HOKKAIDO UNIVERSITY

"Hokkaido University Sustainability Weeks 2013"

International Workshop on Peatland Management
"Future Aspects of Management in Tropical and Cool Temperate Peatlands –Harmonious and Sustainable Relationship with Nature"

10:00-17:00 Thursday, 10th October, 2013 Centennial Hall, Hokkaido University, Sapporo, Japan

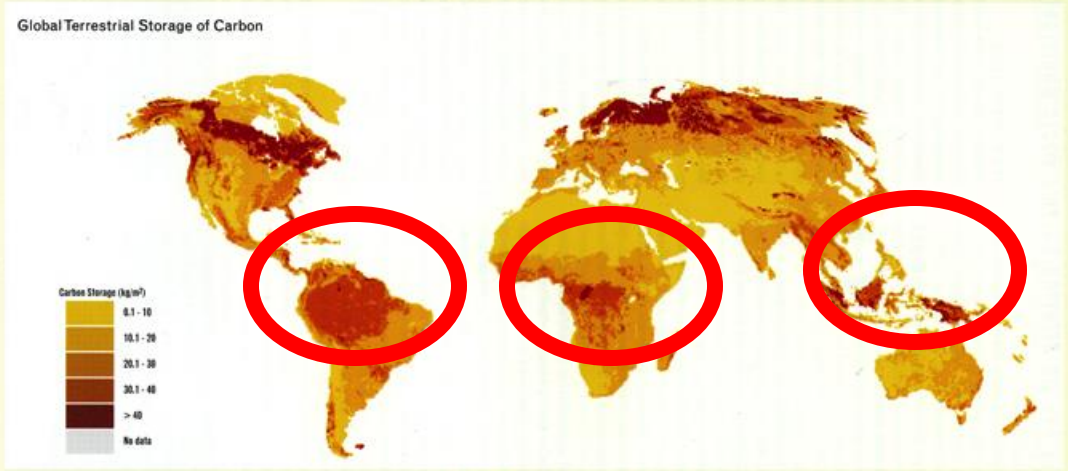
Session 1:
The Overviews of Ecosystem and Carbon Managements in Tropical Peatlands

Prof. Mitsuru Osaki. PhD
Research Faculty of Agriculture,
Hokkaido University

Photo from Erianto Indra Putra (UNPAR)

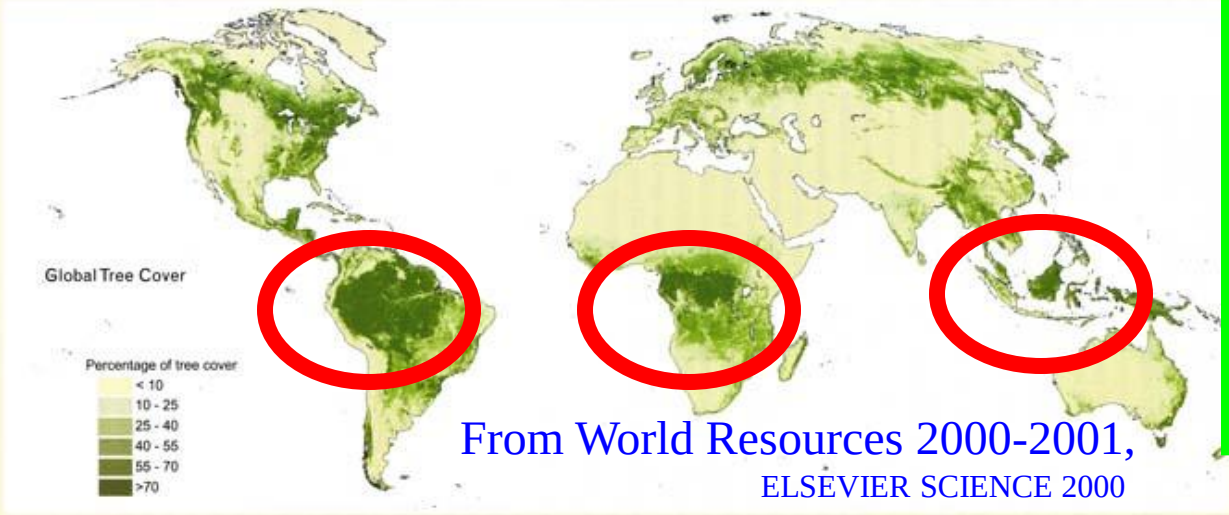
Forest Cover and Soil Carbon Content

Soil carbon content



Sources: Matthews et al. [PAGE] 2000. The map is a combination of two maps: a map of carbon sto
in soils based on Batjes (1996) and Batjes and Bridges (1994).

