The Forest Carbon Monitoring System (FCMS) Project

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Background

- We need to implement a reliable LULUCF(Land Use, Land Use Change & Forestry) monitoring system as a part of the post 2012 regime
- We started a research on Forest Carbon Monitoring System (FCMS) combining in-situ measurements and Remote Sensing data
- The FCMS project is led by the National Institute for Environmental Studies (NIES) in collaboration with JAXA, University of Tokyo (IIS) etc.

Project objectives

- FCMS project aims to map forest carbon changes using ALOS PALSAR for *spatial quantification* of the forest cover as a result of deforestation, degradation and regeneration
- Quantitative estimates of CO_2 emissions induced by deforestation and degradation will be assessed
- FCMS project is a precursor initiative that is foreseen to lead to the development of an operational international monitoring system

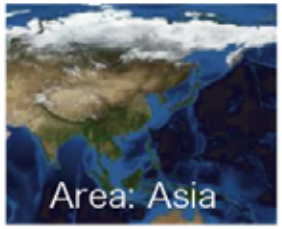
Research plan

The research will be conducted through the following 6 **subtopics**:

1. Developing carbon accounting methods
2. Analysis of PALSAR data for identifying deforestation and degradation
3. Analysis of forest inventories
4. Estimating forest structure parameters
5. Time series mappings of vegetation disturbance
6. Evaluating carbon balance with ecosystem models

[ST1] Development of Carbon Accounting Methods for FCMS

Carbon Accounting Method



afforestation, growth, succession

deforestation and degradation

C emission

① Default method

area-based

carbon stock decrease

② Ecosystem model

temporal dynamics

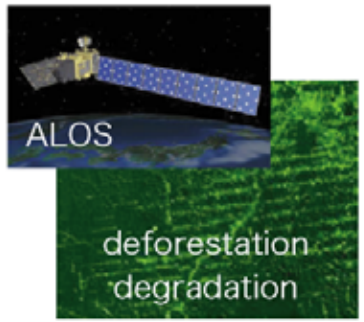
③ Economic evaluation of environmental benefits

Ecosystem service
- hydrological
- food, fibre, etc.
- biodiversity etc.

