10th GEOSS Asia Pacific Symposium (Sep 2017, Hanoi)

Asia Pacific Biodiversity Observation Network (WG2)

Introduction to Sessions 2-4:

Development of biodiversity and ecosystem observation networks, and Challenges in connecting EO to SDGs

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GEO Programme Board (Japan member)

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

GROUP ON EARTH OBSERVATIONS

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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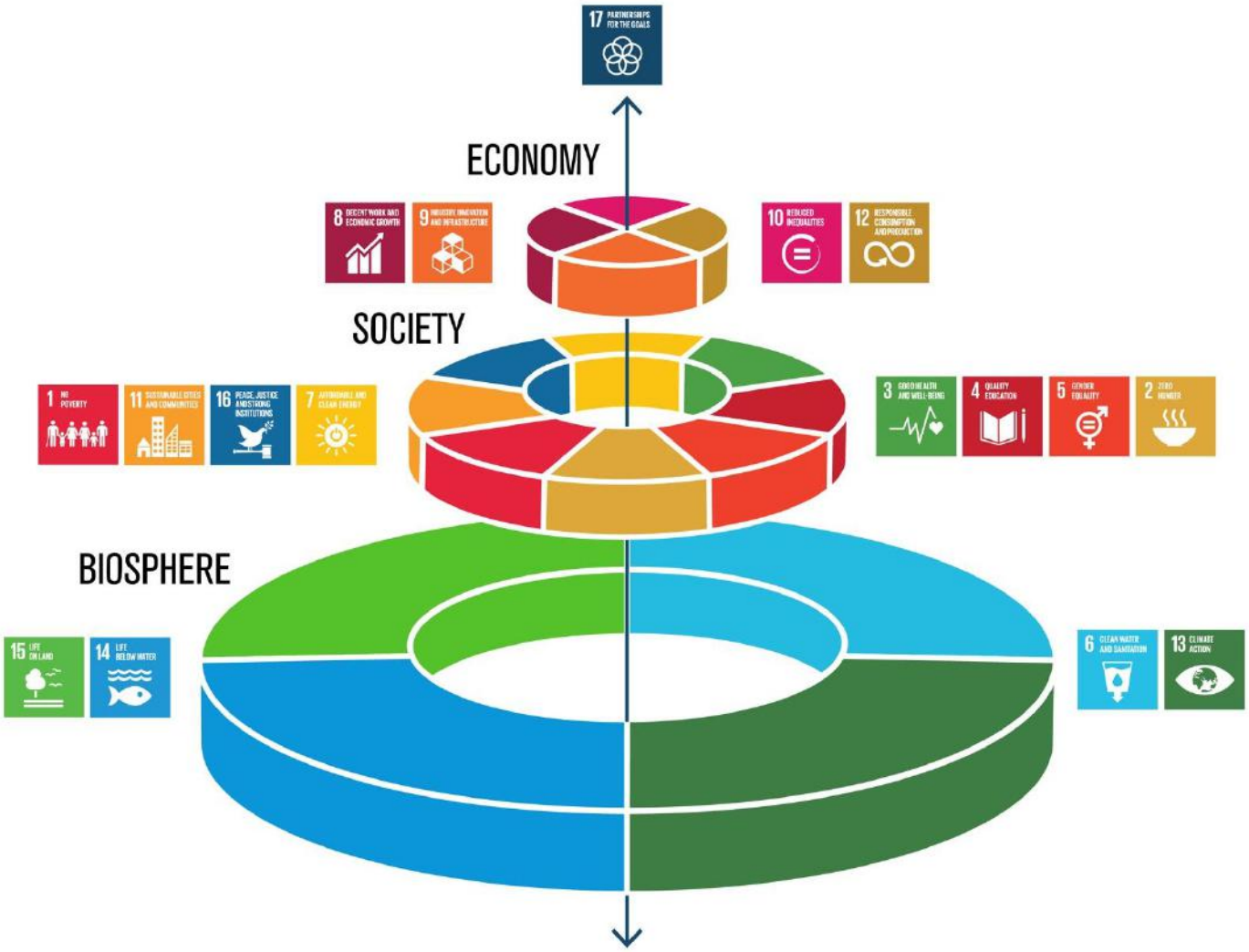
THE GLOBAL GOALS

For Sustainable Development



(Azote Images for Stockholm Resilience Centre)

http://www.stockholmresilience.org/research/research-news/2017-02-28-contributions-to-agenda-2030.html

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Goals

Targets

Indicators

Data **Knowledge**

Ecosystem goods and services

Biodiversity and Ecosystem obs.

