10th GEOSS Asia Pacific Symposium (Sep 2017, Hanoi)
GEO Carbon and GHG Initiative WG

Background Information on GEO 2017-2019 Work Programme, and basic plan of GEO-C Task 3

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Japan Long-Term Ecological Research network (JaLTER)
International LTER East Asia-Pacific regional network (ILTER-EAP)

GEO Programme Board (Japan member)

Contributor to:
AOGEOSS TG 2 (APBON), TG 3 (GEO-C)
In-situ obs. resources Foundational Task

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GEO Strategic Plan 2016-2025: Implementing GEOSS

- GEO's Vision
- Strategic Objectives [Advocate, Deliver, Engage]
- Societal Benefit Areas (SBAs)… Application oriented
- Implementation Mechanisms
- Core functions

GEO 2017-2019 Work Programme

- Implementation mechanisms
  - Flagships
  - Initiatives
  - Community Activities
  - Foundational Tasks

GEO Engagement Strategy

- 2030 Agenda for Sustainable Development (SDGs)
- Climate Change – Greenhouse Gas Monitoring (Paris Agreement)
- Disaster Risk Reduction (Sendai Framework)

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Societal Benefit Areas

Biodiversity and Ecosystem Sustainability

Disaster Resilience

Energy and Mineral Resources Management

Food Security and Sustainable Agriculture

Infrastructure and Transport Management

Public Health Surveillance

Sustainable Urban Development

Water Resources Management

Climate and Carbon as the cross-cutting issues

GEOSS
Global Earth Observation System of Systems

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GEO 2017 – 2019 Work Programme
Cross Cutting Activities

http://www.earthobservations.org/geoss_wp.php

GEO Initiatives

AfriGEOSS: Reinforcing Regional African Engagement
AmeriGEOSS
Asia-Oceania GEOSS (AOGEOSS)
Earth Observations in Service of the 2030 Agenda for Sustainable Development (EO4SDG)
EuroGEOSS
GEO Carbon and GHG Initiative (GEO-C)
GEOSS-EVOLVE
Oceans and Society: Blue Planet

Community Activities

Access to climate data in GEOSS
Advancing Communication Networks
Citizen Observatories and Crowdsourcing
Copernicus Atmospheric Monitoring Services (CAMS)
Copernicus Climate Change Service (C3S)
Data Analysis and Integration System (DIAS)
Digital GEOMUSEUM
GFCS – GEO Collaboration
Himalayan GEOSS
Research Data Science Summer Schools
Socio-Economic Benefits of Earth Observations
Space and Security
Synergized Multi-Source Remote Sensing Products and Services

GEO-Carbon Task 3 Implementation plan outline

Task Objective

To develop and implement on an ongoing basis, a procedure for designing and refining the observation system for identified essential carbon cycle variables that meets user-defined specifications at minimum total cost.

Participating institutions
(as on the proposal document: this is not a closed list)

- University of the Witwatersrand, South Africa [bob.scholes@wits.ac.za]
- Gifu University, Japan [Hiroyuki Muraoka, muraoka@green.gifu-u.ac.jp]
- IG3IS
- Lund University, Sweden
- Hawassa University, Ethiopia [Dong-Gill Kim, donggillkim@gmail.com]
- CAS, China
- Princeton University, USA
- University of KwaZulu-Natal (UKZN)
- National Ecological Observatory Network (NEON) [David Durden, ddurden@battelleecology.org]

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Task 3 items

Activity 3.1: Specifications of an observing system for essential carbon cycle variables

Task 3.1-1 Create an initial list of Essential Carbon Cycle Variables.
Task 3.1-2 Review of carbon observation technologies.
Task 3.1-3 A system design specification.

Activity 3.2: Generating and testing optimized design options

Task 3.2-1 Determining the observation technology mix.
Task 3.2-2 Designing a sampling frame.

Activity 3.3: Periodic adequacy reports

Task 3.3 Mapping the ECVs performance, and analyzing gaps and opportunities.

