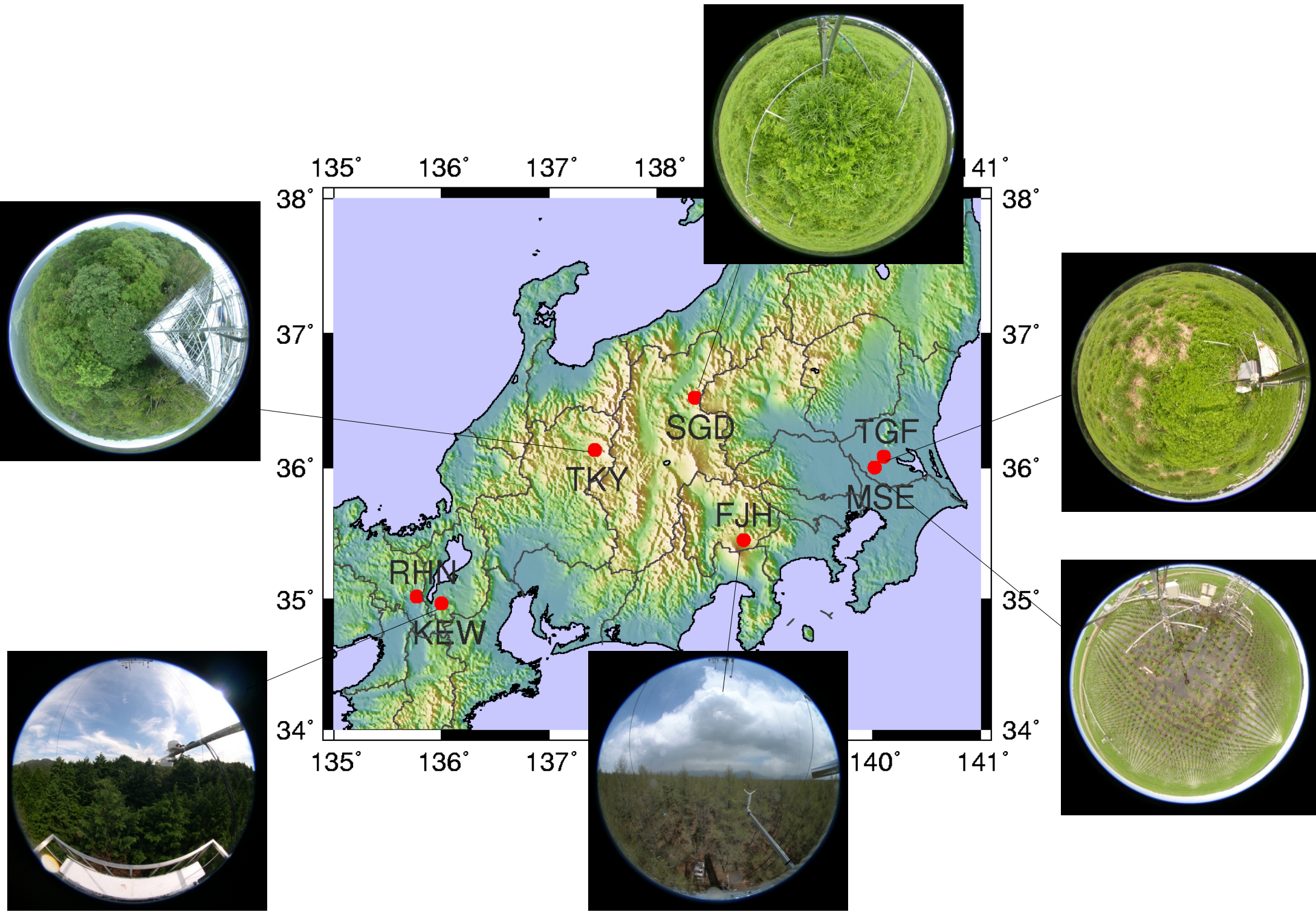
LAI indirect measurement

Device: LAI2000, TRAC
Target: LAI, FPAR



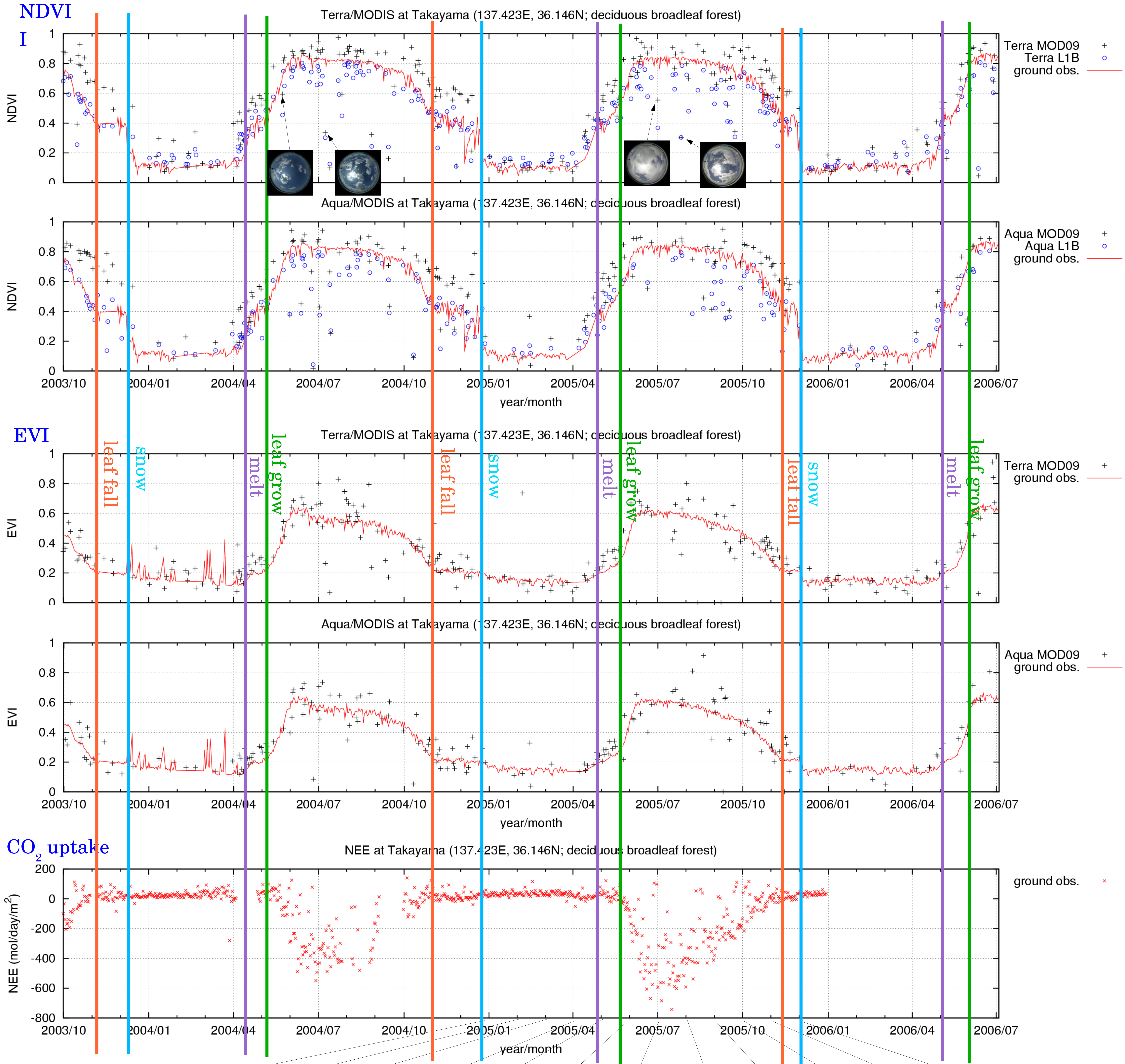
PEN sites

TGF	TERC Grass Field	Grass	2003-
TKY	Takayama Flux Site	DBF	2003-
TFS	Tomakomai Flux Site	DNF	2004- (down)
FJH	Fuji-north Flux Site	DNF	2006-
KEW	Kiryu Expr. Watershed	ENF	2004-
MSE	Mase Flux Site	Rice paddy	2005-
RHN	Research Institute, HN	Urban	2005
SGD	Sugadaira Flux Site	Grass	2005-