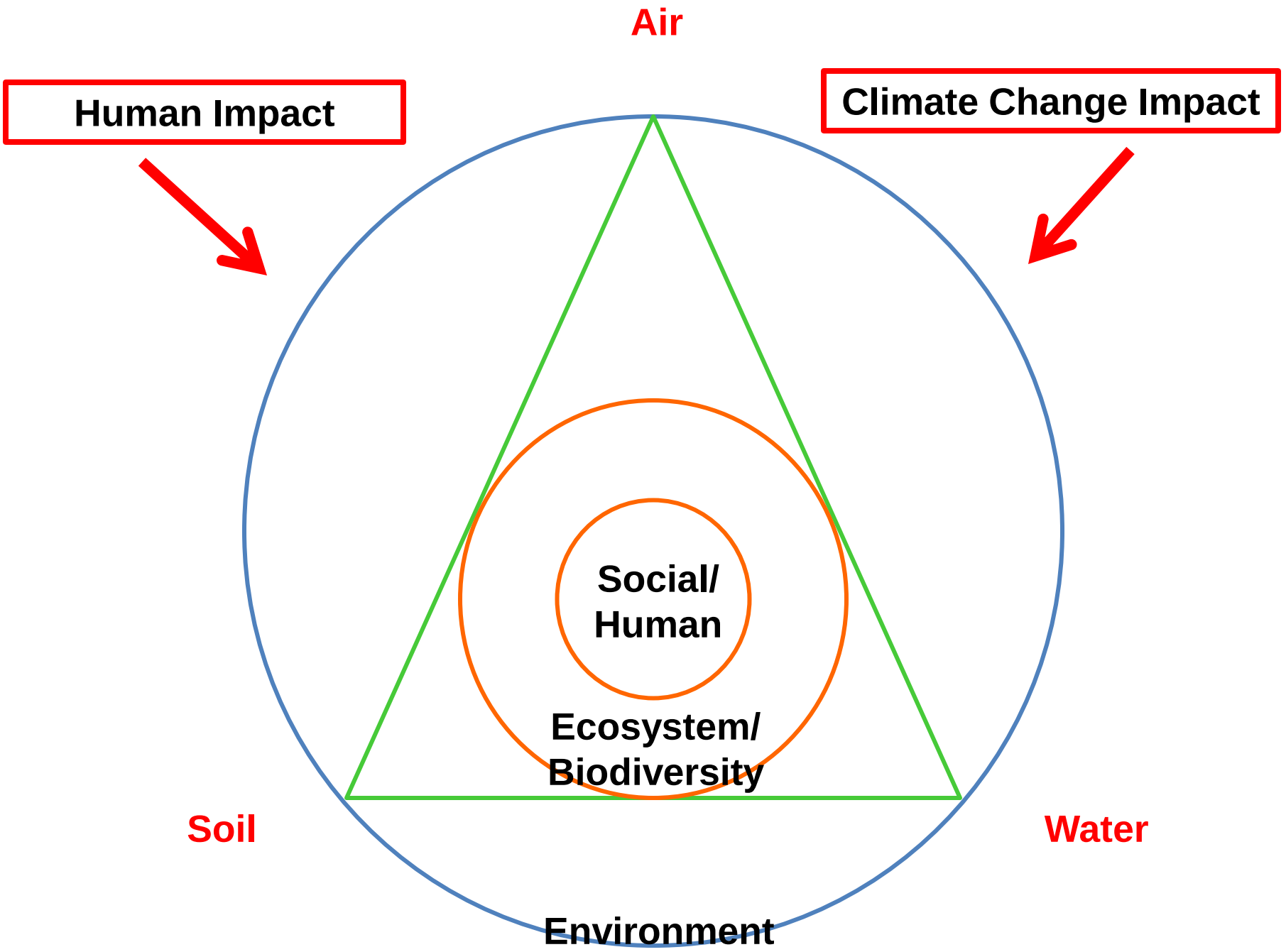
Forest cover



From World Resources 2000-2001,
ELSEVIER SCIENCE 2000

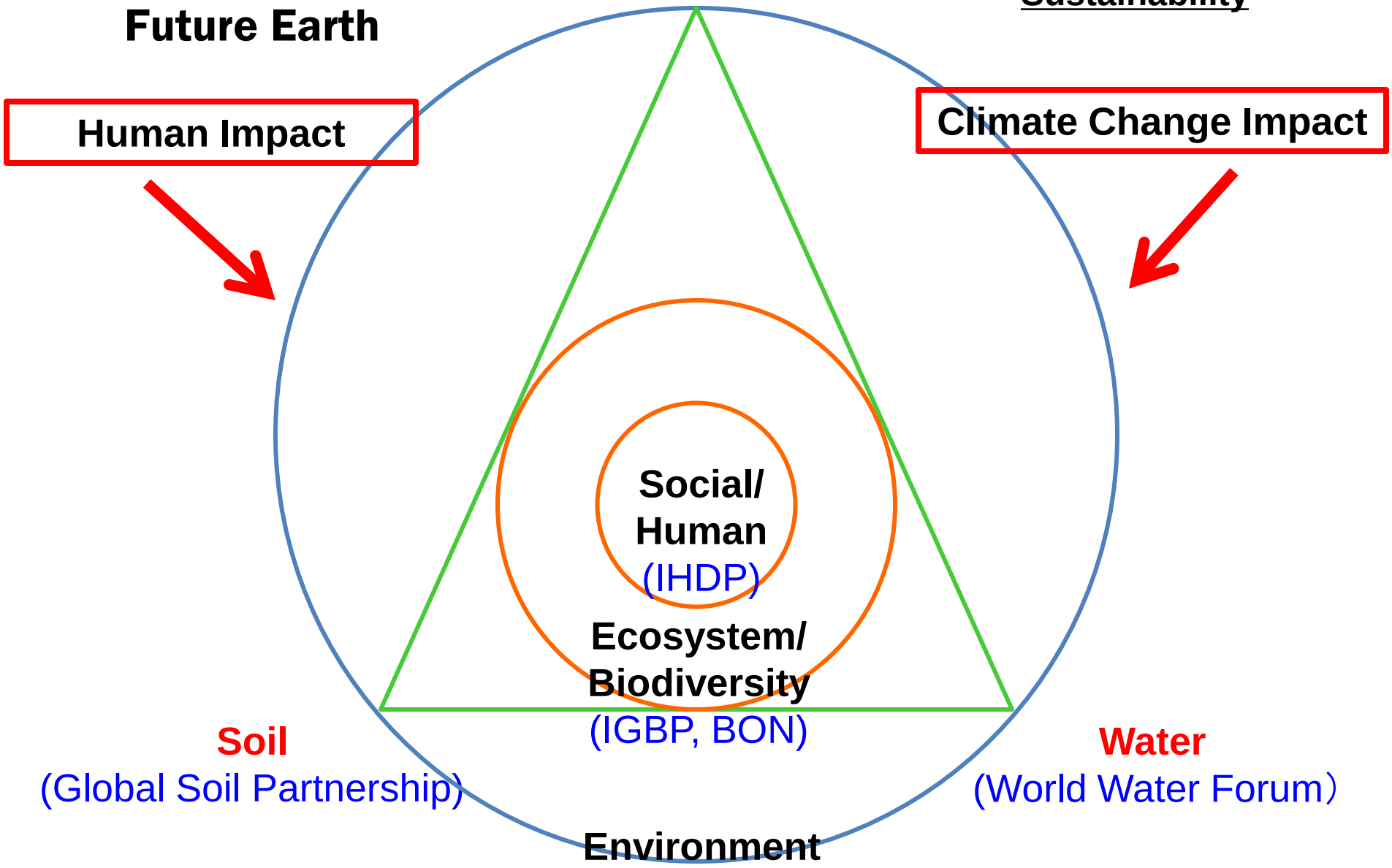
Sources: Matthews et al. [PAGE] 2000. Map is based on Defries et al. (2000). Figure is based on FAO (1997a).

- **Tropical forest remain mainly in lowland and peat (red circles), thus soil carbon content is high under the peat-forestry**
- **Destruction of peat-forest ascribe into "lager carbon emission" and "biodiversity loss"**

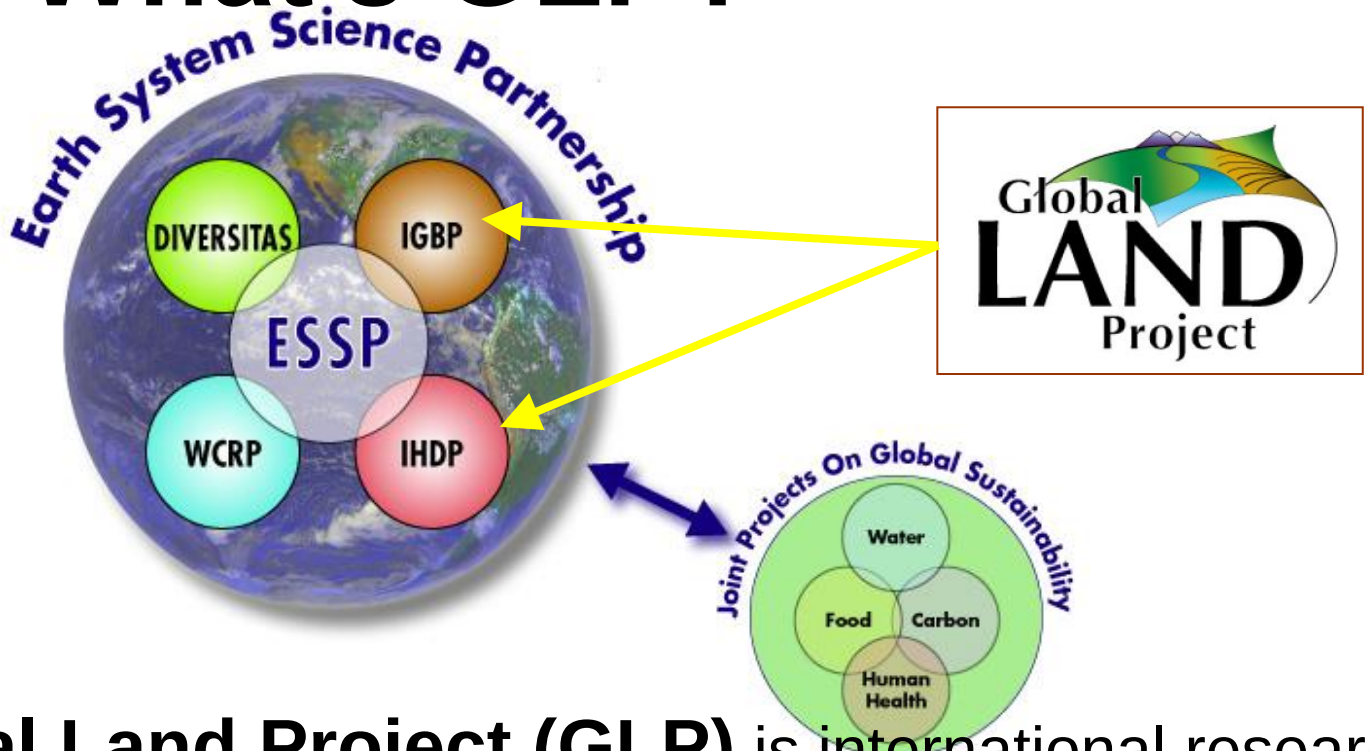

Air
Human Impact
Climate Change Impact
Social/
Human
Ecosystem/
Biodiversity
Soil
Water
Environment

