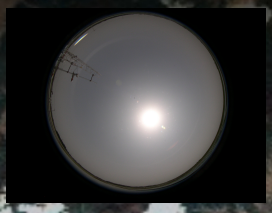
Phenological Eyes Network



Connecting
Satellite Remote Sensing
to the Ground-Level Ecosystems

Satellite remote sensing: A bird's eye looking at the global change

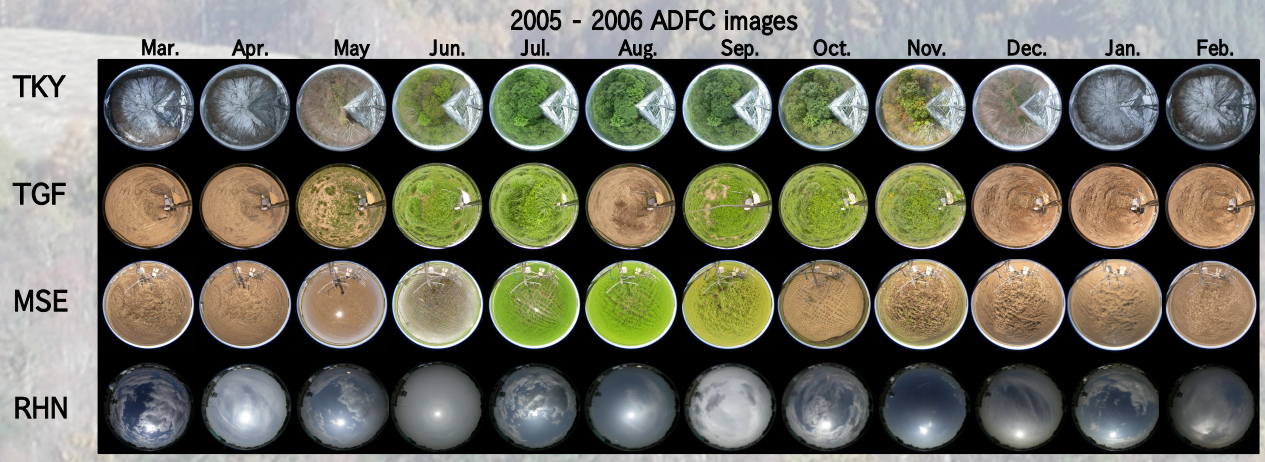
We are facing rapid changes in the global ecosystems caused by human activity and its resulting climate change. In order to adjust or work against these impacts, we need to monitor and predict the changes in the local, regional, and global ecosystems. Satellite remote sensing is one of the most promising approaches for this purpose.

Connecting satellite remote sensing to the reality of ground ecosystems

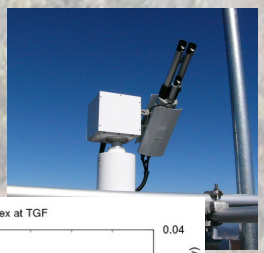
Satellite data are a kind of "superficial" information, which is not easy to interpret in terms of ecological context. Moreover, satellite data are "contaminated" with the noise caused by clouds, aerosols, observation angles, and sensor degradation, etc. Therefore, it is necessary to check the validity of the satellite information with independent and reliable knowledge on the ground-level. PEN (Phenological Eyes Network) aims at providing such knowledge by monitoring the short-term and long-term dynamics (phenology etc.) of the ecosystems.

ADFC Automatic-capturing Digital Fisheye Camera

ADFC captures high-quality images of the sky, canopy, branches, and the ground, etc. with short-term intervals (2 - 180 min) every day. The sky images are useful to check the sky condition at the instance of a satellite's overpass with the sky images. Other images are useful to check the timing of snow cover, bud-burst, leaf fall, etc. Canopy images enable estimation of leaf area index (LAI).