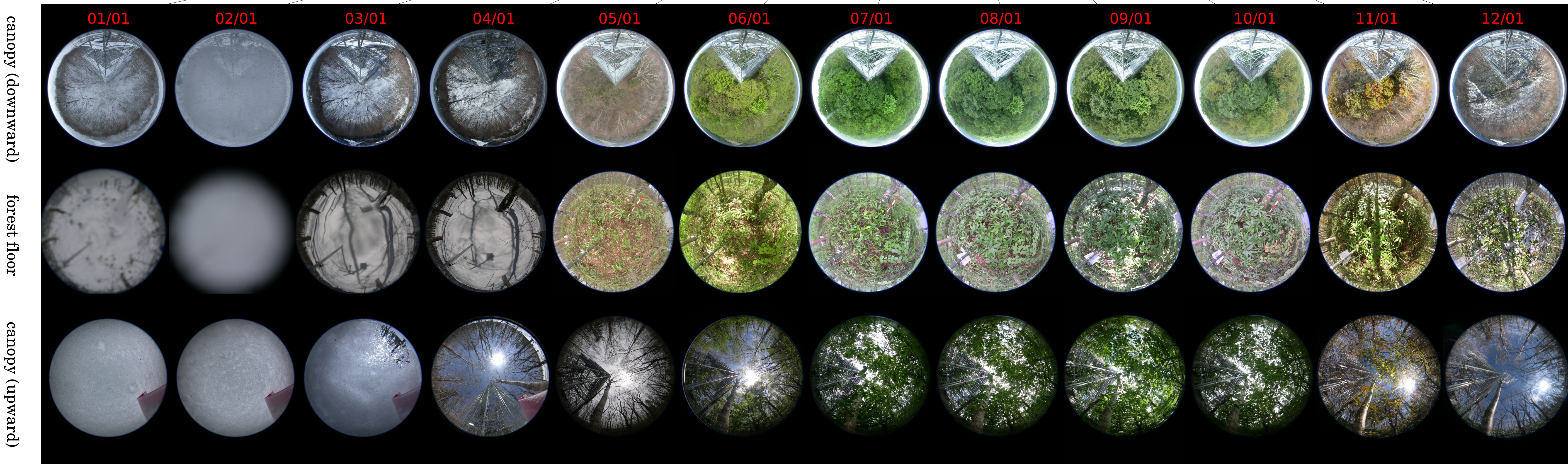


Ground validation of MODIS in terms of NDVI, EVI, CO₂-uptake, phenology events, and spectrum

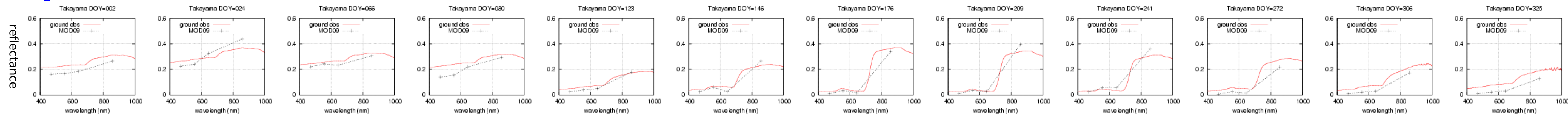
All the MODIS data are after cloud-screening based on the MOD09GQK QC flag



Phenology



Spectrum



Conclusions

- MOD09 cloud flag does not detect all the cloudy cases (error is about 7%).
- NDVI is well represented by L1B rather than MOD09. This may be due to troubles in the atmospheric correction applied to MOD09.
- Change of forest floor (snow, melt, understory) is well captured with NDVI rather than EVI.
- MOD15 LAI gives reasonable annual-maximum LAI. But the seasonal change of MOD15 LAI does not correspond well with the ground observation.