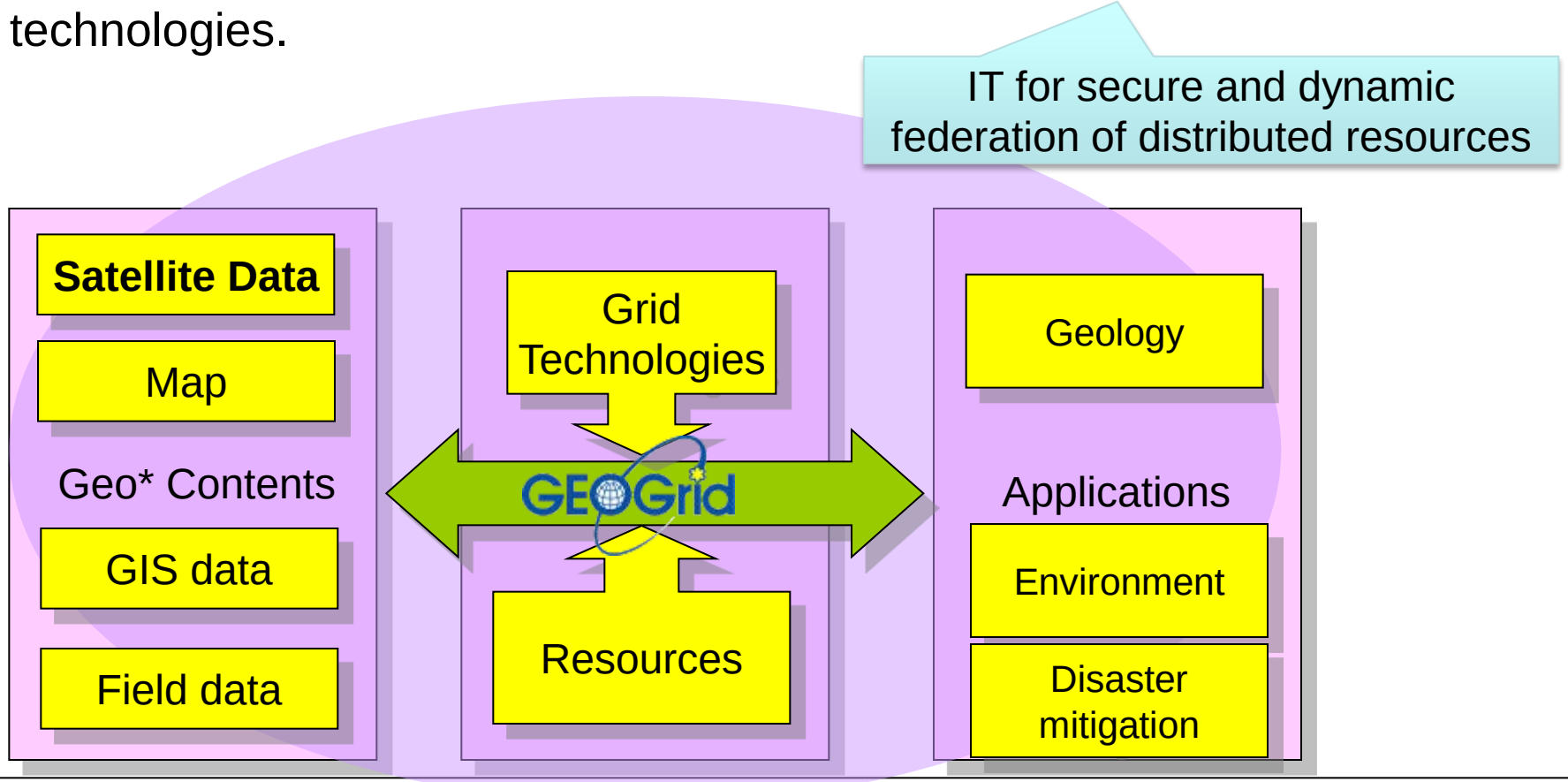
Introduction of GEO Grid

Yoshio Tanaka

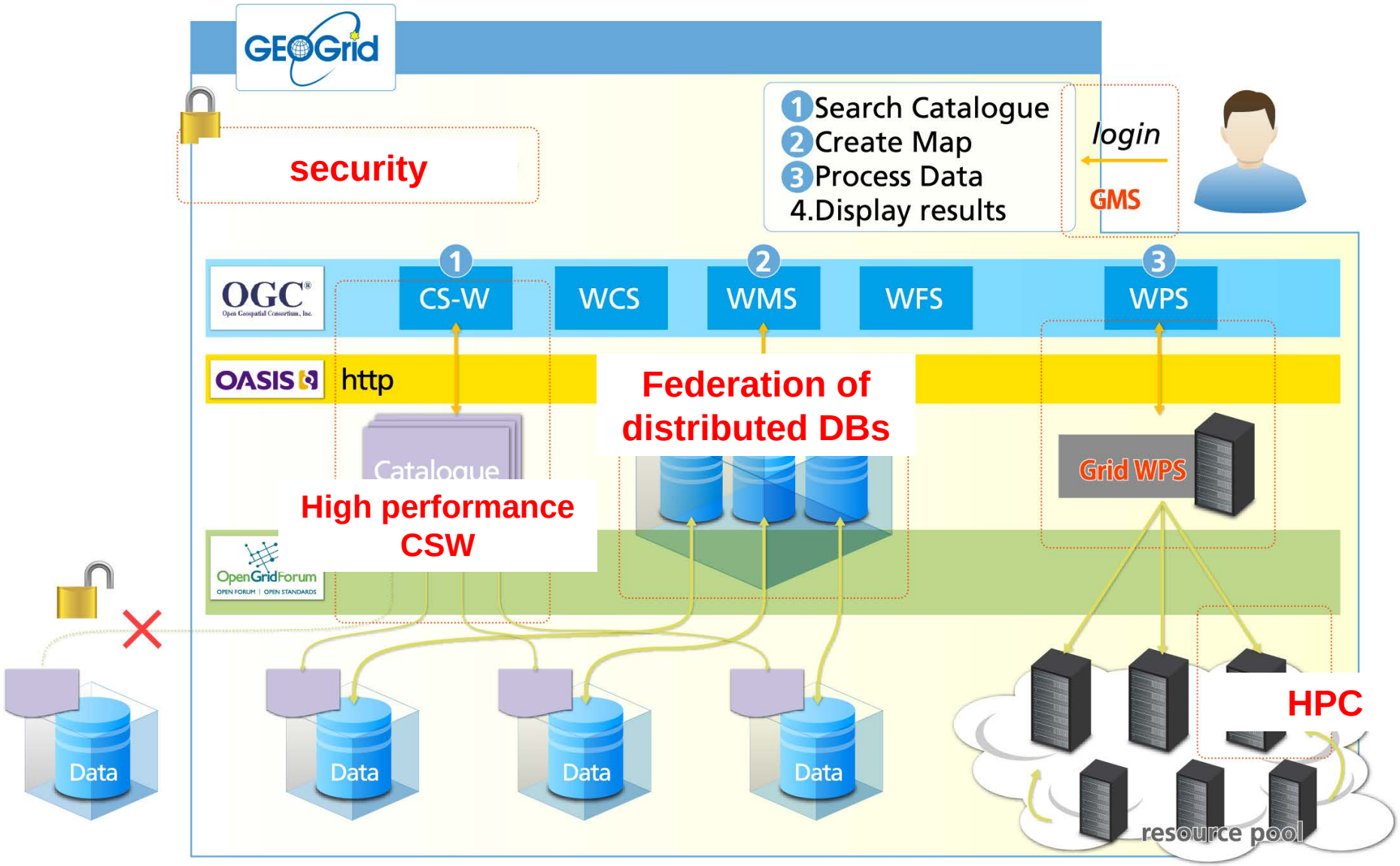
AIST, Japan

What is the GEO Grid ?

- The GEO (Global Earth Observation) Grid is aiming at providing an *E-Science Infrastructure* for worldwide Earth Sciences communities to accelerate GEO sciences based on the concept that relevant data and computation are *virtually integrated* with a certain *access control* and ease-of-use interface those are enabled by a set of Grid and Web service technologies.



Why Grid?



By courtesy of S.Sekiguchi

GEO Grid Service Examples

- Satellite data archive and processing
  - ASTER, PALSAR, MODIS, etc.
- Satellite data application
  - Application of Satellite-Field data Integrator (SFI) for aerosol monitoring Description http://fon.geogrid.org/aerosol/
  - SDCP (Science Degree Confluence Project) –Community validation tool for global land-cover & digital elevation models http://eco.geogrid.org/sdcp/