Global Land Project (GLP) to Future Earth

Keyword of “Future Earth” is **Sustainability**



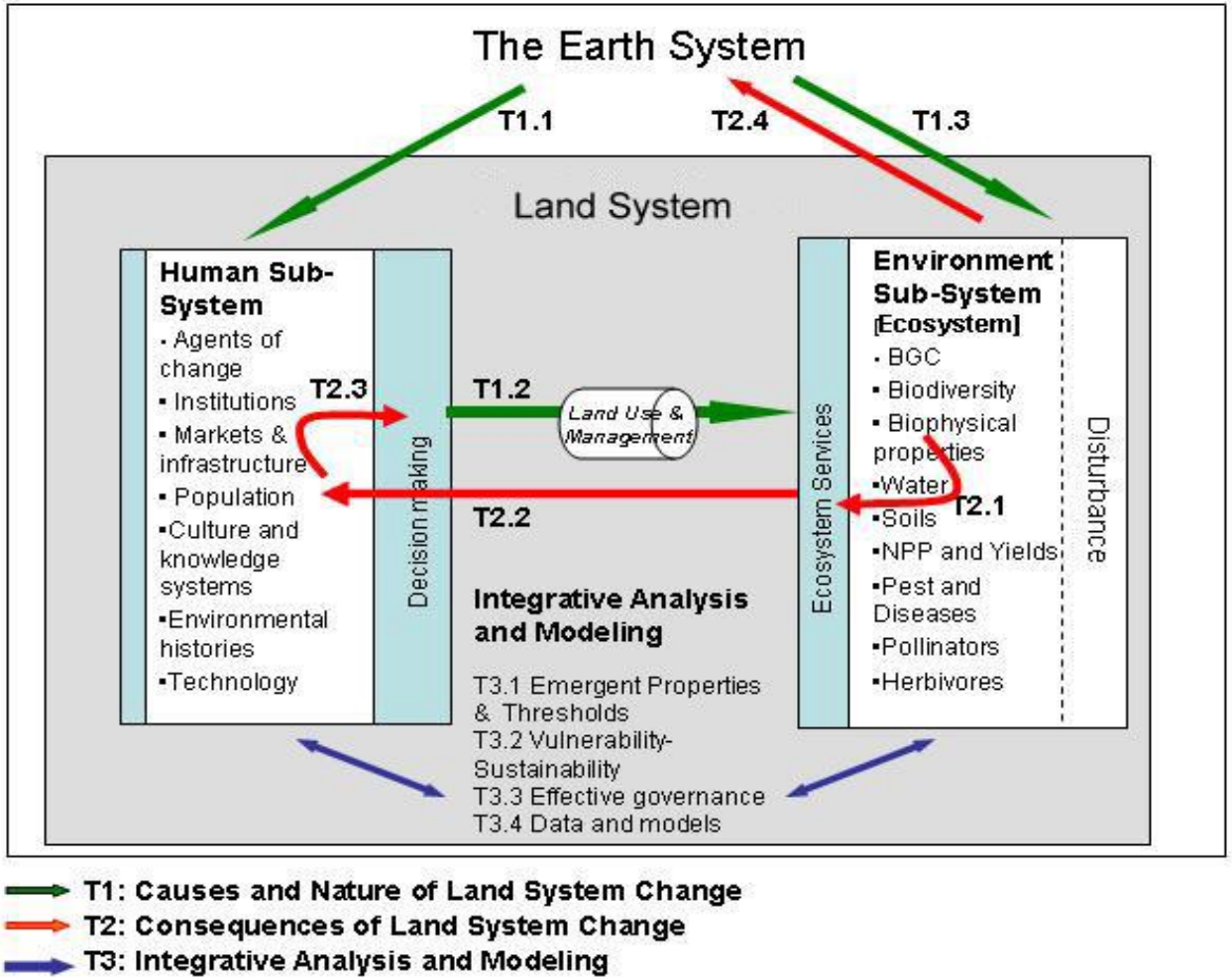
What's GLP?



✓**Global Land Project (GLP)** is international research project on **Land system science** that is designed to better integrate the understanding of the coupled human-environment system.

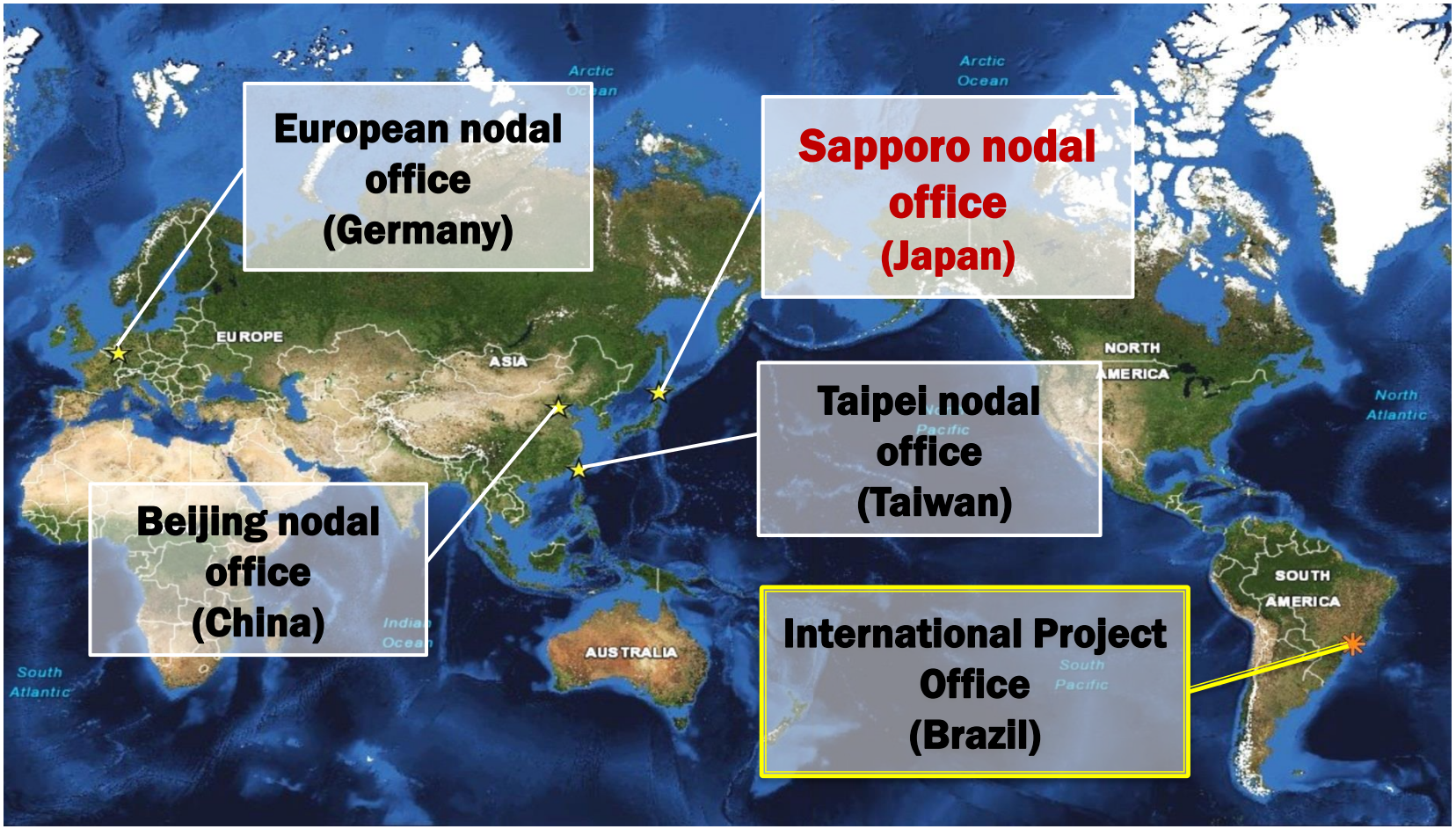
✓GLP is joint project for International Geosphere-Biosphere Programme (**IGBP**) and the International Human Dimensions Programme (**IHDP**) under the umbrella of Earth System Science Partnership (ESSP).