change in

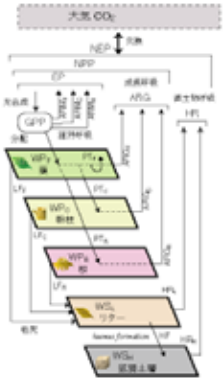
ecosystem services

Advanced satellite monitoring system



forest monitoring

Improved ecosystem model



simulation

International Carbon Monitoring System

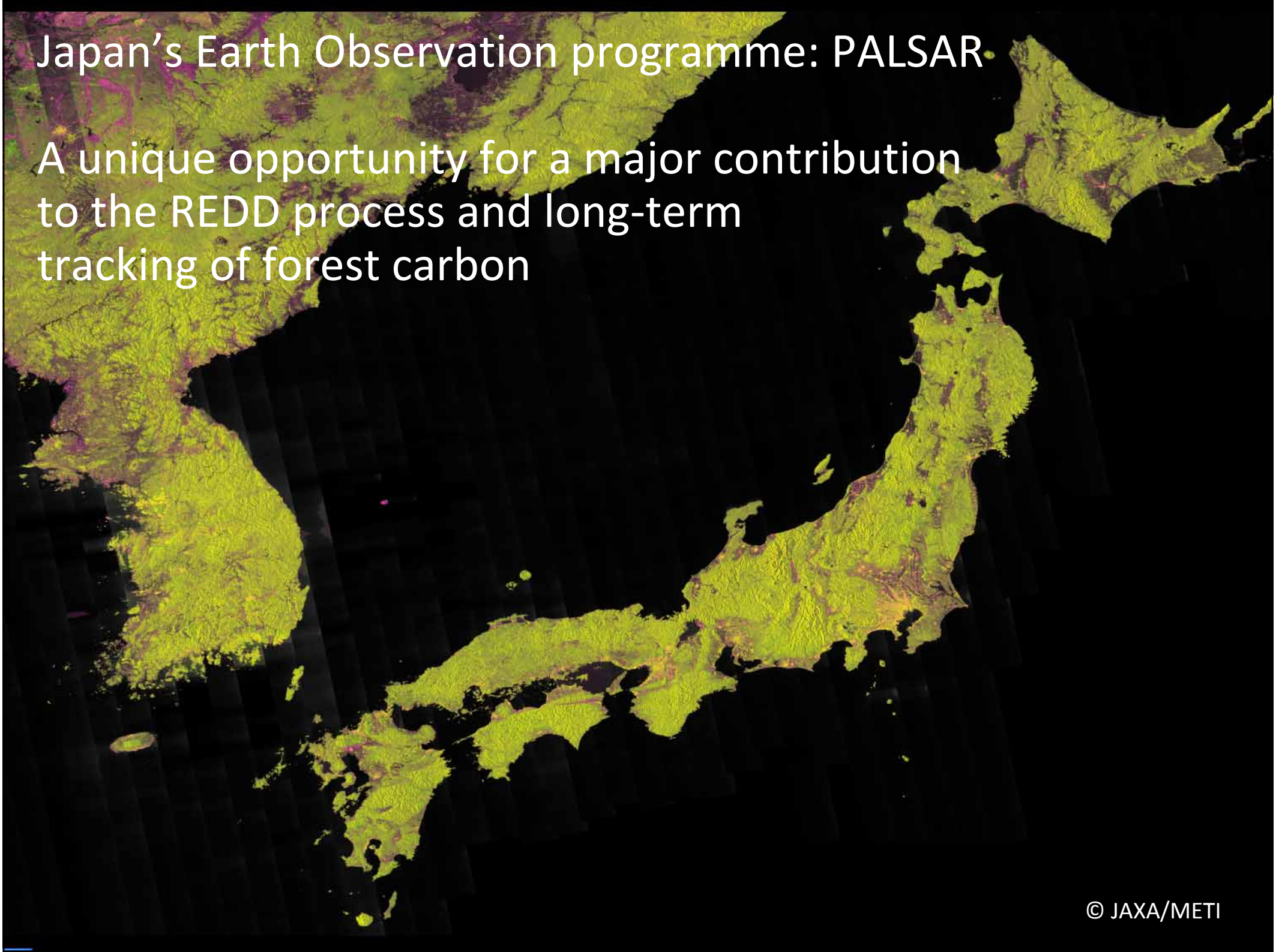
results

Requirements for Remote Sensing data

- An important requirements for remote sensing data which is to feed into an operational FCMS system are:
  - nation-wide without gaps (wall-to-wall)
  - fine ground resolution (< 20m)
  - acquired within a short time window (< 3month)
  - on a repetitive (annual) basis
  - encompasses the commitment periods (eg. 2013-2020)
- The ALOS PALSAR mission is unique in this respect, being the only satellite sensor which accommodates cloud-penetrating, wall-to-wall observations of the global forest cover at fine spatial resolution