Essential Variables?

Available online at www.sciencedirect.com

ScienceDirect

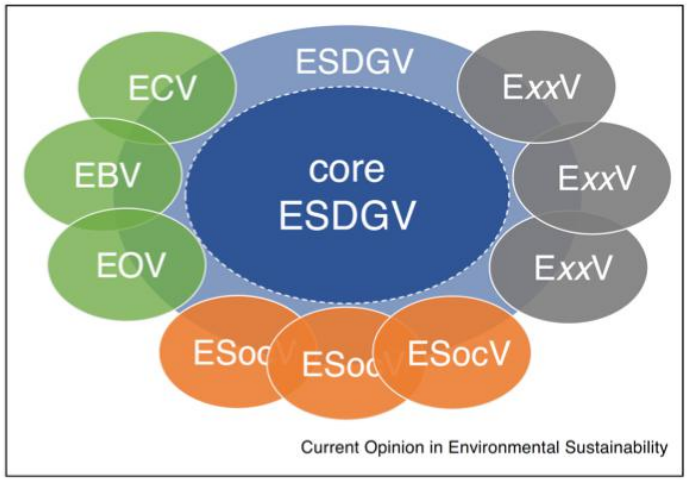
Current Opinion in Environmental Sustainability

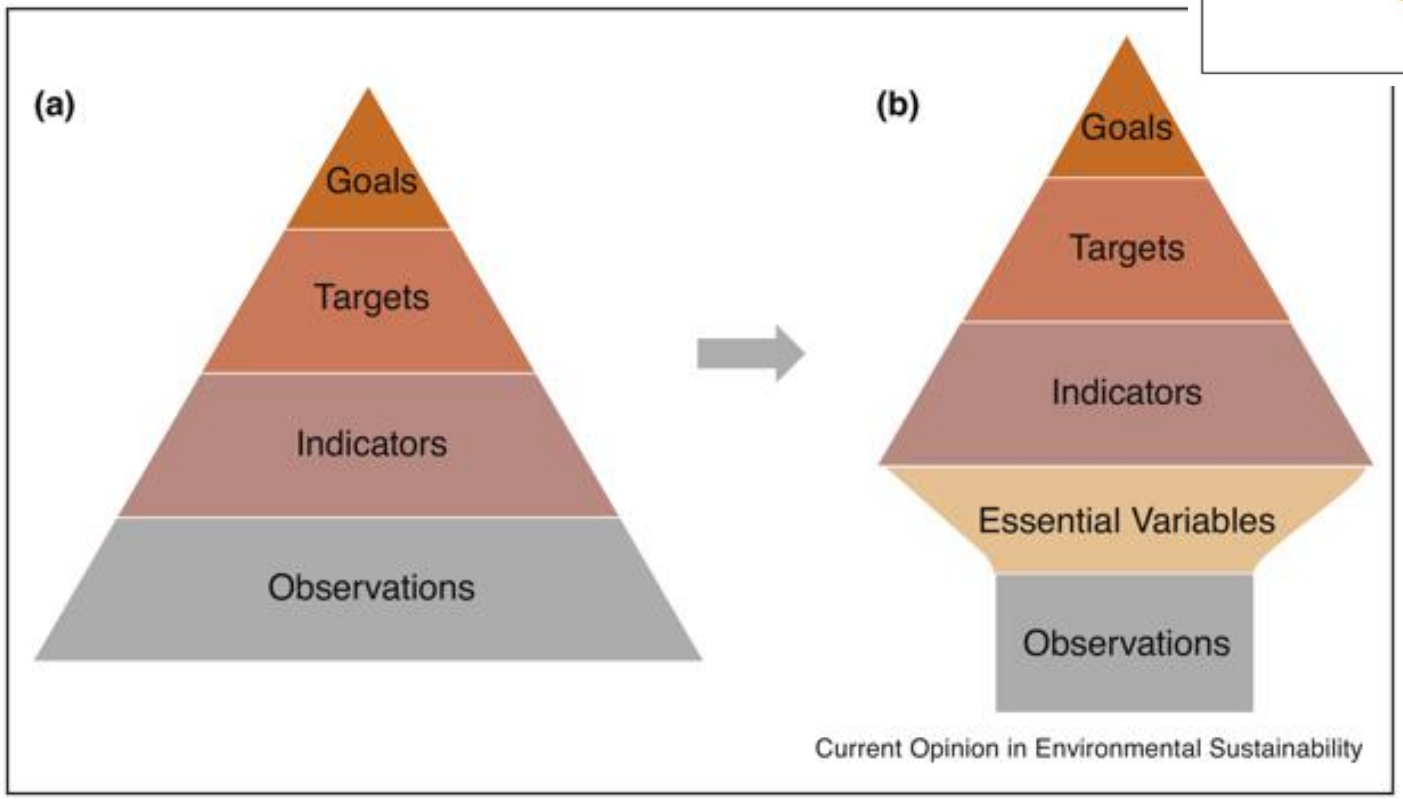
Essential Variables help to focus Sustainable Development Goals monitoring