Global Land Project conceptual framework



GLP International project office and nodal offices

Sapporo nodal office is based at Hokkaido University, Japan



Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, UPR-EGP, and the GIS User Community

GLP Sapporo Nodal Office

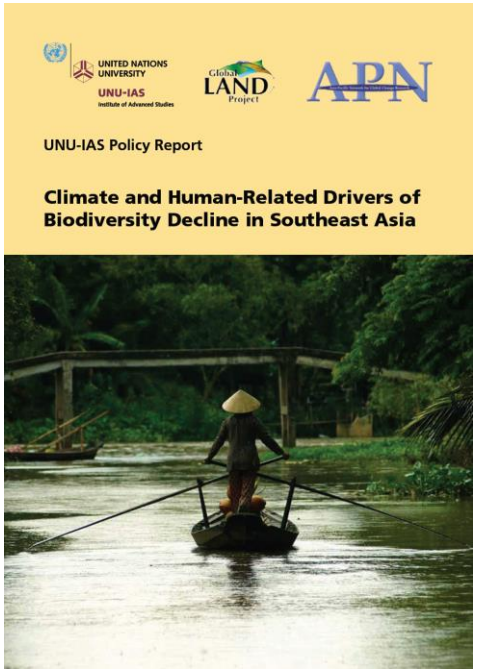
Vulnerability, Resilience and Sustainability of Land Systems

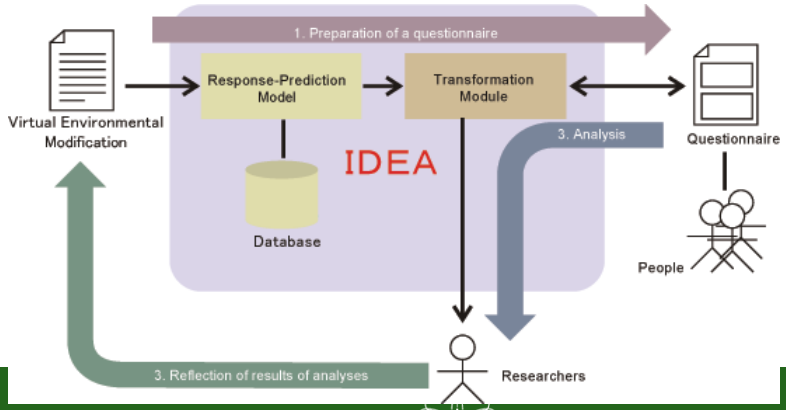
Hokkaido University, Sapporo, JAPAN




GLP endorsed projects through Sapporo Nodal Office

- **Wild Fire and Carbon Management in Peat Forest in Indonesia (PI: Mitsuru Osaki)**
- **Collapse and Restoration of Ecosystem Networks with Human Activity (PI: Norio Yamamura)**
- **Ecosystem Services Management in Asia (ECOSMAG) (PI: Ademola Braimoh)**
- **Environmental Valuation Project (PI: Tasuki Sekino)**
- **Human activities in Northeastern Asia and their impact on the biological productivity in North Pacific Ocean (Amur-Okhotsk Project) (PI: Takayuki Shiraiwa)**





GCTE

LUCC

GLP →

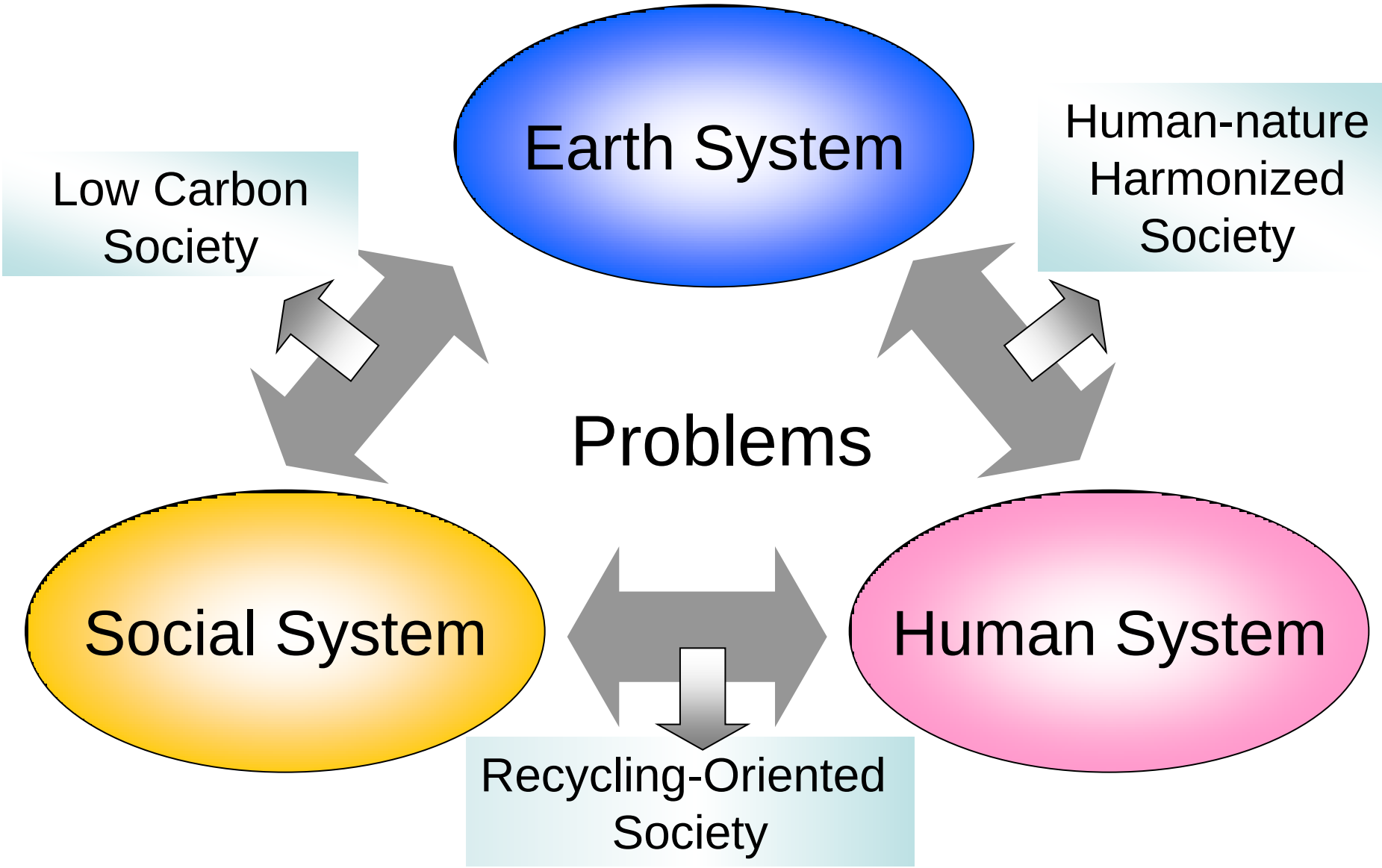
Toward global sustainability research – Future Earth

Japan Peatland Society
Establish in 9 October 2013

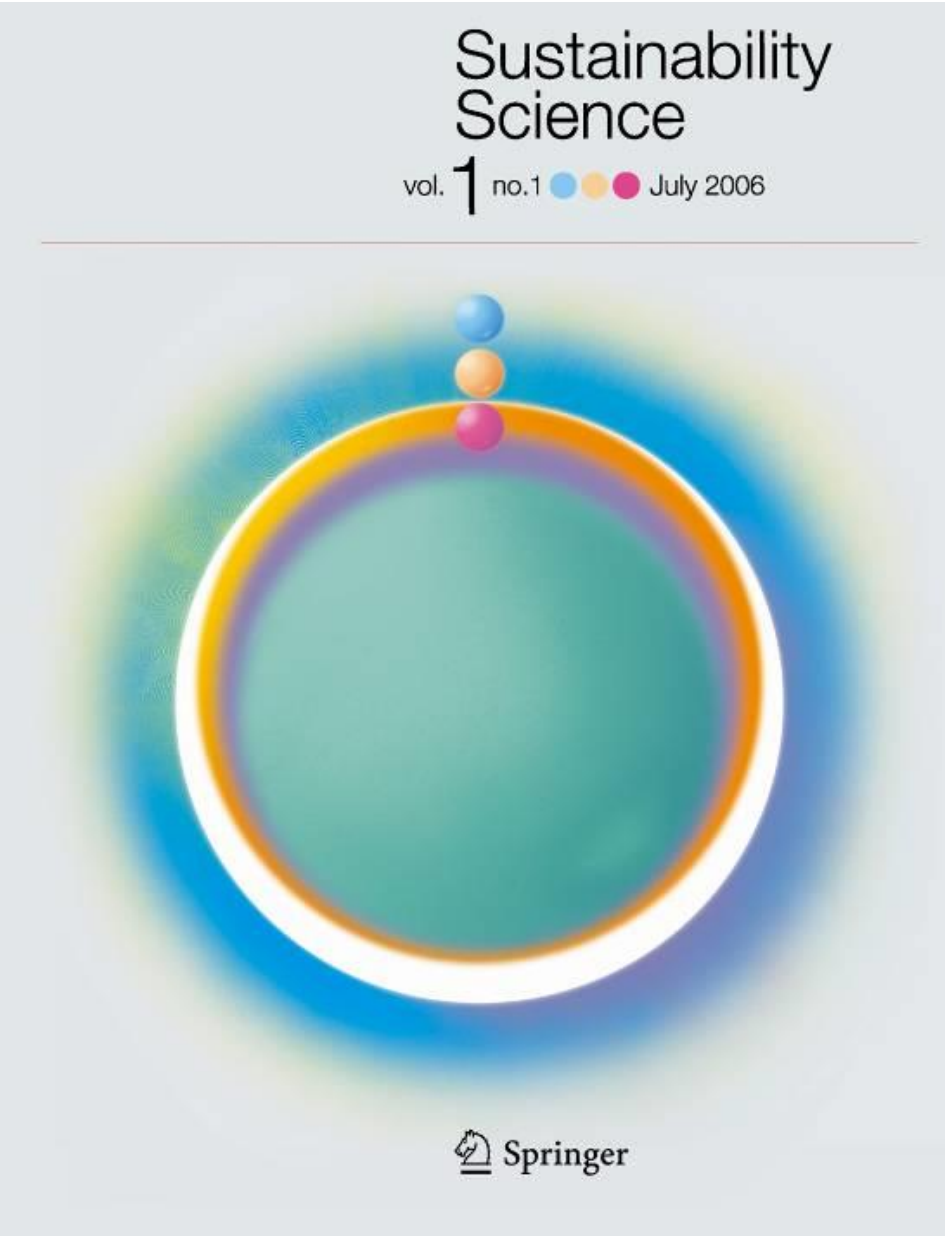
Integrated Research System for Sustainability Science (IR3S)