- Hazard information
  - QuiQuake (Quick Estimation System for Earthquake Maps Triggered by Observation Records) http://qq.ghz.geogrid.org/QuakeMap/index.en.html
  - Volcanic Gravity Flow Simulations on Volcanic Area http://volcano.geogrid.org/applications/EnergyCone/
- Geoscience data
  - Geological maps, Active fault data, etc.

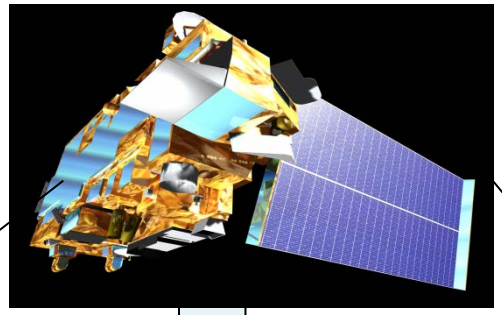
Satellite RS & Ground-based

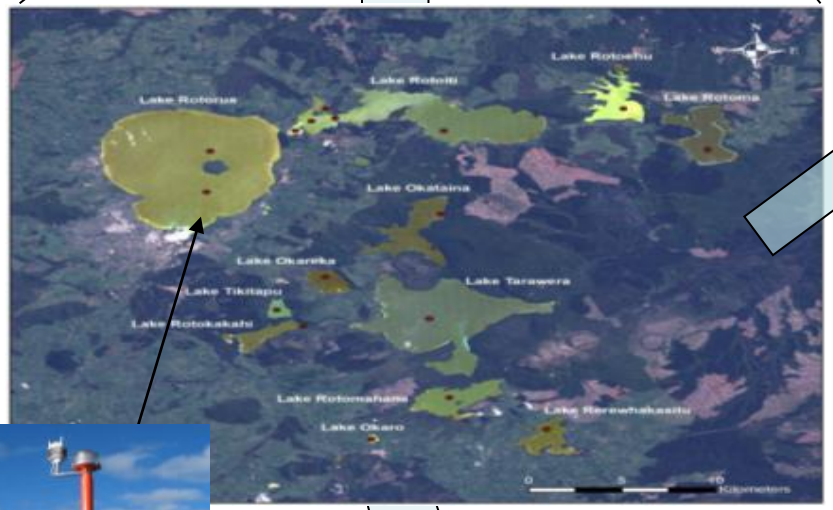
- Benefit of satellite RS:
  - Cheap and rapid over large geographic area
  - Regional coverage and broadly spectral resolution
  - Continuous acquisition of data
  - Archive of historical data

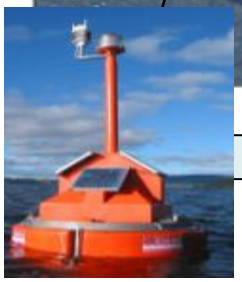
- Limitation of satellite RS:
  - Interference of atmospheric gaseous and particles
    - Absorbing (H_20, O_3 etc.) and Scattering (mainly by aerosol particles such as dust, ash and smoke)
  - Not direct sample of the phenomenon.