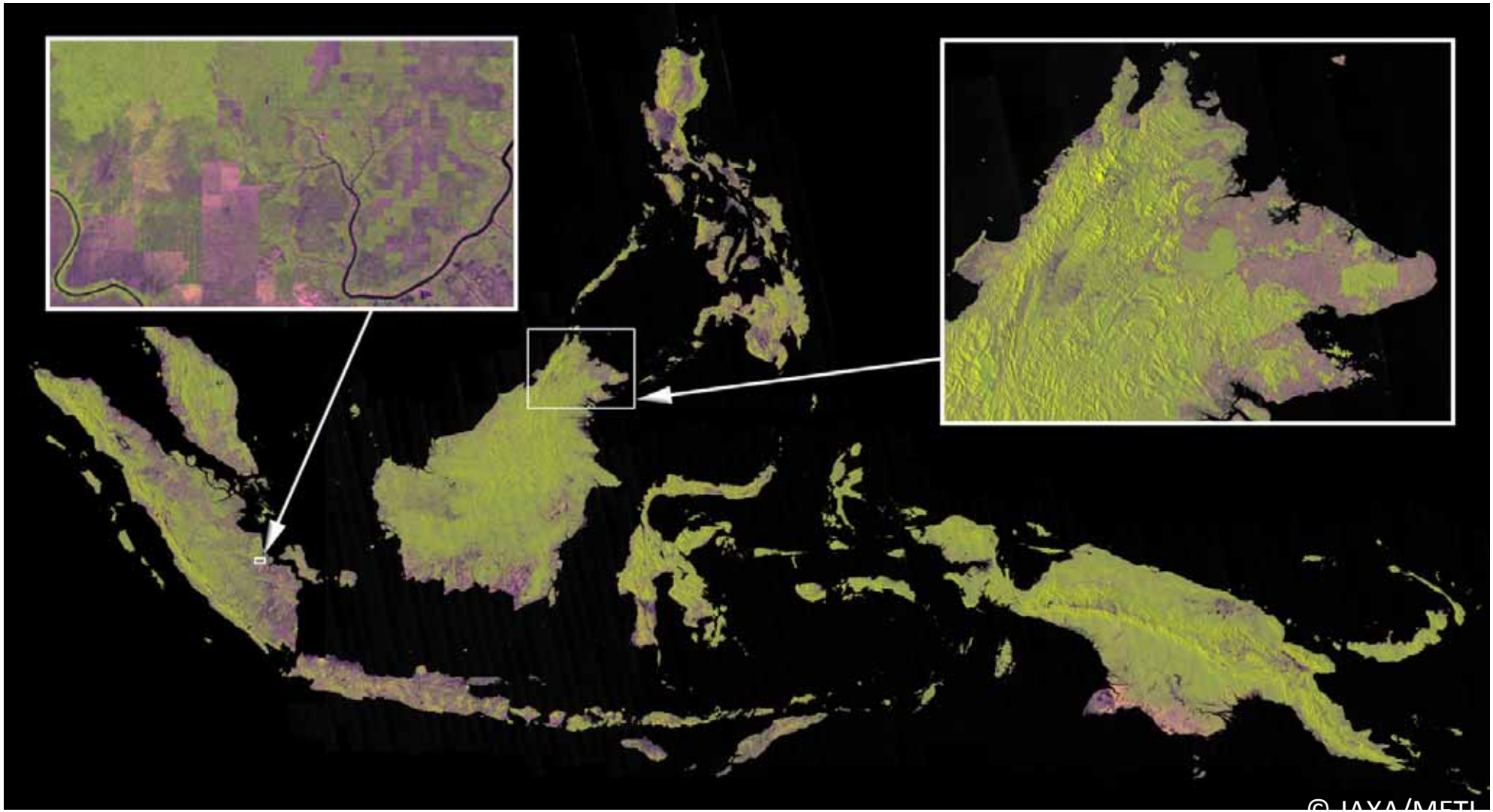
Japan's Earth Observation programme: PALSAR

A unique opportunity for a major contribution to the REDD process and long-term tracking of forest carbon



ALOS PALSAR baseline data collection

Semi-annual global wall-to-wall coverage at fine resolution



Data analyses with in-situ data

- Ground-based forest inventory data required for the methodology development and analysis of the SAR data
- Data will be obtained through collaboration with forest ecosystem/inventory researchers in countries through a Plot Network (data-base) in this project.

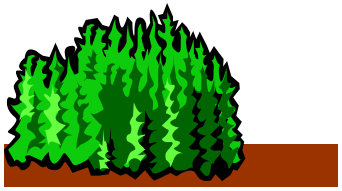
[ST 3] Analysis of Forest Inventory Data

Forest Inventory Dataset

National

Region (sub-National)

Site



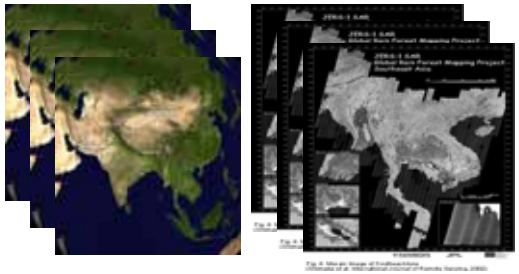
Deforestation

Analysis of detection accuracy of deforestation by integrated method with remote sensing and forest inventory data

Degradation

Analysis of forest stand structure and pattern of different forest types.