Belinda Reyers[1,2,3], Mark Stafford-Smith[4,2], Karl-Heinz Erb[5] Robert J Scholes[6] and Odirilwe Selomane[3,7]

Current Opinions in Environmental Sustainability
Vol 26-27: pp 97-105

Figure 3

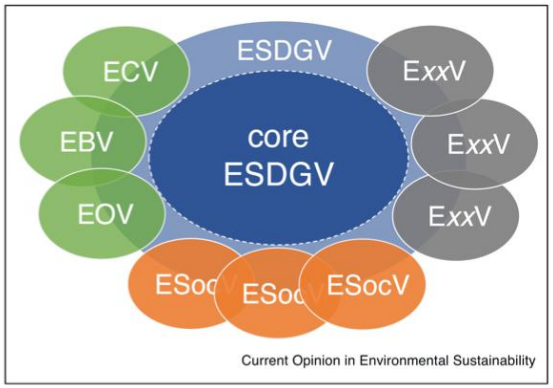




Essential Variables help to focus Sustainable Development Goals monitoring

Belinda Reyers[1,2,3], Mark Stafford-Smith[4,2], Karl-Heinz Erb[5], Robert J Scholes[6] and Odirilwe Selomane[3,7]

Figure 3



1. Develop/draw on social-ecological model(s) of SDG system

2. Identify first order EV categories, through sensitivity analysis or expert judgement

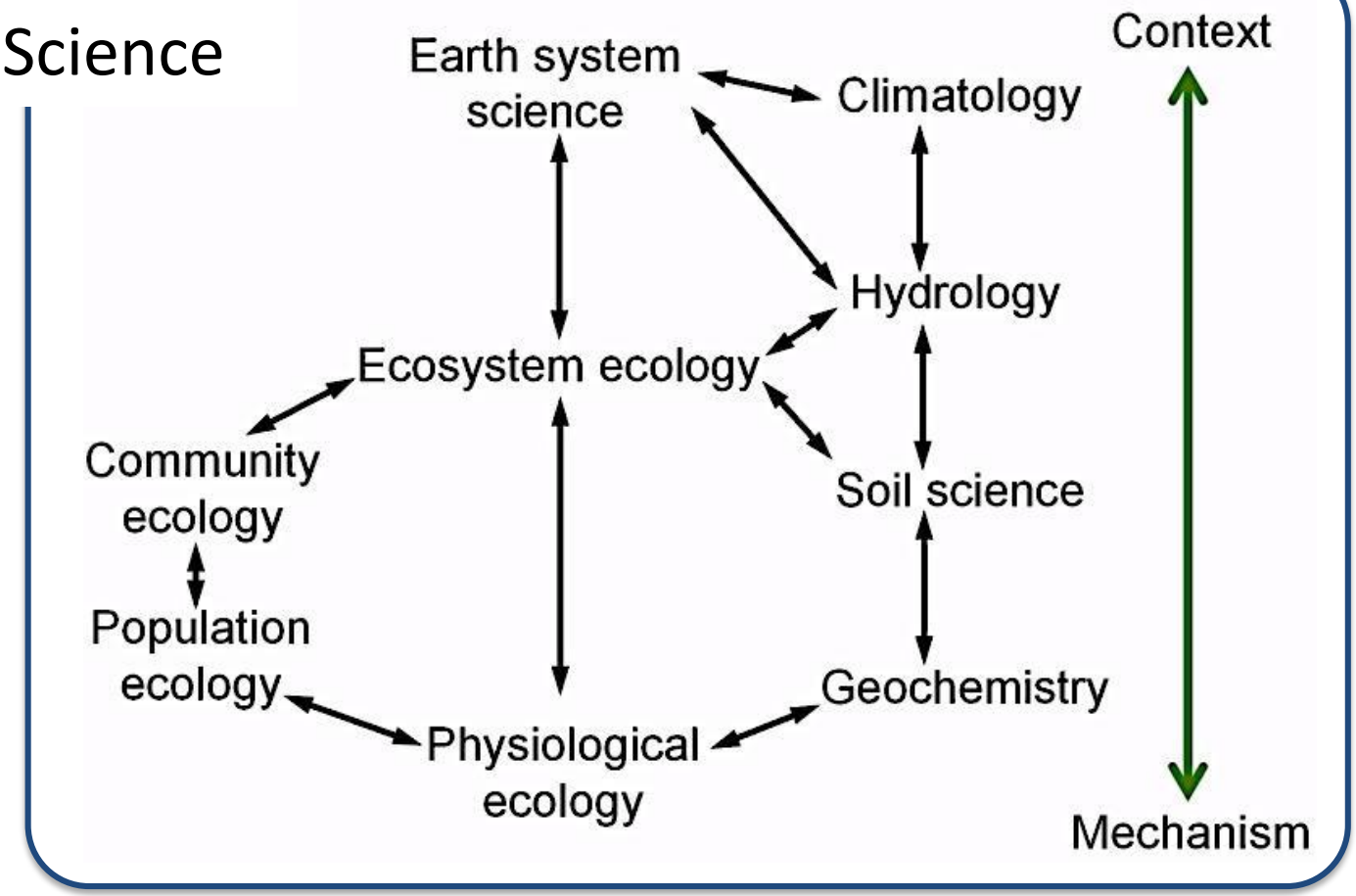
(a) Identify key flows between system components
(b) Highlight/filter for transformation facilitators
(c) Add variables exposing interactions between policy domains
(d) Filter set on basis of redundancy/ indispensability