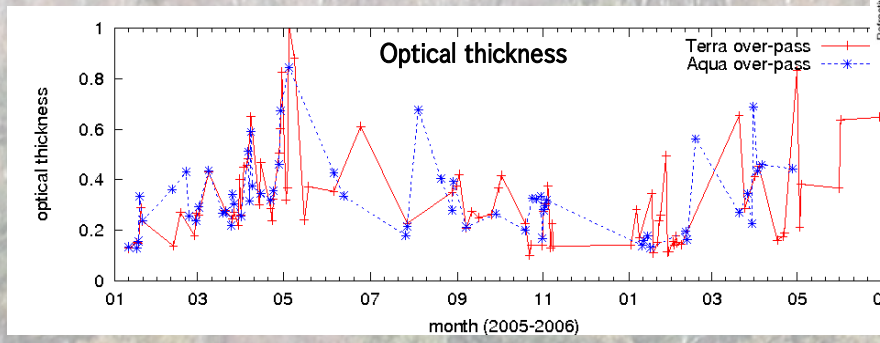


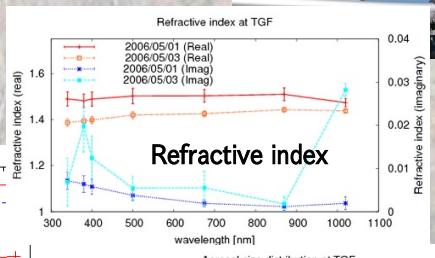
SP SunPhotometer

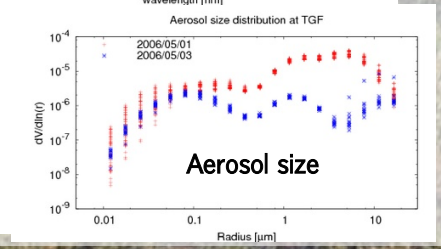


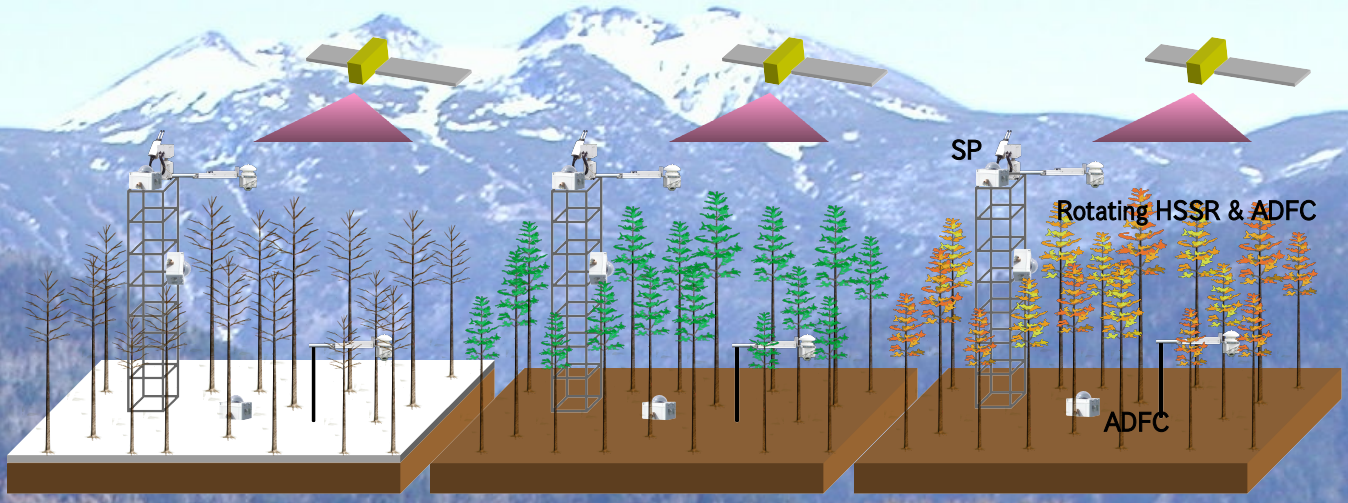
SP measures atmospheric transmittance with 11 spectral bands. It derives atmospheric parameters such as optical thickness, aerosol size, and aerosol refractive index etc., which are most critical for validation of the atmospheric correction of satellite data. SP also serves as a monitoring tool of atmospheric pollutions.

Features ... Spectral bands (center wavelength): 340, 380, 400, 500, 675, 870, 940, 1020, 1225, 1600, 2200 nm. Half-band-width: 10nm. Field of view: 1 degree. PREDE Co. Ltd., Japan.