Hysteresis analysis of forest disturbance



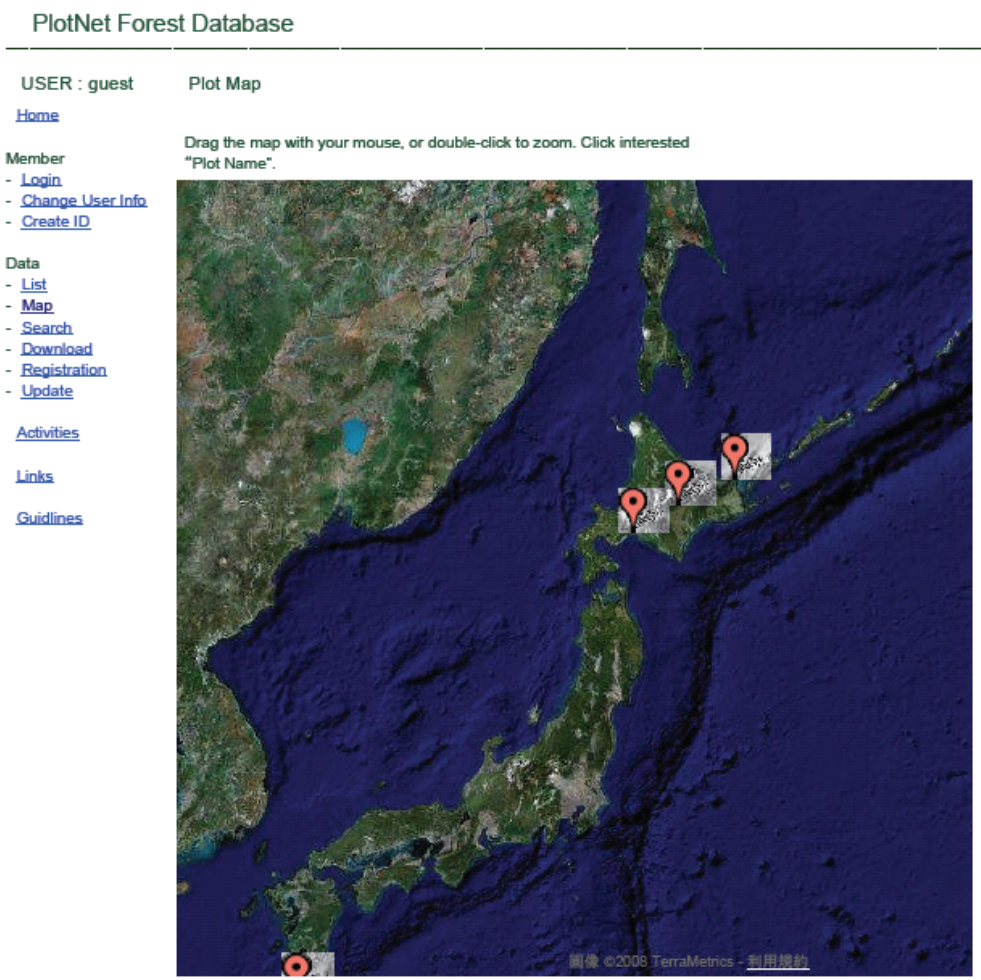
Remote Sensing Data

Integrate

PlotNet Database

PlotNet Forest Database

PlotNet is designed to facilitate storage and access to forest plot data



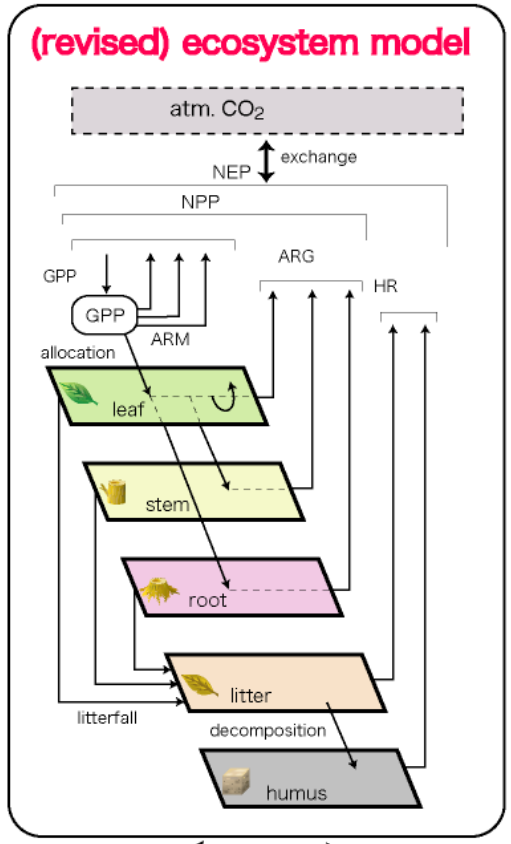
(a) Plot name
(b) Location: country, region, latitude and longitude
(c) Altitude (optional)
(d) Dominant species (optional)
(e) Whether litter measurements have been carried out
(f) Database in which observation data is archived as needed.
(g) URL of the database

[ST4] Evaluating Carbon Balance with Ecosystem Models

[ST3] Inventory information
- basic inventory data