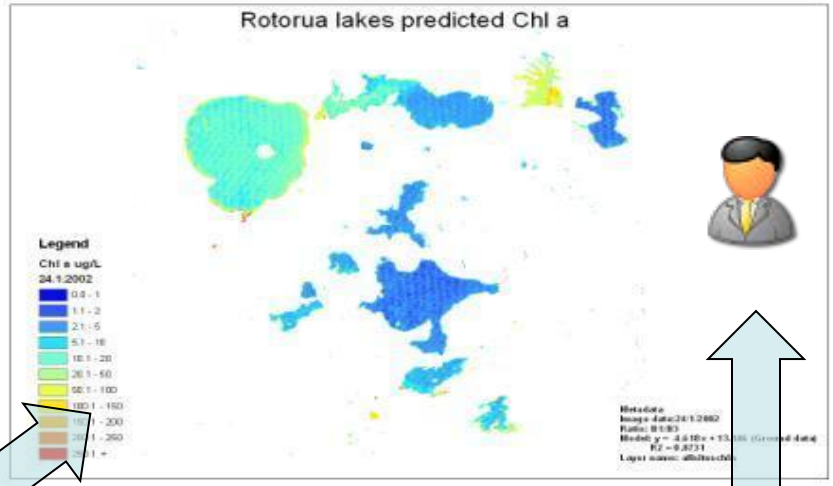
- Ground-based observation:
  - Direct sample of the phenomenon is possible
  - Real-time or Near Real-time observation
  - High temporal resolution
  - Expensive for wide area observation

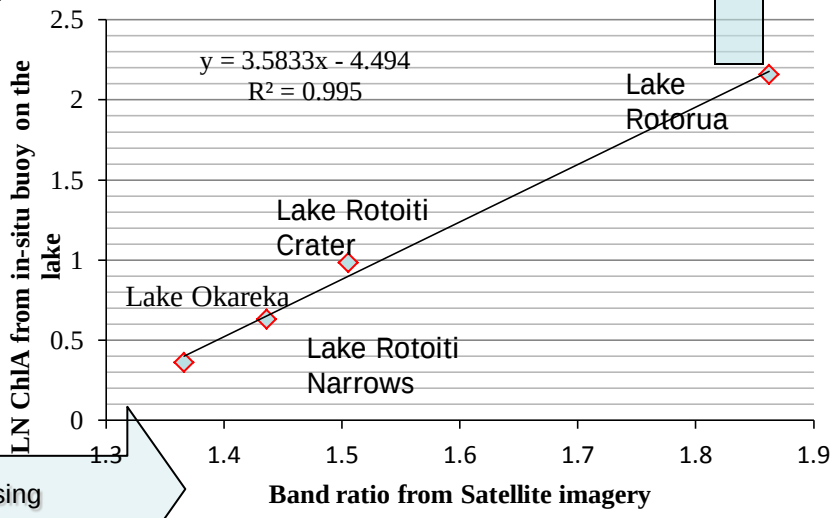
Synergy of satellite and field data











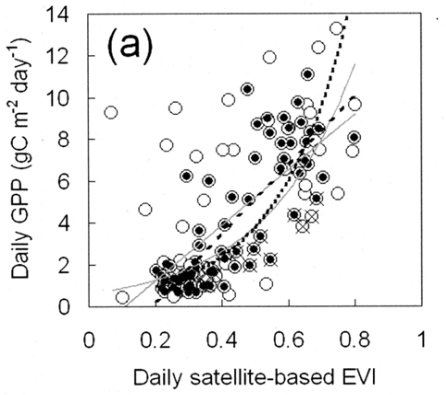
SOS=Sensor Net

WPS= Satellite data processing

Accurate water quality map production with GLEON

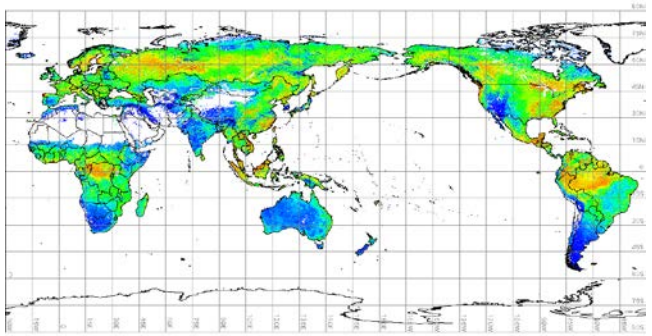
Use Case and Research Issues
- Federation of CO_2 Flux data and Satellite data -

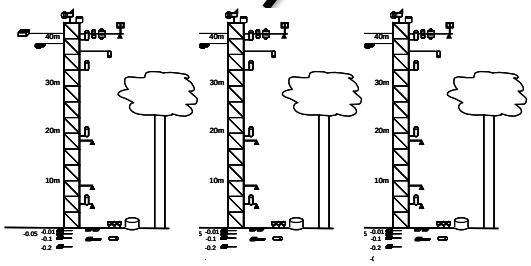
Calibration of Satellite Data using In-situ Observation Data