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Task 3 … to start

(draft ver. 0) H. Muraoka and D. Durden, July 7, 2017

Inputs and discussions on Day 1&2 **… [to be mapped into above tasks, with names of contributors]**

1. **Listing essential variables (ECV, EOV, EBV), and analyzing their operability as carbon cycle variables**
   a. Based on paper/report review (Antonio will join to list EVs)
   b. Sensitivity analysis (needs modeling work member)… essential for which scale?
2. **Reviewing existing (*in-situ*) observations and white papers, etc.**
   a. Need information from data availability (co-work with Task 2), for each domain (terrestrial, ocean, atmosphere)
   b. Matrix and maps of thematic and geographical distributions, for networks/programs
3. **Equating different measurement techniques and measurements across platforms/networks**
   a. Community best practices
   b. Defining essential variables, with a few priorities (depending on targeted products)
4. **Gap analysis (geographical, thematic)**
   a. Based on findings from budget calculations / synthesis works (Task 4)
   b. Overlaying maps of budget calculation, uncertainty (Task 4), and spatial distribution of plots/data
   c. Need implication from synthesis perspective, IPCC inputs, etc.
   d. Start from terrestrial *in-situ* observations/data (because of the large gap and non-coordinated condition) Observation by satellite is documented by CEOS (2014).
      - Intensive sites (‘super-sites’) may help us to review the design and consider coordinated obs in link with satellite RS (try to ecophysiological use of satellite RS: photosynthetic capacity, etc.)
5. **Collaboration / consulting with networks and initiatives**
   a. Learning constraining factors of observations by interviewing to other existing initiatives/networks.
   b. Need support of **‘GEO *In-situ* obs resource foundational task’**
   c. “Optimized design” should be discussed with the communities, as there may be on-going activities/efforts, and also because ‘one-way’ recommendation may not make sense… co-design is needed.

Essential Climate Variables

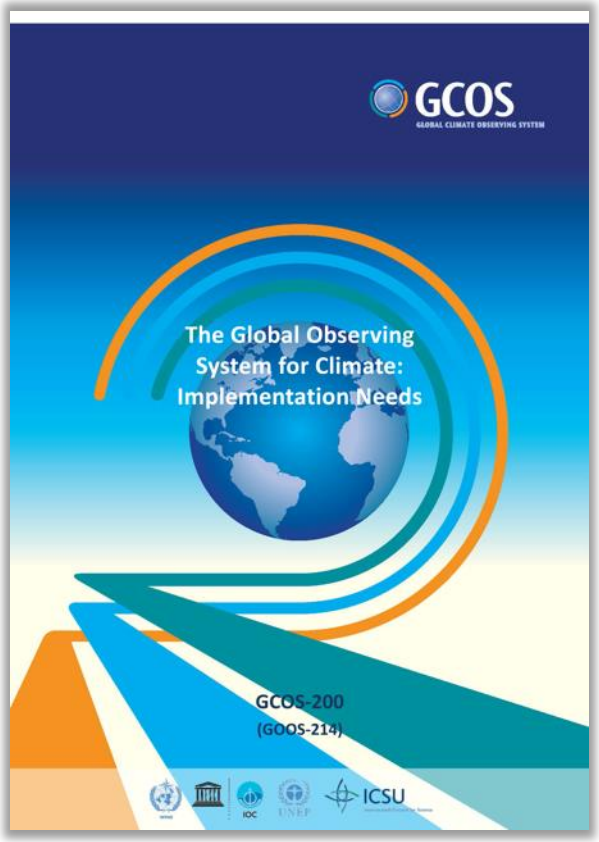

Table 2. GCOS ECVs grouped by measurement domain and area covered. The groups show how observations across all the measurement domains are needed to capture specific phenomena or issues. *(NOTE: Terrestrial Latent and Sensible Heat fluxes are not currently an ECV but are being considered as a potential future ECVs)*