- past disturbance

[ST2, 4] RS forest structure
- aboveground biomass
  (dead tree, coarse debris ?)
- stand structure (height etc.)
- leaf area index (LAI)

[ST5] RS land use change
- forest decrease and degradation
- cropland classification
- conversion to pasture
- natural / artificial forest

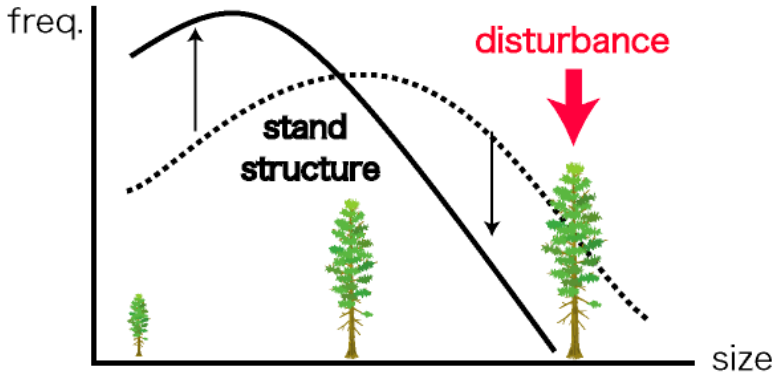


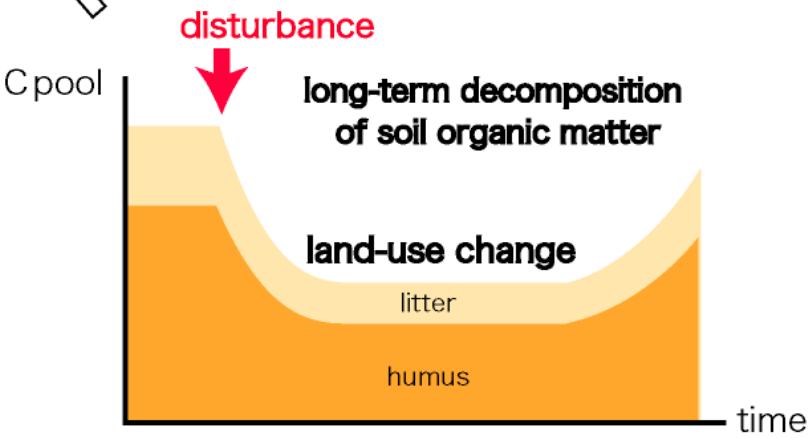
[ST1] Carbon accounting method
- simulations at core-area
- expansion to regional/global
- temporal change in carbon pools
  in aboveground / belowground
- carbon emission by forest
  decrease and degradation
- comparison with inventory data
- sensitivity analysis, uncertainty