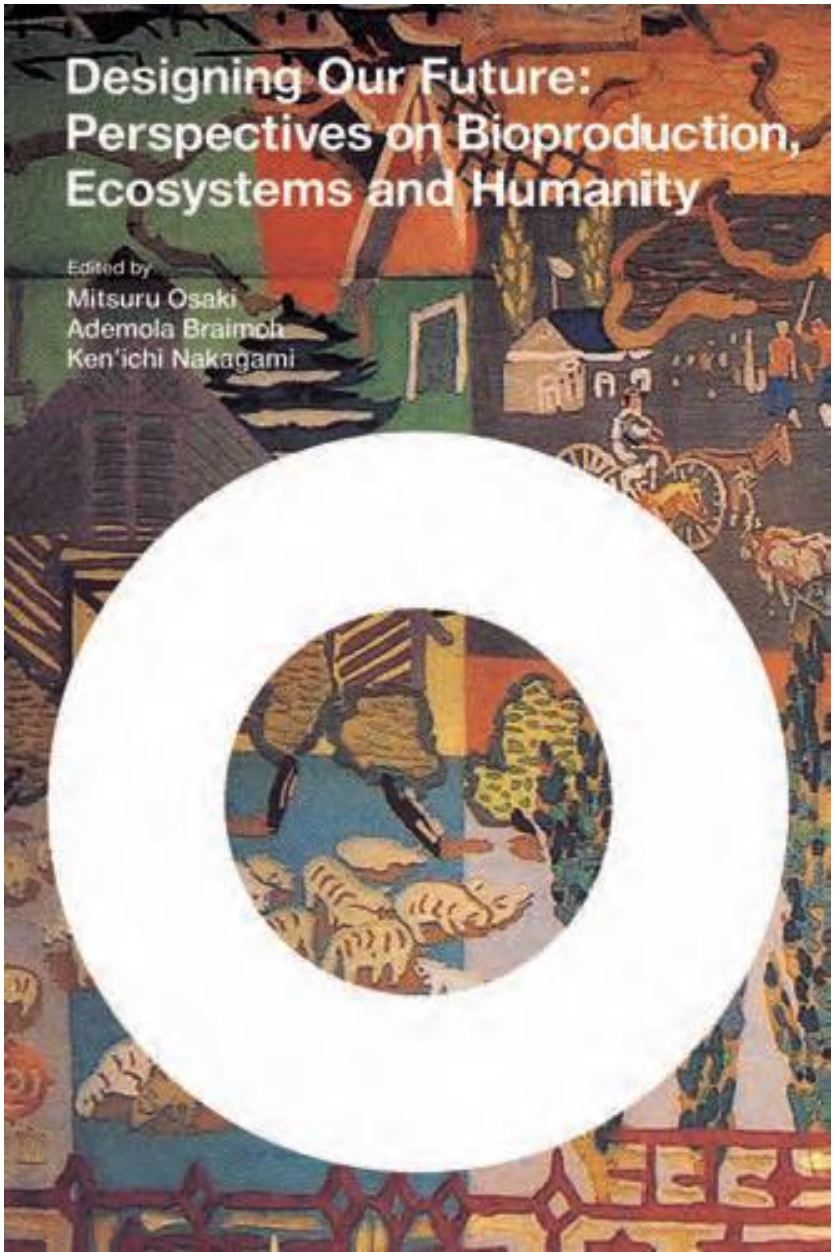
- Transdisciplinary Approach
- Weak Interaction
- Integration
- Network

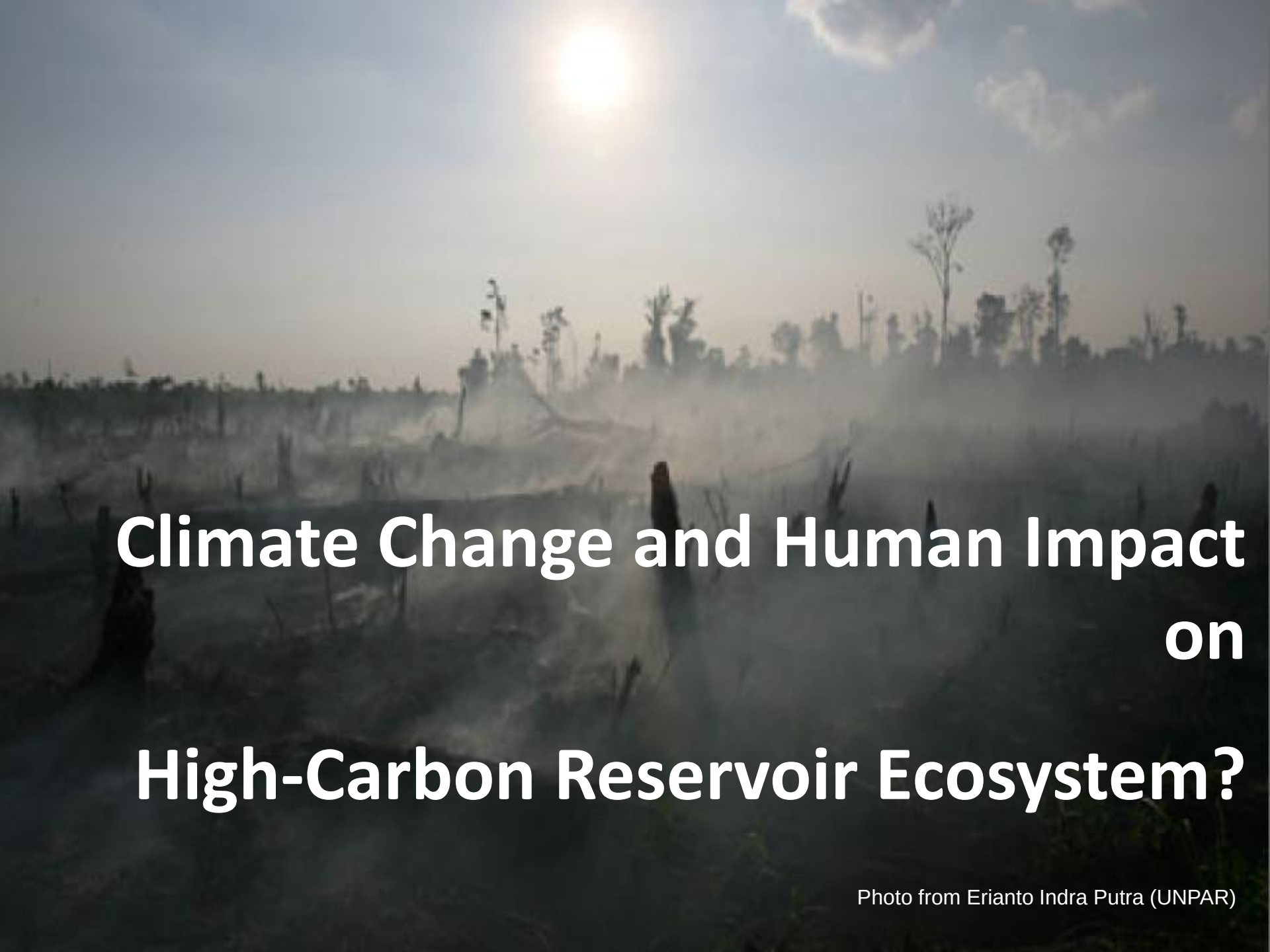
Sustainable Society



Journal & Book Publication







Climate Change and Human Impact on High-Carbon Reservoir Ecosystem?