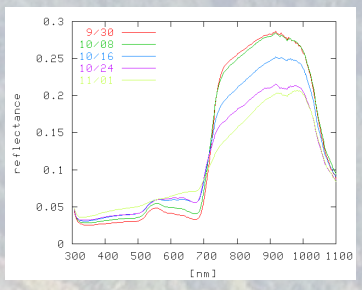


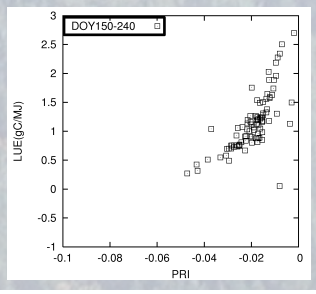


HSSR Hemi-Spherical Spectral Radiometer

HSSR measures hyper-spectral radiation. It serves validation data for the satellite multi-spectral sensors (such as MODIS, Vegetation, ASTER, AVNIR2). It enables simulation of any spectral-response functions and any vegetation indices (such as NDVI, EVI, SAVI, PRI) with HSSR's data. Combination of HSSR and ADFC helps checking the phenology detection algorithms based on the spectral indices.

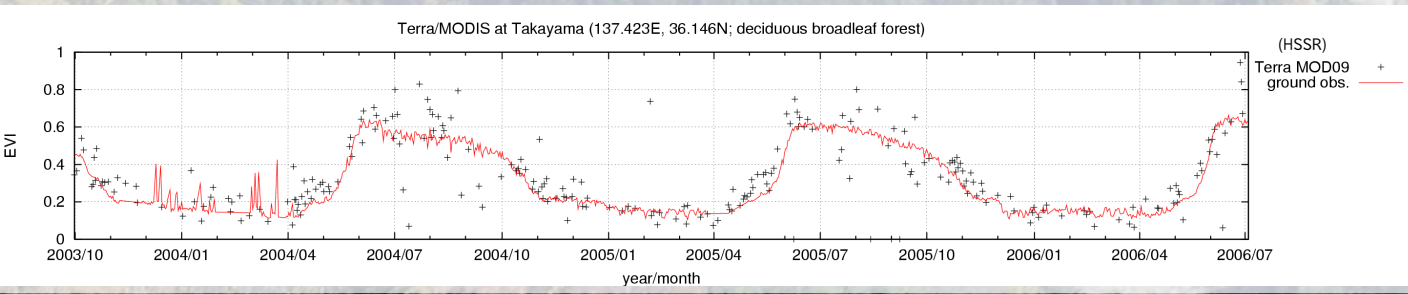
Features of MS700 HSSR ... Spectral bands (center wavelength): 300-1100nm with 3.3nm interval. Half band-width: 10nm. Field of view: 180 degree. Eko Instruments Co. Ltd., Japan.





If HSSR is mounted on a rotating device (see the above photos), it measures both the incoming (solar and sky) and outgoing (reflection) radiation successively within a short interval and provides the spectral reflectance of the vegetation canopy. It is better than mounting two sensors (one at upward and one at downward) because it saves duplicate instruments and avoids troubles relating to the calibration between the two sensors. Moreover, it can drop snowpack on the sensor by the flip-flop motion.

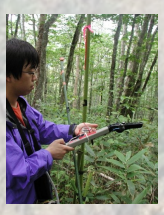
In order to avoid complex mechanical manoeuvres and save weight, the next generation HSSR system is under development (see photo below; 130mm * 220mm * 96mm, 2.8kg. Much smaller than the current system.)



Other Measurements

Leaf area index (LAI):