3. Identify ESDGVs in each category through expert workshops, on-line consultation and filter criteria

4. Identify ESDGVs not curated in other communities, and prioritise collecting these

5. Refine/revise to check whether all key system interactions and flows and policy coordinations (criteria A & C) are covered

Biodiversity and Ecosystem observations in Earth System Science



Chapin et al. (2002) *Principles of Terrestrial Ecosystem Ecology*

- Ecosystem ecology in Earth system science — Multi-disciplinary / Cross-scale
- Ecological knowledge for sustainable development — Societal and User Need
- Engagement of broad communities — Networking / Advocacy

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GEO CARBON AND GHG INITIATIVE

Example..

GEO Carbon and GHG initiative

Task 3 Implementation plan outline

(Task 3 co-lead: H. Muraoka)

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]

Essential Climate Variables

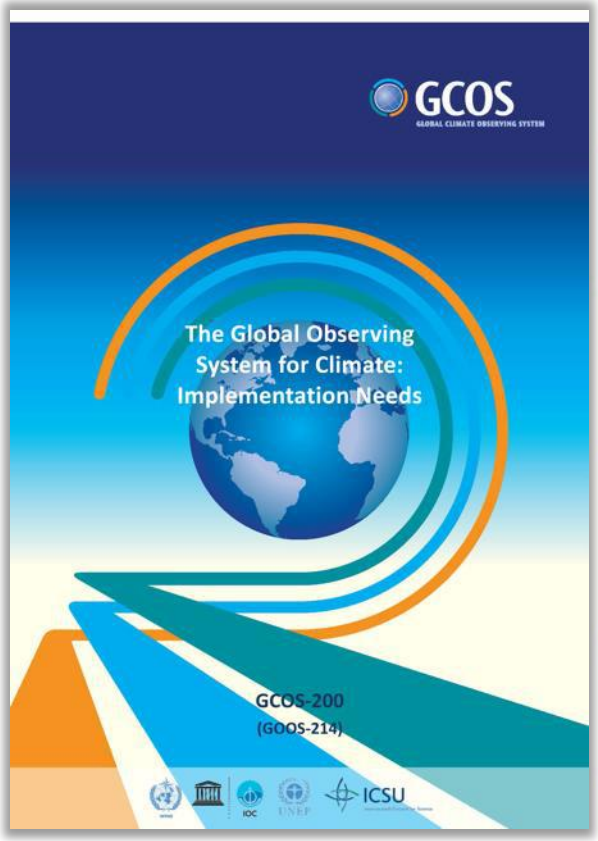

Table 2. GCOS ECVs grouped by measurement domain and area covered. The groups show how observations across all the measurement domains are needed to capture specific phenomena or issues. *(NOTE: Terrestrial Latent and Sensible Heat fluxes are not currently an ECV but are being considered as a potential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