Apply to the similar vegetation area

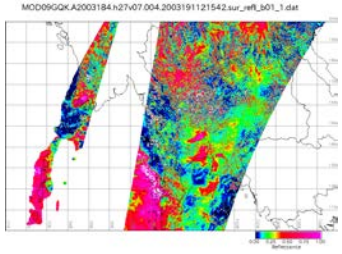
Global CO_2 Map generated from In-situ data and Satellite data





Flux Tower

Digital Camera



Satellite data

Research Issues and approach

(1) Development of IT infrastructure which federates distributed and heterogeneous Earth observation data.
Approach: Integration of Grid and OGC standards

(2) Establishment of multi-disciplinary and cross boundary scientific community
Approach: Linking IT and application networks

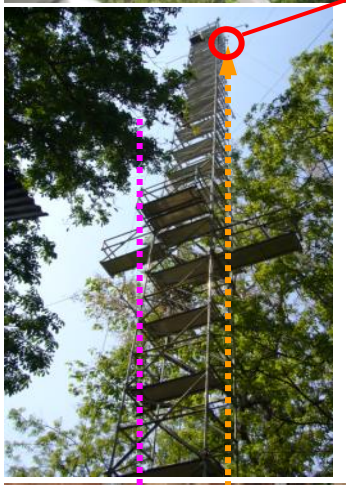
Observation site in Maeklong, Thailand

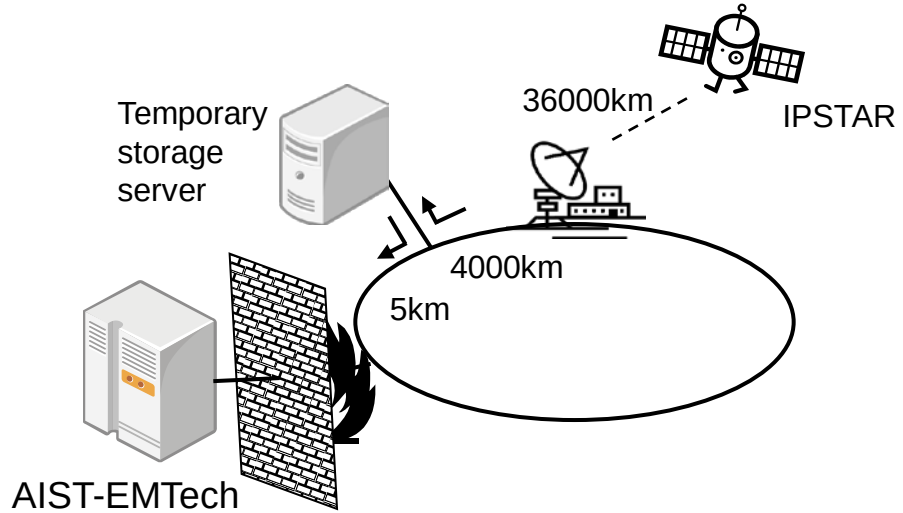
Data transfer from MKL to Tskuba

Long Distance Wireless LAN (PtP)

Satellite network (IPSTAR)

36000km





State of Problems

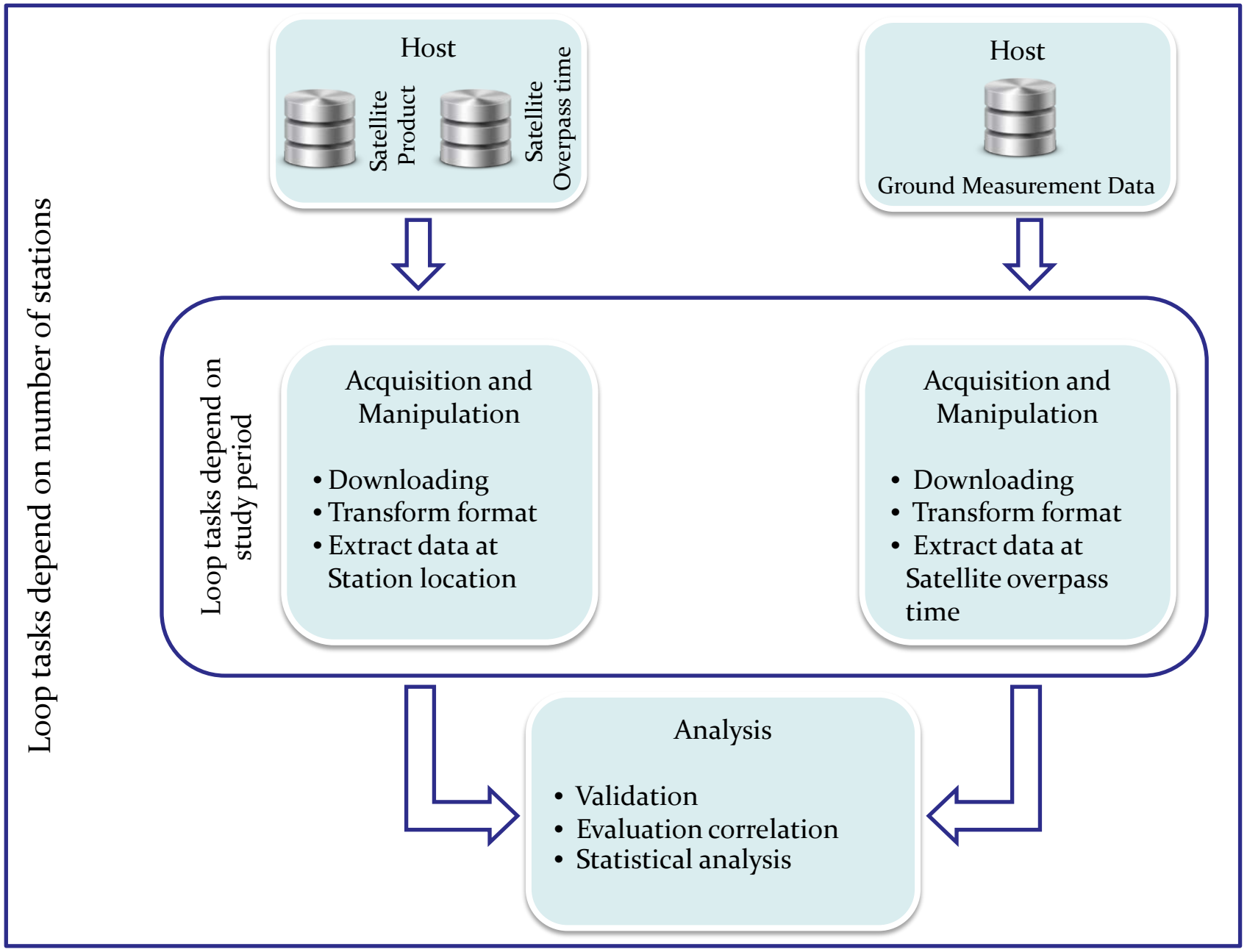
- There is a lack of comprehensive framework that provides an estimated air temperature map from satellite remote sensing image with ease of use to the end-users.