Photo from Erianto Indra Putra (UNPAR)

Net primary production increased 6% (3.4 petagrams of carbon over 18 years) globally during 1982 to 1999

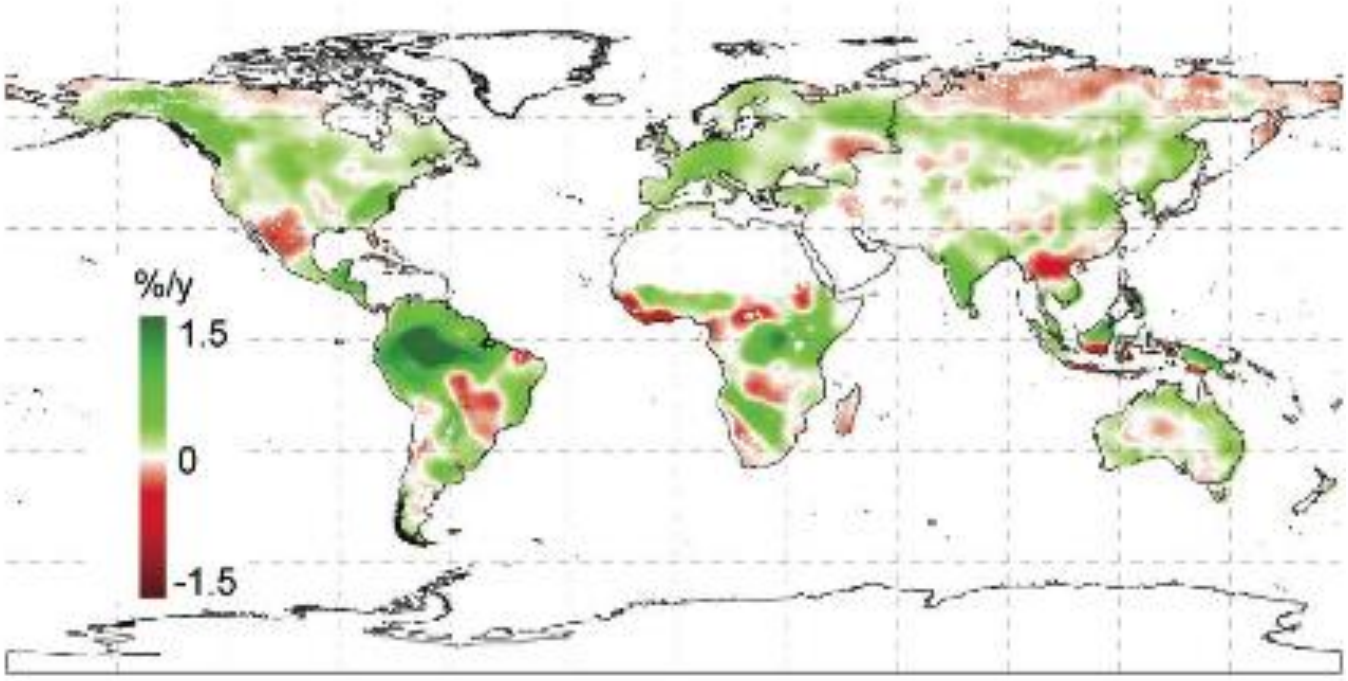


Fig. 2. Spatial distribution of linear trends in estimated NPP from 1982 to 1999. NPP was calculated with mean FPAR and LAI derived from GIMMS and PAL data sets.

www.sciencemag.org SCIENCE VOL 300 6 JUNE 2003

We present a global investigation of vegetation responses to climatic changes by analyzing 18 years (1982 to 1999) of both climatic data and satellite observations of vegetation activity. Our results indicate that global changes in climate have eased several critical climatic constraints to plant growth, such that net primary production increased 6% (3.4 petagrams of carbon over 18 years) globally. The largest increase was in tropical ecosystems. Amazon rain forests accounted for 42% of the global increase in net primary production, owing mainly to decreased cloud cover and the resulting increase in solar radiation.

Ramakrishna R. Nemani, *et al* : Climate-Driven Increases in Global Terrestrial Net Primary Production from 1982 to 1999. *Science 300, 1560 (2003);*

Net primary production decreased 1% (0.55 petagrams of carbon over 10 years) globally during 2000 to 2009

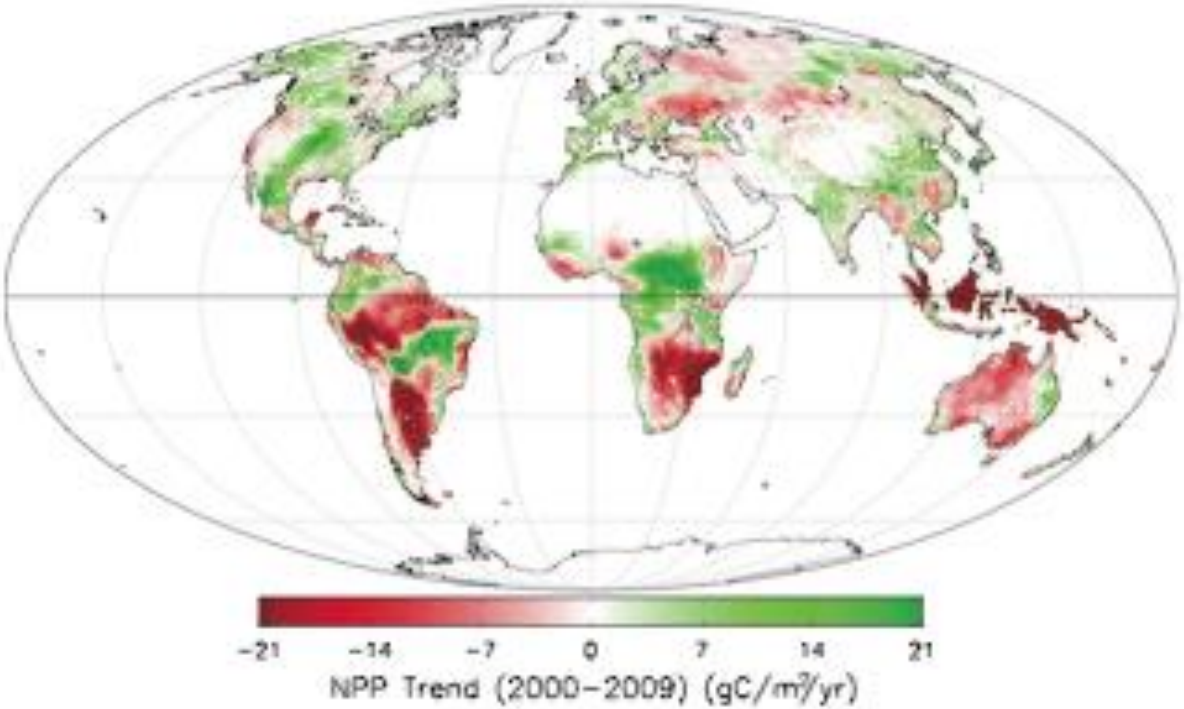
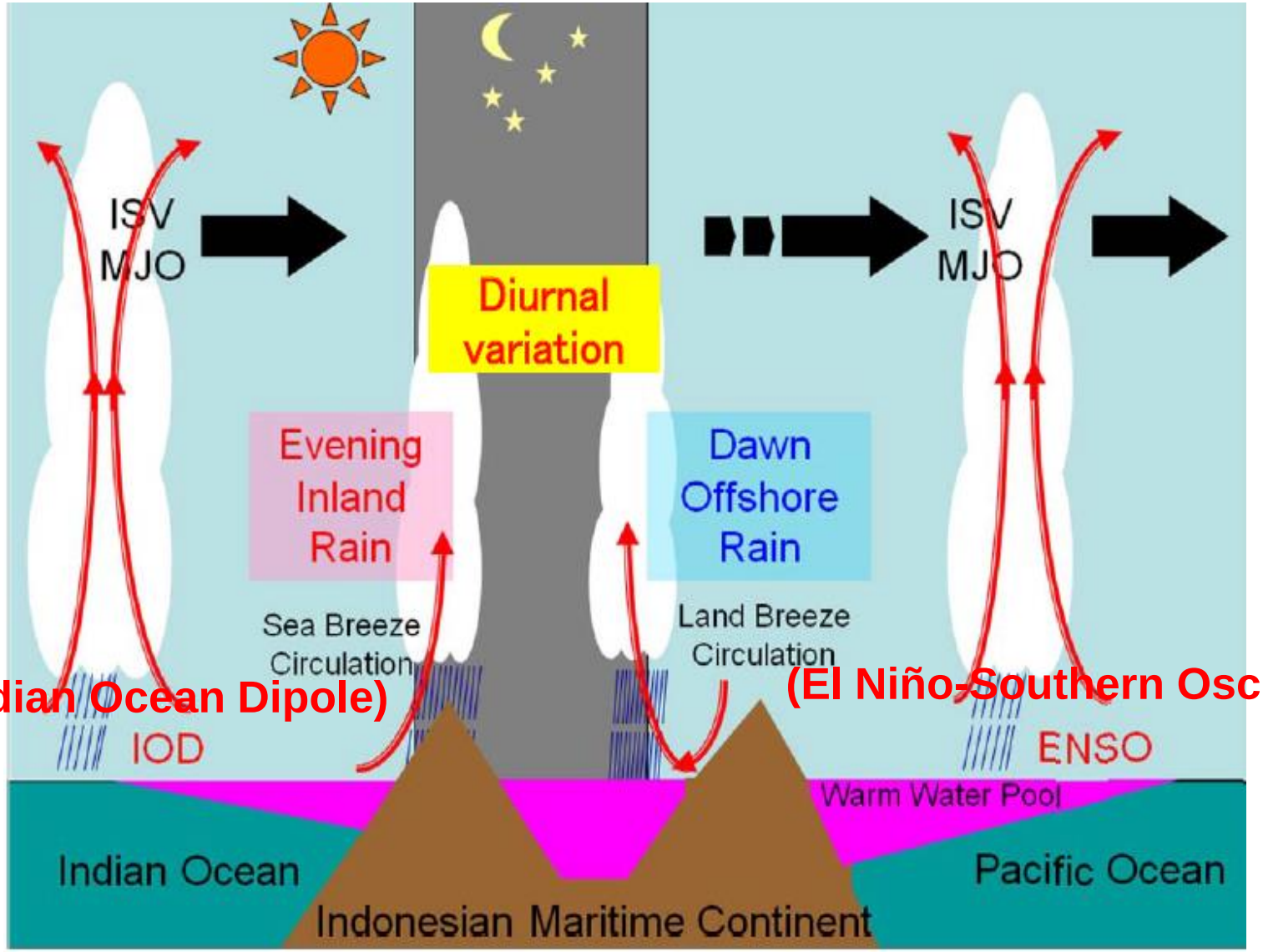