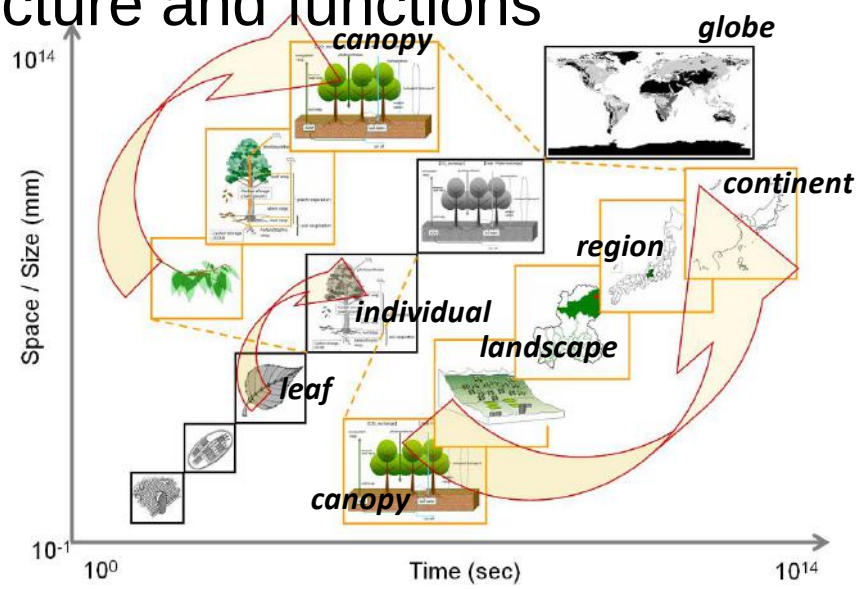
Land-use change

Challenges of ecosystem science under climate change

- Mechanisms of dynamic responses of terrestrial ecosystems to changing environment.
- Geographical patterns of biodiversity, ecosystem structure and functions, and their consequences with regional climate.
- *In-situ* raw data → Essential Variables – Indicators → Evaluation

- *In-situ* detailed, long-term obs. and experiments at research sites
- Satellite RS for ecosystem structure and functions

1. **Site networks** along geographic/climatic gradients
2. **"Super-site"** for
   - interdisciplinary obs.
   - linking *in-situ* and satellite obs. for up-scaling, broad-spatial



(Muraoka & Koizumi 2009, JPR

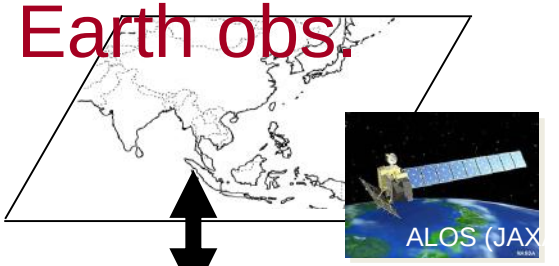
Biodiversity - Ecosystem - Earth observation

Satellite Ecology concept (2009-) in APBON

Earth system and ecosystems

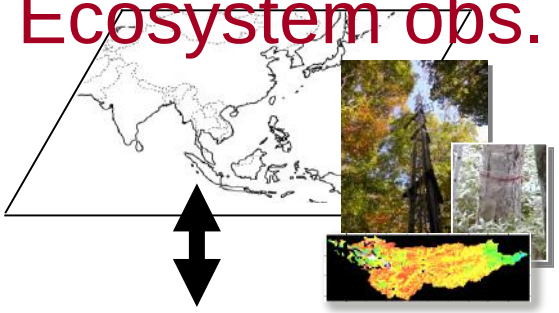
Biological and ecological processes

Earth obs.