- Huge amount of effort from user such as

  - Prepare, analyze and process both of datasets to achieve final results.

  - High requirement of user skills and sufficient computer support system.

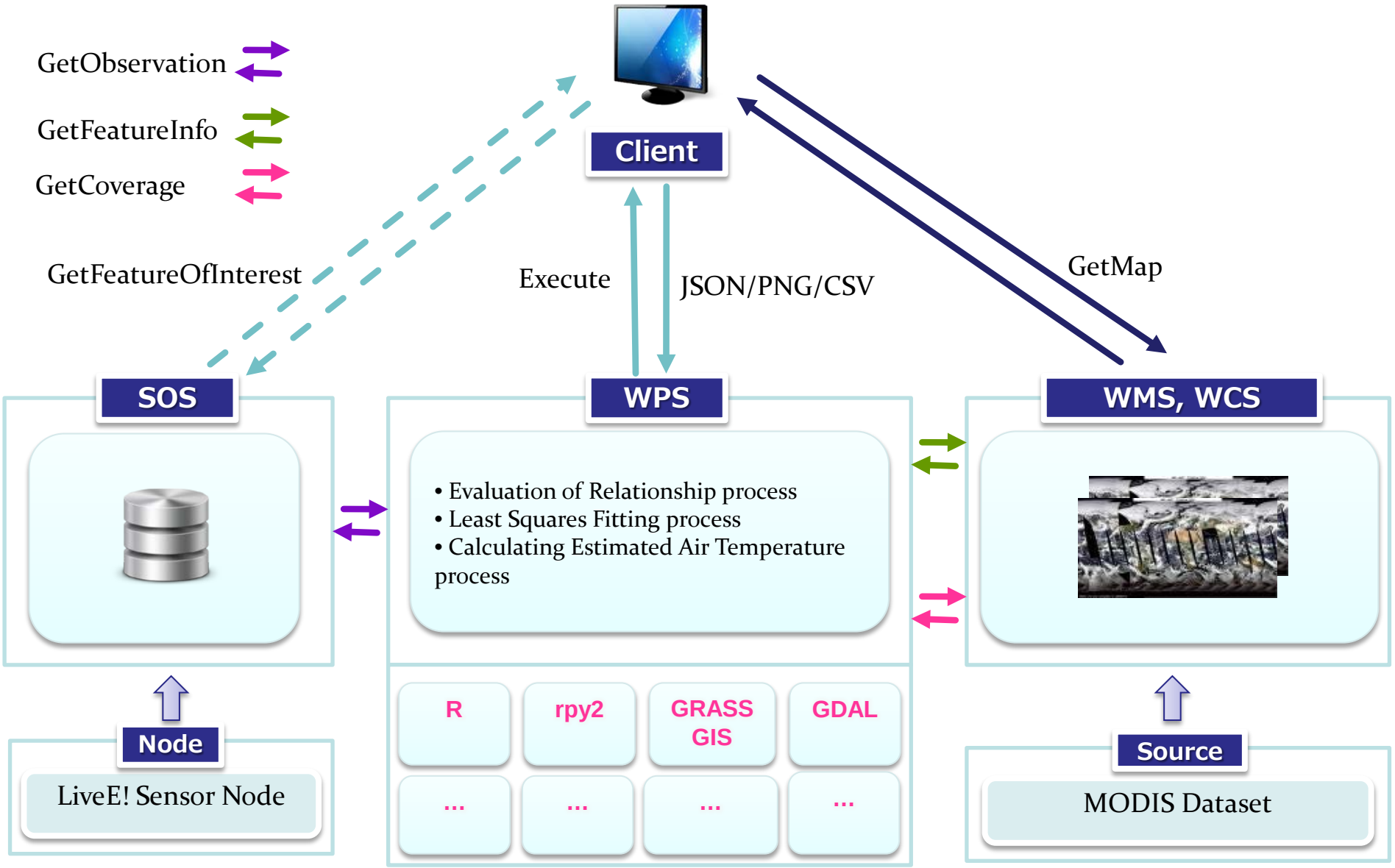
Traditional Workflow



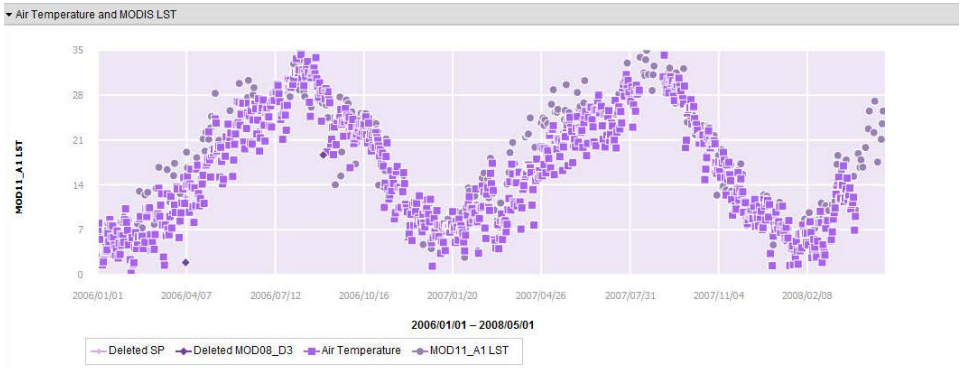
Satellite Field Integrator (SFI)

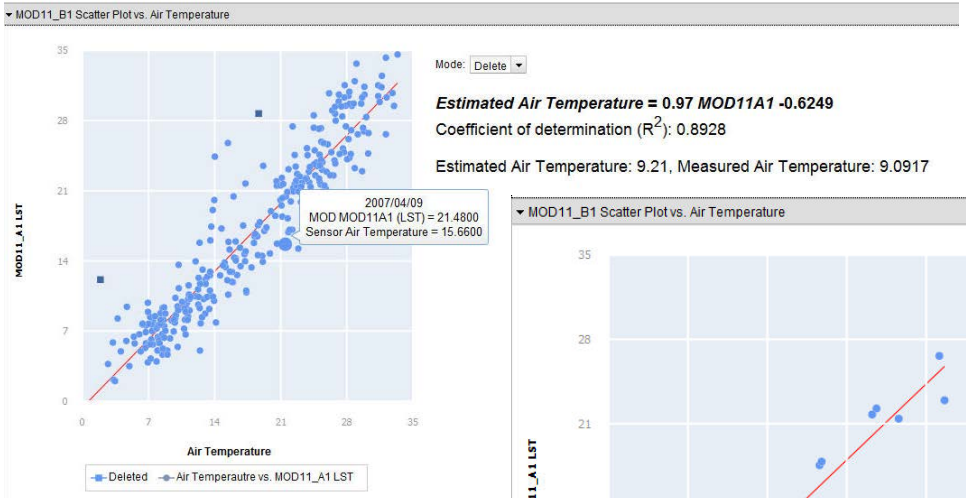
- The SFI framework is designed to reduce the onerous tasks of data gathering, manipulating, and processing
  - Supports heterogeneous data formats in both remote sensing and sensor observation data
  - Scalability to handle the increasing number of datasets currently available.
  - Offers a robust, on-demand processing service
- The development is based on various open standards of OGC Web Service specifications such as
  - Web Mapping Service (WMS)
  - Web Coverage Service (WCS)
  - Sensor Observation Service (SOS)
  - Web Processing Service (WPS)