	Atmosphere	Terrestrial	Ocean
Energy & Temperature	Surface Radiation Budget, Earth Radiation Budget, Surface Temperature, Upper Air Temperature, Surface and Upper Air Wind Speed	Albedo, *Latent and Sensible Heat* fluxes, Land Surface Temperature	Ocean Surface Heat Flux, Sea Surface Temperature, Subsurface Temperature
Other Physical Properties	Surface Wind, Upper Air Wind, Pressure, Lightning, Aerosol Properties		Surface Currents, Subsurface Currents, Ocean Surface Stress, Sea State, Transient Traces
Carbon Cycle and other GHGs	Carbon Dioxide, Methane, Other long-lived GHG, Ozone, Precursors for Aerosol and Ozone	Soil Carbon, Above-ground Biomass	Inorganic Carbon, Nitrous Oxide
Hydrosphere	Precipitation, Cloud Properties, Water Vapour (Surface), Water Vapour (Upper Air), Surface Temperature,	Soil Moisture, River Discharge, Lakes, Groundwater,	Sea Surface Salinity, Subsurface Salinity, Sea Level, Sea Surface Temperature
Snow & Ice		Glaciers, Ice Sheets and ice shelves, Permafrost, Snow	Sea Ice
Biosphere		Land Cover, Leaf Area Index (LAI), Fraction of Absorbed Photosynthetically Active Radiation (FAPAR), Fire	Plankton, Oxygen, Nutrients, Ocean Colour, Marine Habitat Properties
Human Use of Natural Resources		Water Use, Greenhouse Gases (GHG) Fluxes	Marine Habitat Properties

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Satellite remote sensing

Land-use change

Biophysical information

Column CO_2 & CH_4

SIF

Seasonal change of vegetation surface

Modeling

Inversion

Ecosystem C cycle

Validation of column CO_2

Mechanistic interpretation of atmospheric CO_2 change

Climate change impacts on terrestrial ecosystem and carbon cycle, and its feedback (local – regional – global)

→ Needs of cross-disciplinary observations

Model input parameters

In-situ observations

CO_2 flux (NEE, GPP, Reco)