Fig. 2. Spatial pattern of terrestrial NPP linear trends from 2000 through 2009 (SOM text S1) (*8*, *10*).

The past decade (2000 to 2009) has been the warmest since instrumental measurements began, which could imply continued increases in NPP; however, our estimates suggest a reduction in the global NPP of 0.55 petagrams of carbon. Large-scale droughts have reduced regional NPP, and a drying trend in the Southern Hemisphere has decreased NPP in that area, counteracting the increased NPP over the Northern Hemisphere.

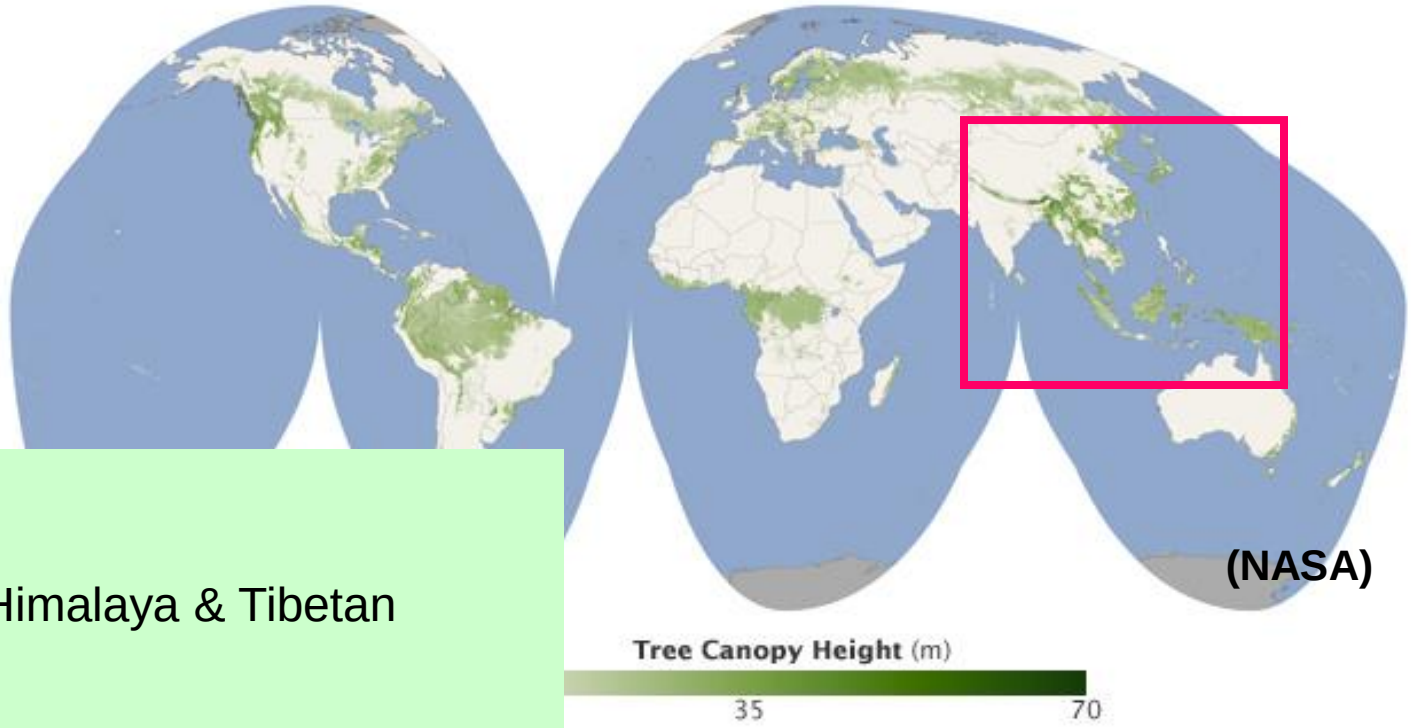
Maosheng Zhao, *et al.*: Drought-Induced Reduction in Global Terrestrial Net Primary Production from 2000 Through 2009 *Science 329, 940 (2010)*

Great Impact of Climate Change in Indonesia



From M. Evri

Tropical Peatland and Wet/low-land in South East Asia and South Asia is typically
1) Eco-System of Carbon-Water-Soil, and
2) Impacts of Climate Change and Human