[ST6] Model development
(long-term change after disturbance)

forest dynamics

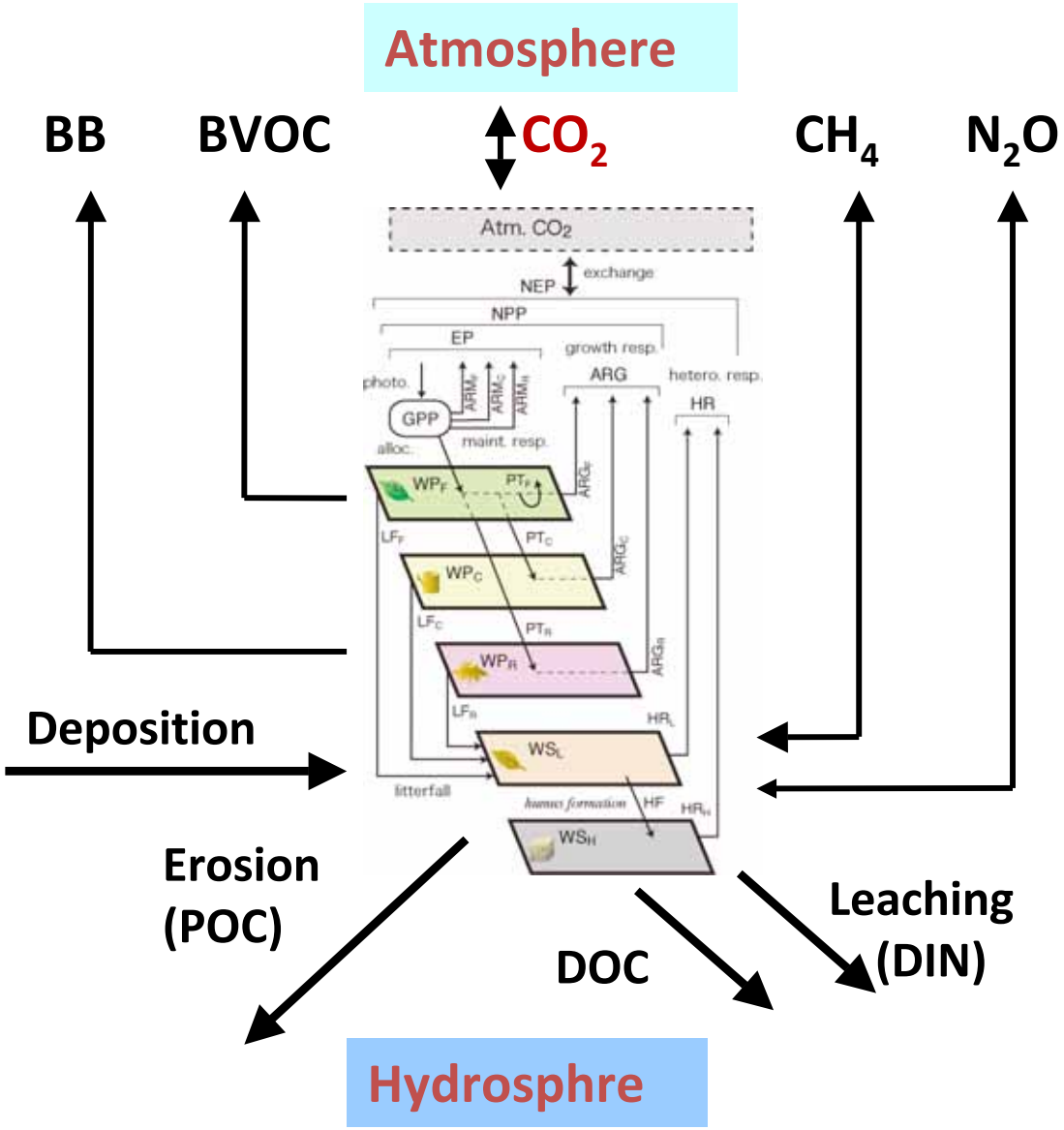
soil dynamics





Terrestrial Ecosystem Model: VISIT

VISIT: Vegetation Integrative SImulator for Trace gases



Currently included

- ↑ ↓ CO_2: Ito & Oikawa 2005
- ↓ CH_4: Ridgwell et al. 1999
- ↑ N_2O : Parton et al. 1996
- ↑ BVOC : Guenther et al. 1999
- ↑ BB : Hoelzemann et al. 2004
- ↑ Erosion : Ito 2007
- ↑ DOC : Boyer et al. 1996
- ↑ Leaching : Lin et al. 2000
- ↑ Land-use change emission