NPP

Biomass

LAI

Photosynthesis

Phenology

Chlorophyll fluorescence

Water/energy budget

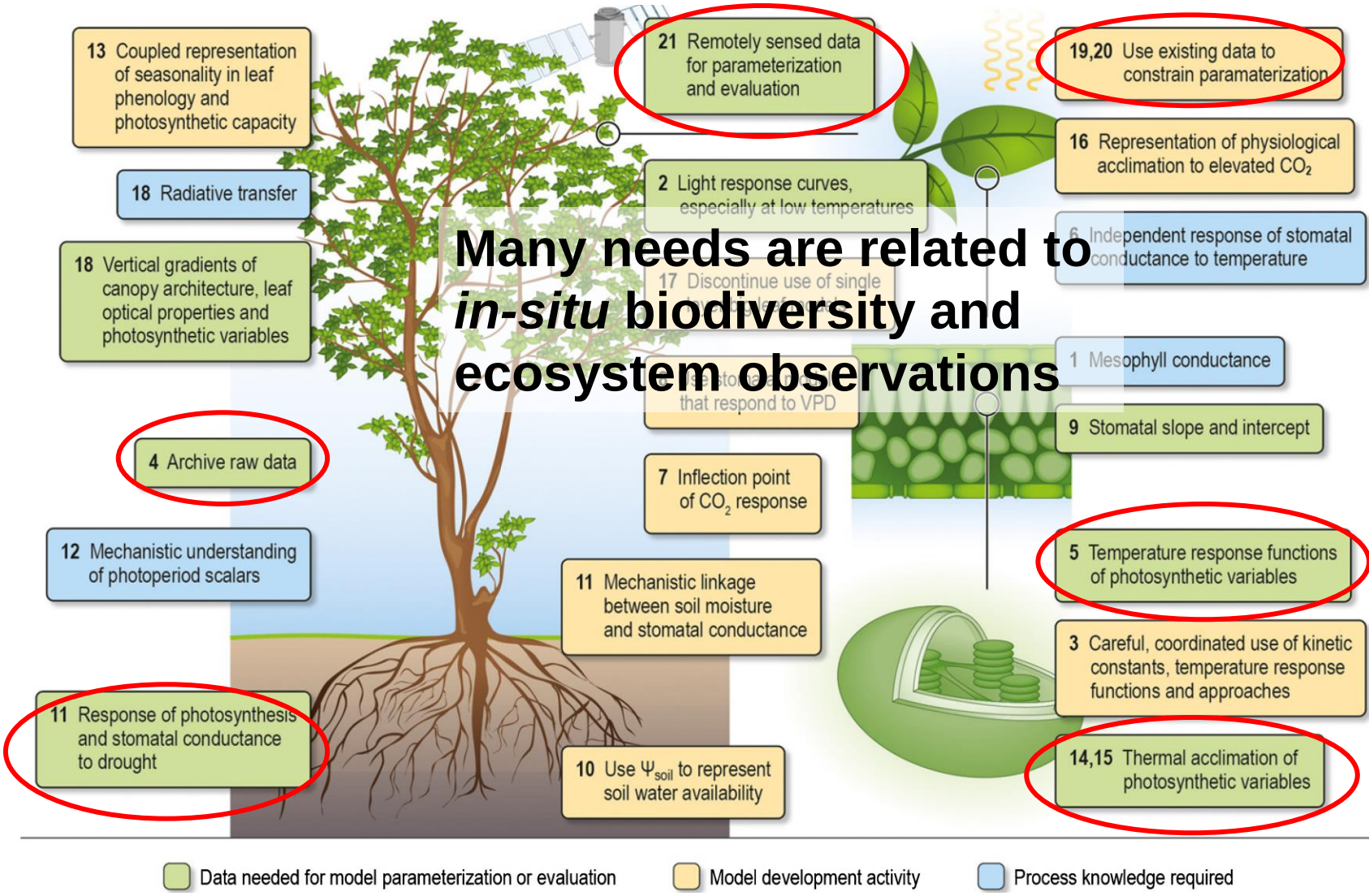
Soil respiration

Land-use change

In-situ observation needs

A roadmap for improving the representation of photosynthesis in Earth system models

Rogers et al. (2017)
New Phytologist



Many needs are related to *in-situ* biodiversity and ecosystem observations

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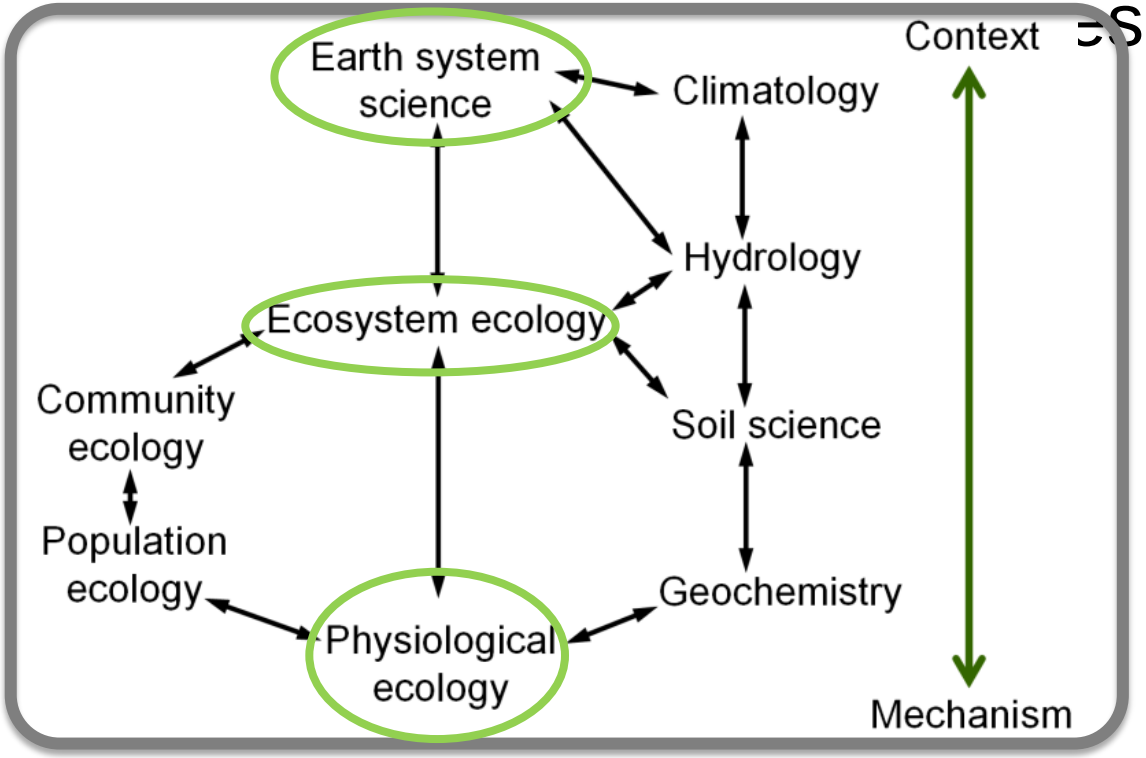
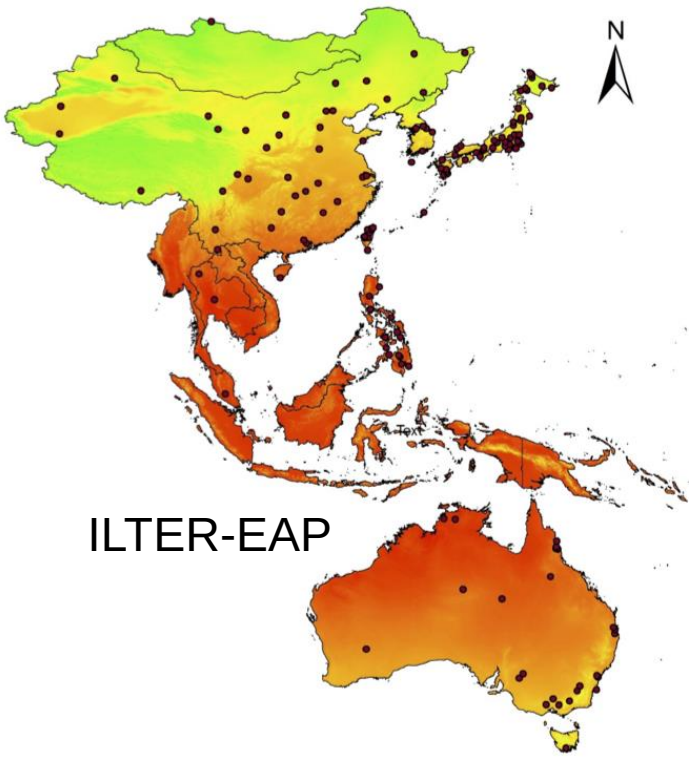
Cross-cutting network is needed for Earth observations of biodiversity, ecosystems and C cycle