Satellite remote sensing

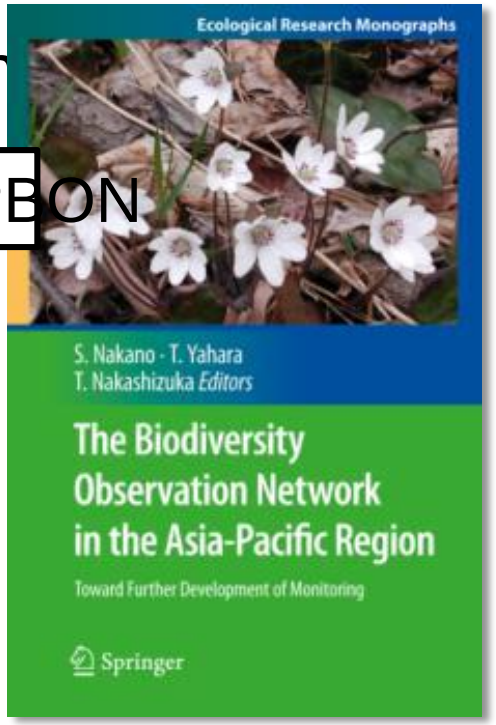
Ecosystem obs.

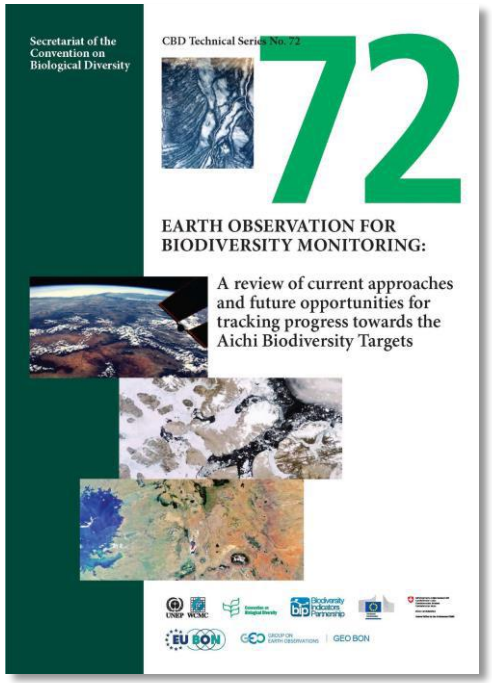


Ecological process research, tower flux obs. and ecosystem modeling

Biodiversity obs.