Future implementation

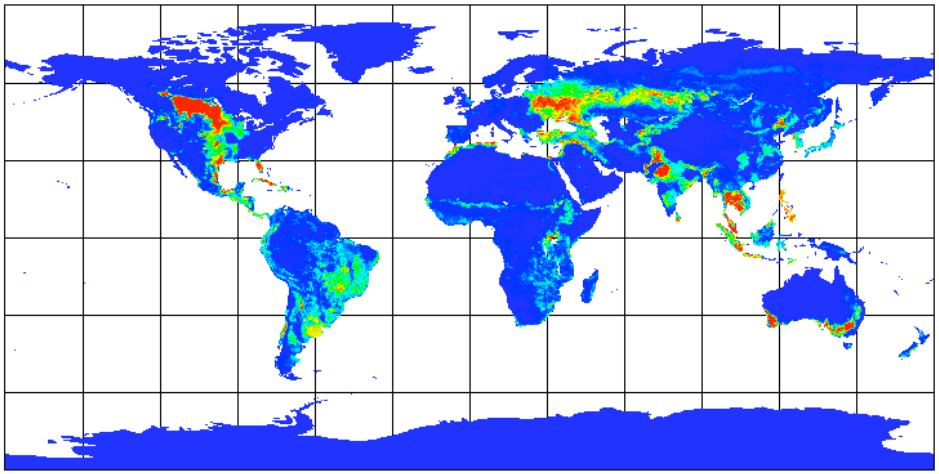
- ↑ CH_4: Walter & Heimann 2001

Isotopes: $d^{13}C$, $d^{18}O$, $d^{15}N$ …

River export: TRIP2?

Land-use change emission

Land use change: 1901-1990



Historical cropland area

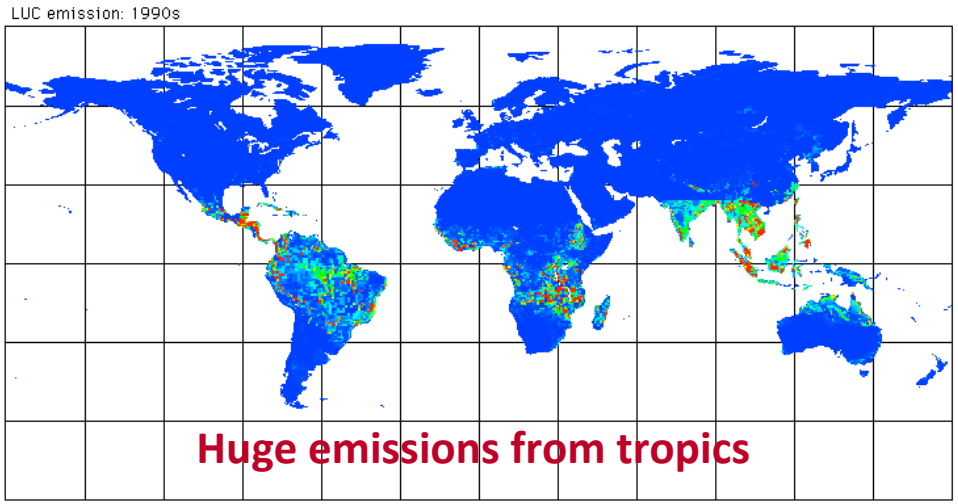
- Hurtt et al. (2006)

Future projection

- IMAGE2 (Wang et al. 2006)

Note: empirical parameterization used

Land use change emission, 1990s



International collaborations

- International advisory group from the EU, Australia and the USA has been established
- Scientific support on SAR applications to forestry is achieved through links with the JAXA's Kyoto & Carbon Initiative project
- Collaboration with international research institutions through this research will promote international harmonisation and contribute to the GEOSS

Duration and budget

- The long-term goal of the FCMS project is the development and subsequent implementation of an operational system, divided into the following phases:
  - Phase 1: Research: JFY 2008-2010
  - Phase 2: System Development: JFY 2011-2012
  - Phase 3: Operational implementation: JFY 2013 -
- The present FCMS project described here only covers the research part (phase 1). Started in April, 2008, it is funded for 3 years