from Chapin et al. (2002)



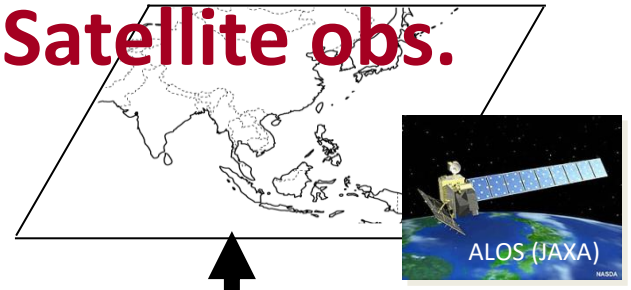
Carbon cycle and its ecological processes (elements) are the cross-cutting them of this network

To fill the observational gaps of essential carbon cycle variables
… link *in-situ* biodiversity & ecosystem obs. with satellite obs.
(collaborate with AsiaFlux, ILTER, APBON, etc.)

Earth system and ecosystems

Biological and ecological processes

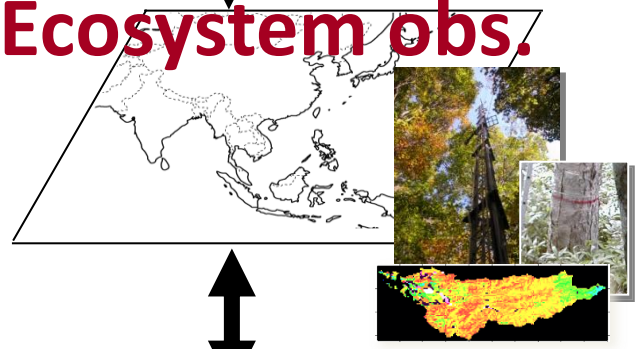
Satellite obs.



Satellite remote sensing

Ecosystem and land-use types
Vegetation structure
Temporal change in ecosystems

Ecosystem obs.



Ecological process research, tower flux obs. and modeling

Primary production (carbon cycle)
Eco-hydrology
Nutrient cycling

Biodiversity obs.