Species and genetic level research

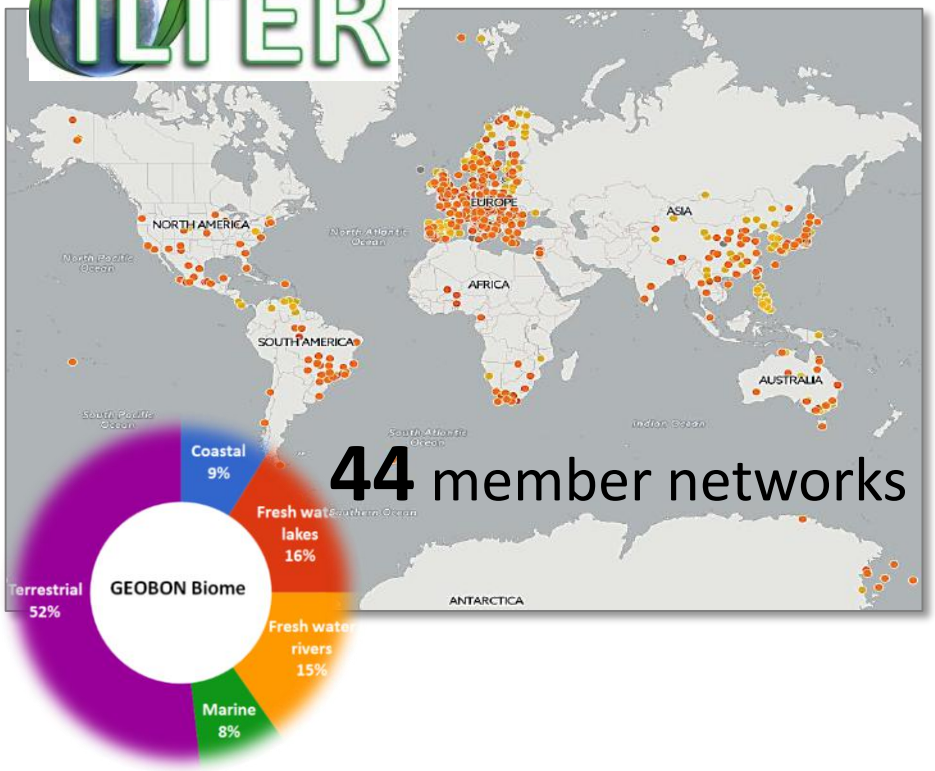


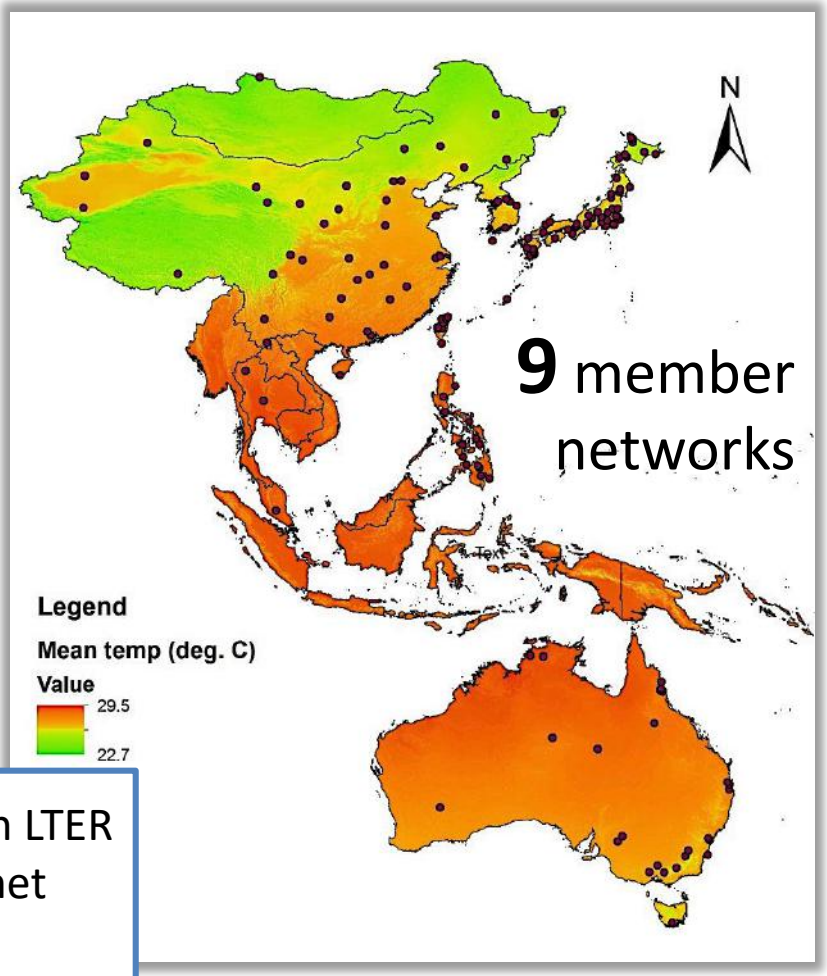


Ex.) Phenology and Photosynthesis (Carbon cycle) are fundamental and cross-cutting phenomena

LTER:
Long-Term Ecological Research network

ILTER-EAP East Asia and Pacific region





Australia - TERN / LTERN
China - CERN
Japan - JaLTER
Korea - KLTER
Malaysia - Malaysia LTER
Mongolia - Mongolian LTER
Philippines - PhiLTERnet
Taiwan - TERN
Thailand - Thailand LTER

Map by Y. Trisurat (Thailand LTER, Science Committee of ILTER-EAP)

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From **"Tokyo Statement"** (Jan 2017, Tokyo):

> *"APBON will promote data sharing to increase access to biodiversity related information and the effective monitoring systems of biodiversity and ecosystems. Gaps in available information will be addressed by improving collaboration among researchers in observation sites, designing incentives for data publications and deriving solutions to relevant science questions. APBON sees the need to improve communication and collaboration among biodiversity and ecosystem observation networks, to identify more national, thematic and regional networks and to reach out to other parts of Asia and the Pacific..."*

Objective items in this APBON WG include to

(1) share the current status of thematic and geographical coverage of biodiversity, phenology and ecosystem research sites (plots),

(2) plan mechanisms for data and knowledge delivery to Earth Observation community by inter-operable data system such as GEOSS portal and DIAS, and

(3) build the practical networks for integrated biodiversity and ecosystem observations by *in-situ* and satellite systems