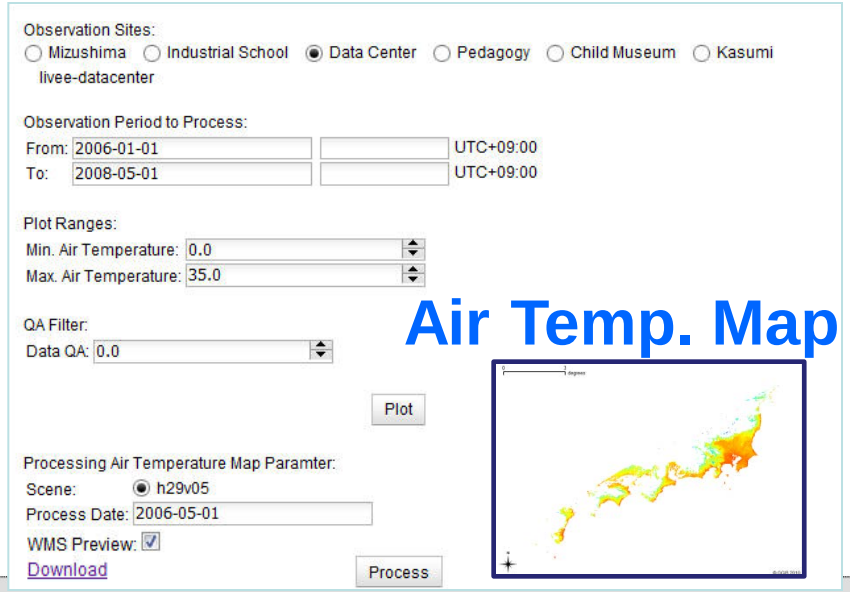
SFI Framework



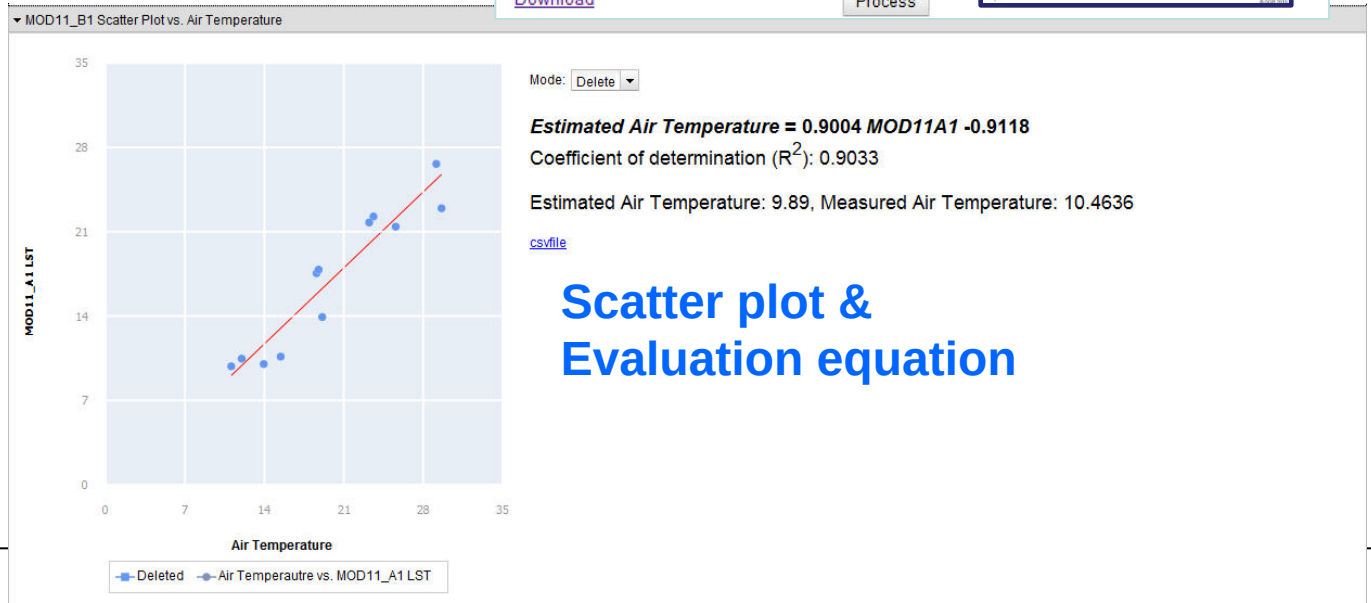
Prototype System





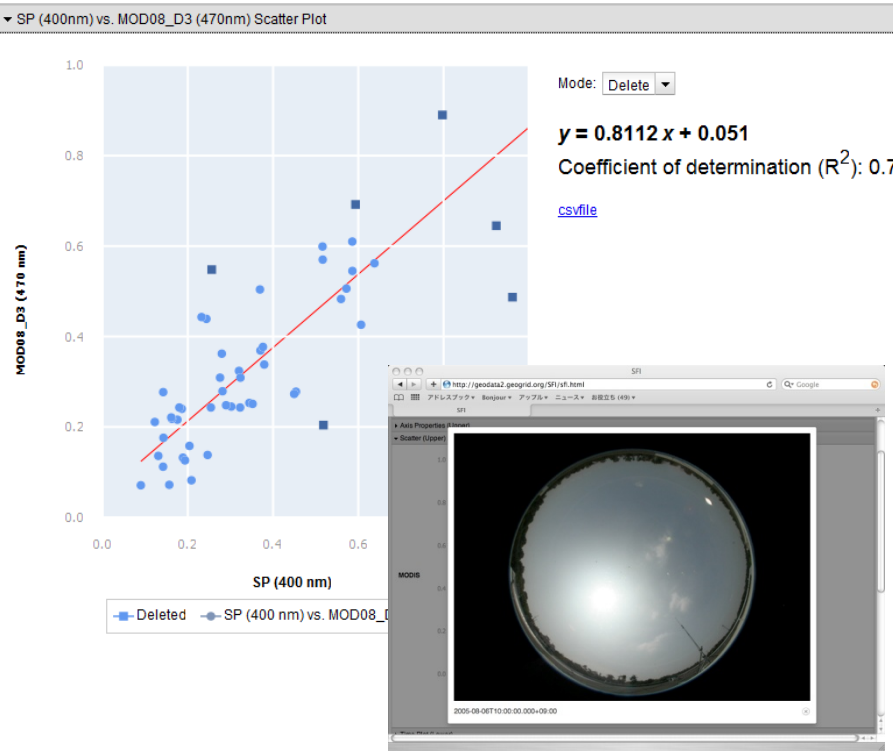


Air Temp. Map



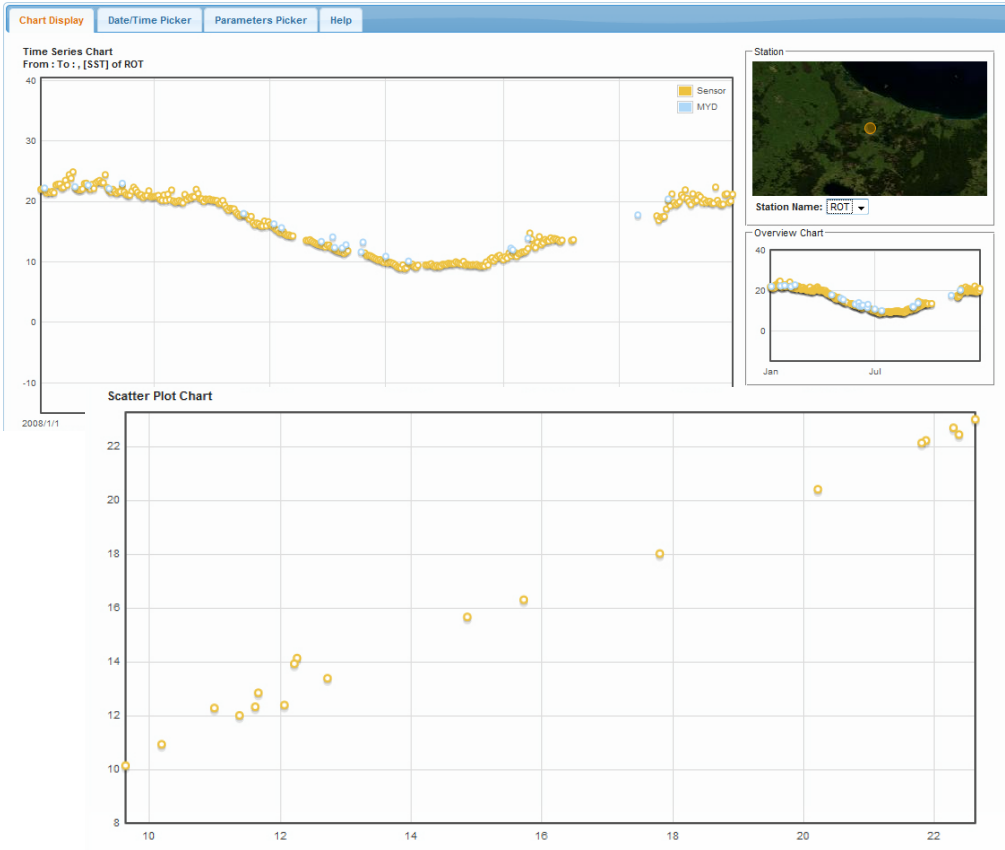
Scatter plot &
Evaluation equation

Various Applications



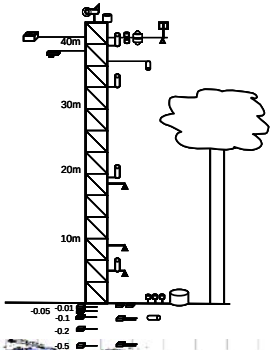
Aerosol Optical Depth

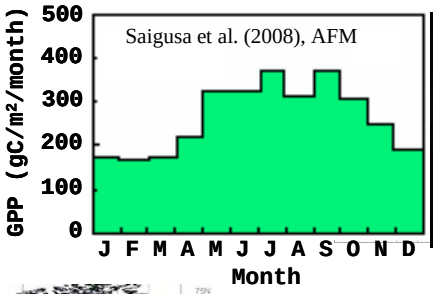
Sea Surface Temperature

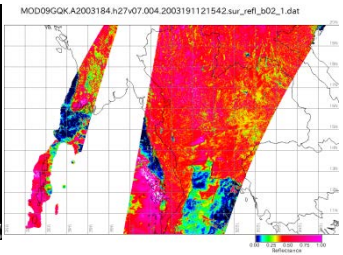


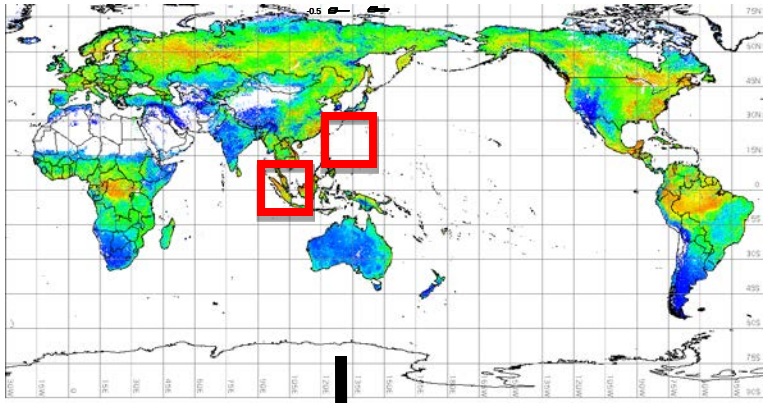