Species and genetic level research

Plant species distribution
Wildlife habitat assessment
Biological interactions

(Muraoka, Ishii et al. 2013)

Networking networks

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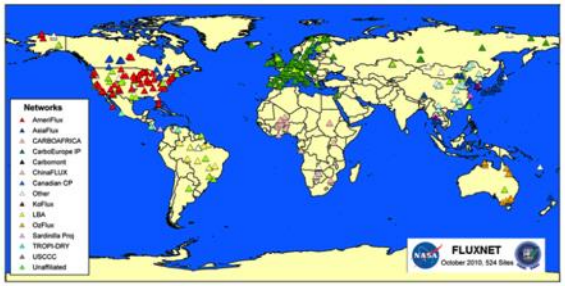
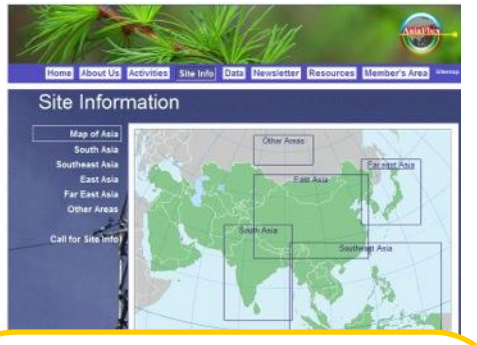
FLUXNET



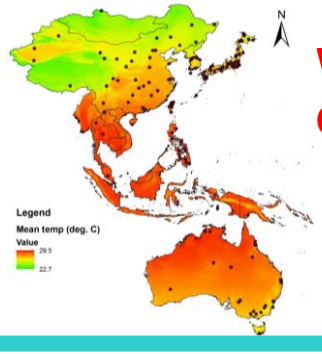
ILTER

GEO BON

AsiaFlux

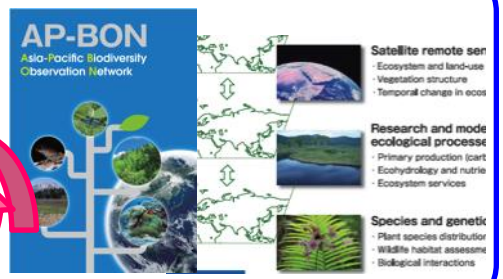


ILTER-EAP

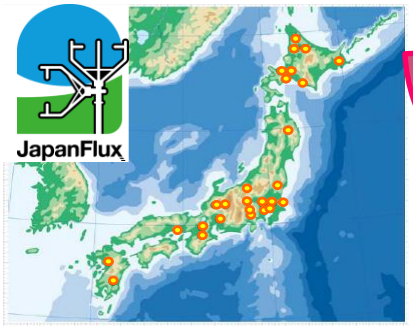


WG2 of GEOSS-AP

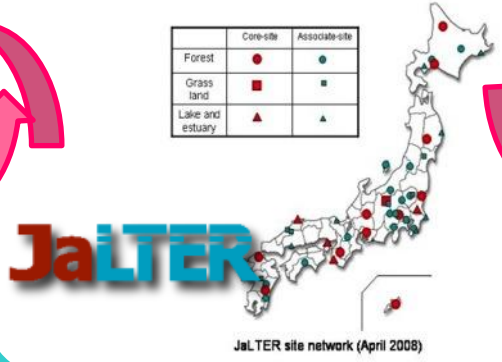
AP BON



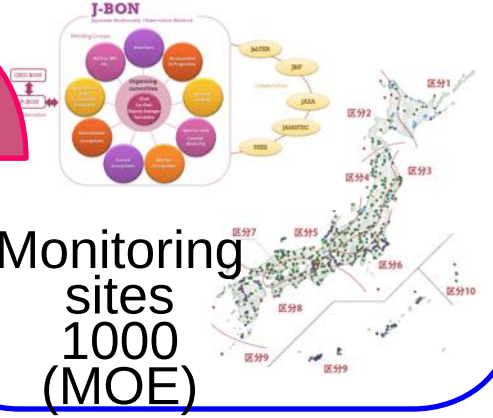
JapanFlux



JaLTER



J-BON



Monitoring sites 1000 (MOE)

(by N. Saigusa and H. Muraoka)