Litter-trap, LAI2000, TRAC, and laser-profiling system



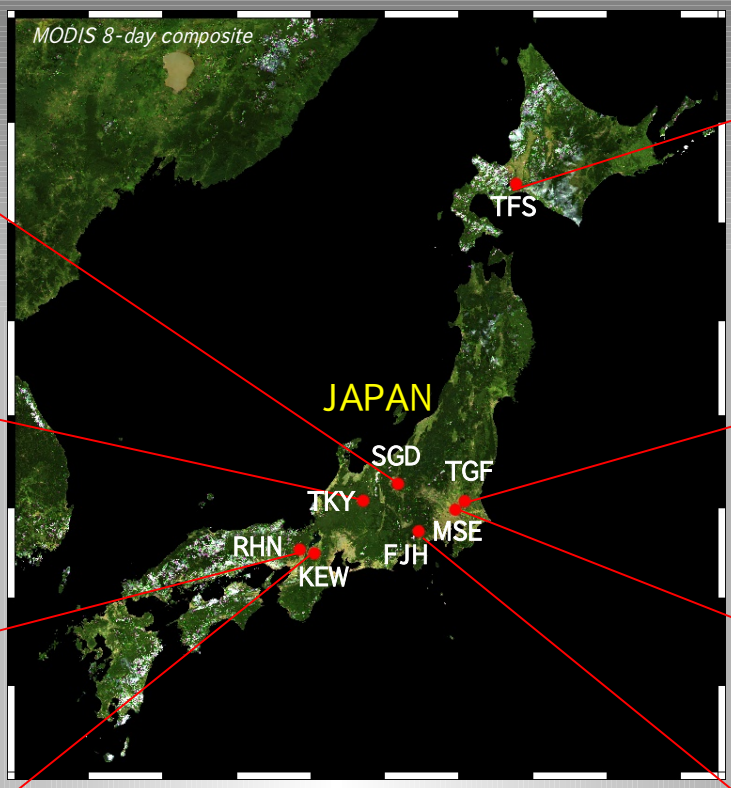
Leaf-level measurements:

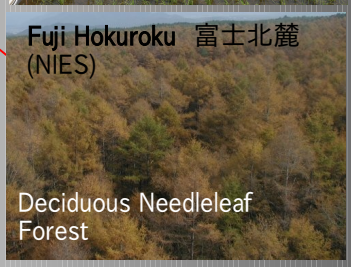
Physiology (LI6400), optics (FieldSpec + integrating sphere), pigments (SPAD and chemical extraction), C/N, leaf-mass-per-area (LMA).

Canopy-level measurements: Incoming and transmitting PAR, shoot-phenology.

Ecosystem-level measurement: NEE (CO2 uptake), evapotranspiration (ET), soil respiration etc. (by the Asia Flux network).

PEN Sites



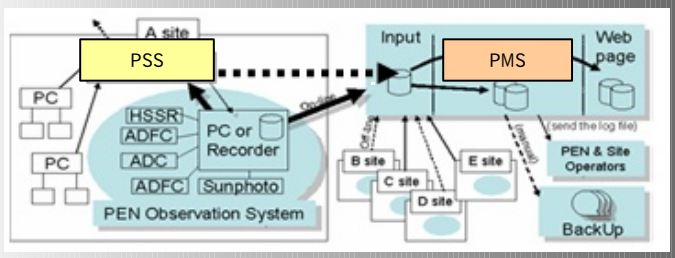


Most of the PEN sites are located at the AsiaFlux sites. AsiaFlux is a monitoring network of carbon, water and energy fluxes between ecosystems and the atmosphere.

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

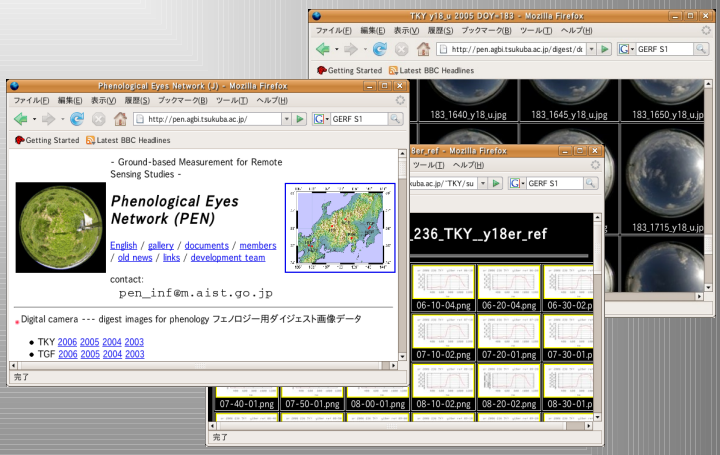
Network system & Database

The PEN Site-Server (PSS) at each site collects, stores, and transmits the measured data. The PEN Mother Server (PMS) at the PEN headquarters receives data from all site servers, and integrates the data into the database all of which is open to the PEN community and a part of which is open to public.



PEN community

Anybody may join the PEN community by contacting the following address. The community members can obtain technical support of installing the PEN system to their field site. They can also obtain detailed information on the PEN framework, access raw data taken at all PEN sites, and contribute data taken at their own PEN sites.



Visit http://pheno-eye.org/

E-mail to pen_inf@m.aist.go.jp

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