Field Observation data
(Primary production, daily)

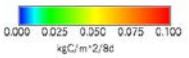
MOD09, MOD17a2
→Vegetation Index (EVI, NDVI)
→ GPP





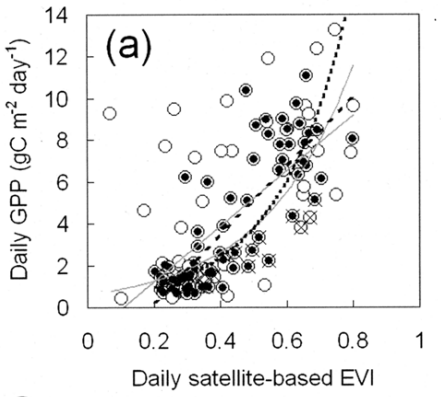






Satellite / Field data study

Applying to same forest type for GPP map.



(Nagai et al., submitted to IJRS)

- The prototype system will done with observation in Japan, Taiwan and Thailand.
- The success of study will extend sensor network to regional and global FLUX group.

Conclusions

- Comprehensive web-based GIS system framework enabled
  - Based on various open standards of OGC specifications
- Assimilation of sensor observation data and satellite image
  - Wider area, More accuracy, Reasonable cost
- Minimal effort by overcoming the need for
  - Complex workflow, high skills requirement, and expensive facilities
- HPC & Cloud for Geo Science
  - **Source** : Spatial and Temporal
  - **Cost** : Disk Space, Network, Processing Power etc.