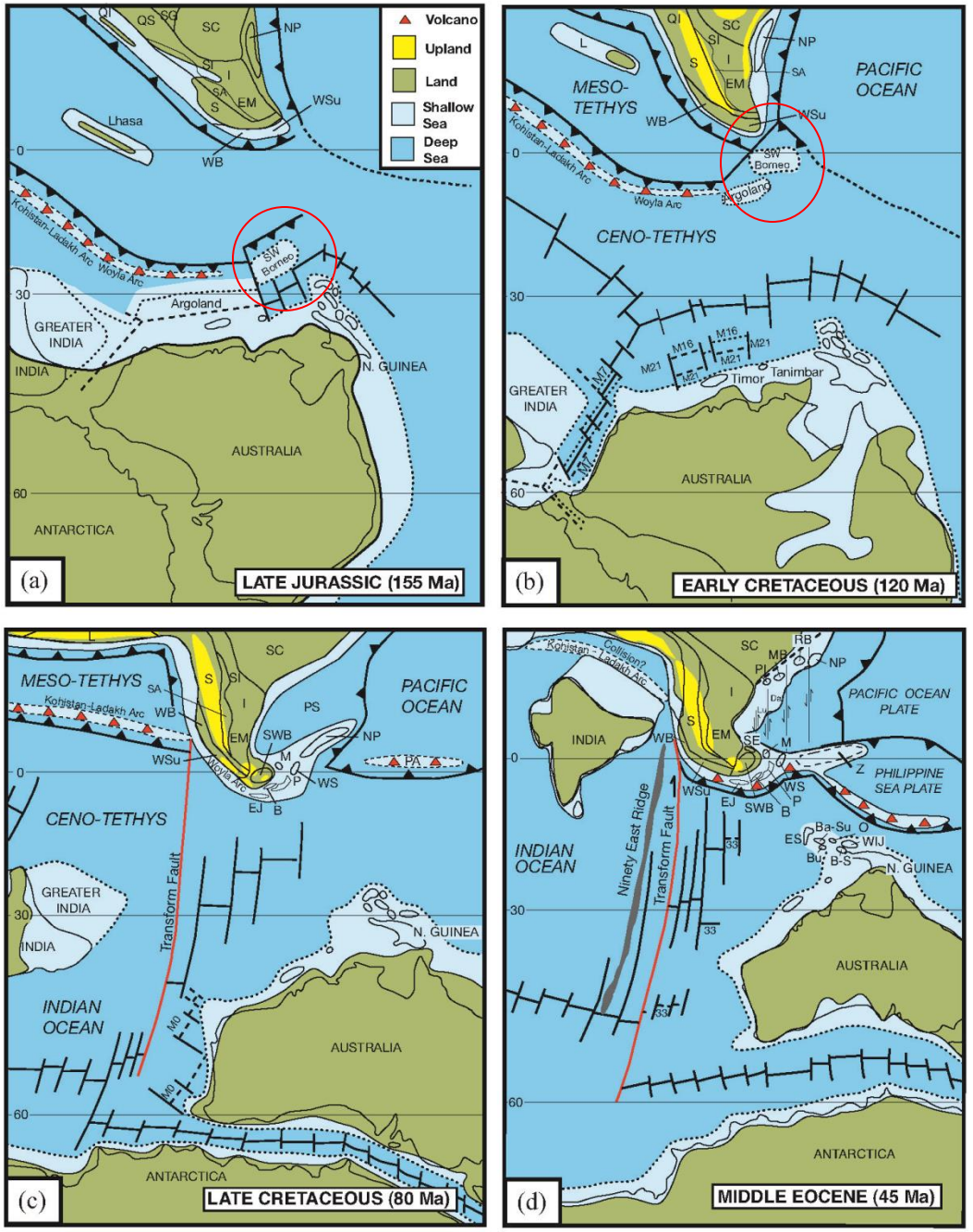


(NASA)

Uniqueness
- Asian Monson
- Water Tower at Himalaya & Tibetan
- Carbon Content
- Biodiversity
- High soil fertility: Sediment & Volcanic Ash

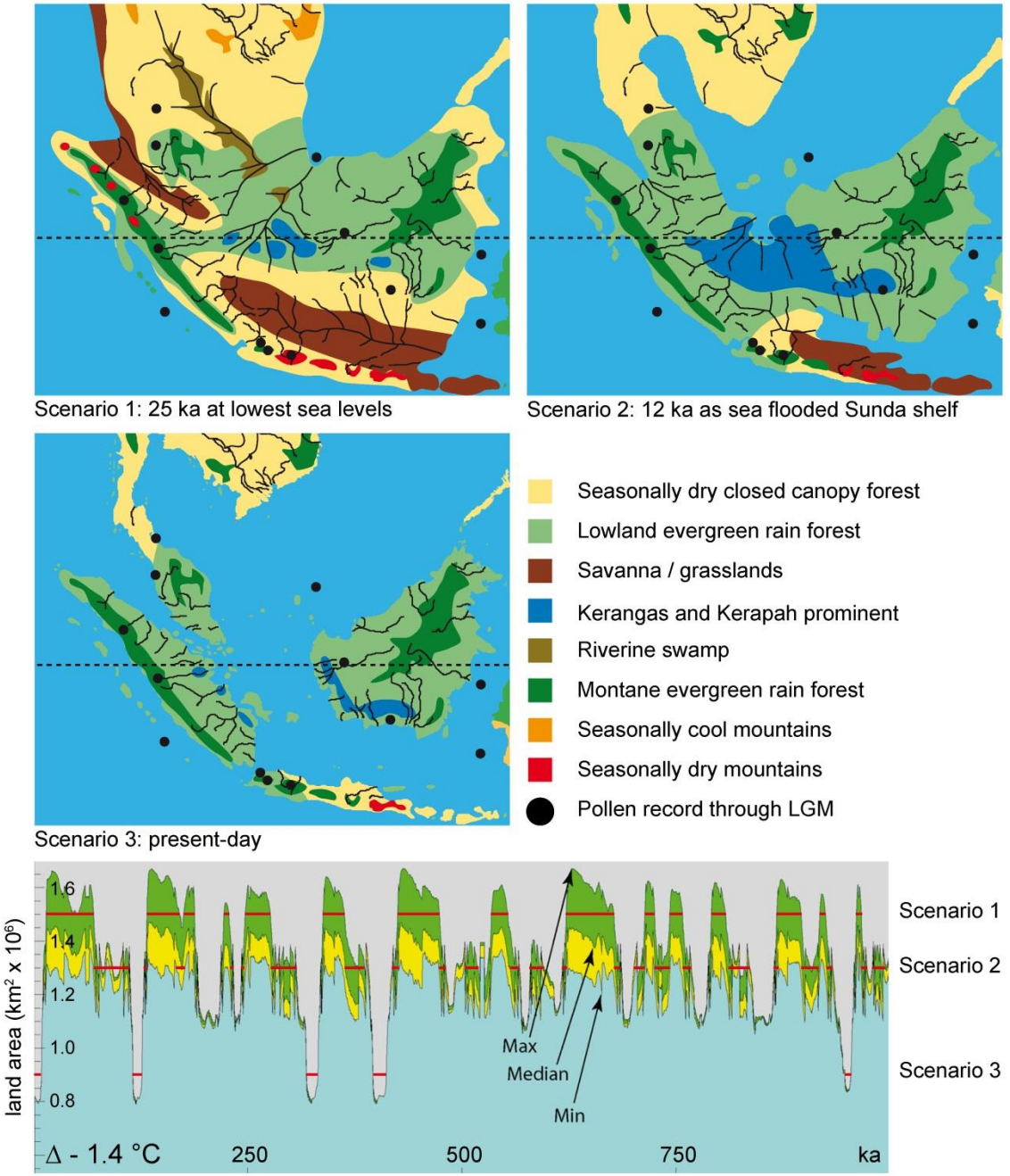
Impact
- Climate change
- Human

Borneo: Jurassic to Eocene



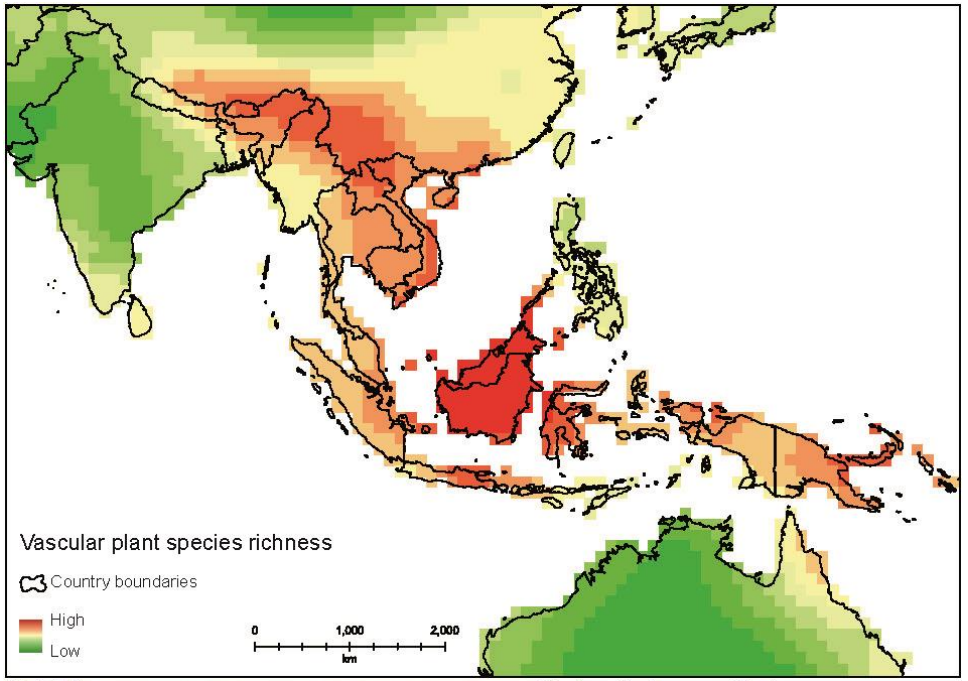
de Bruyn, M et al in review. Borneo is a major evolutionary hotspot for Southeast Asian biodiversity. Science.

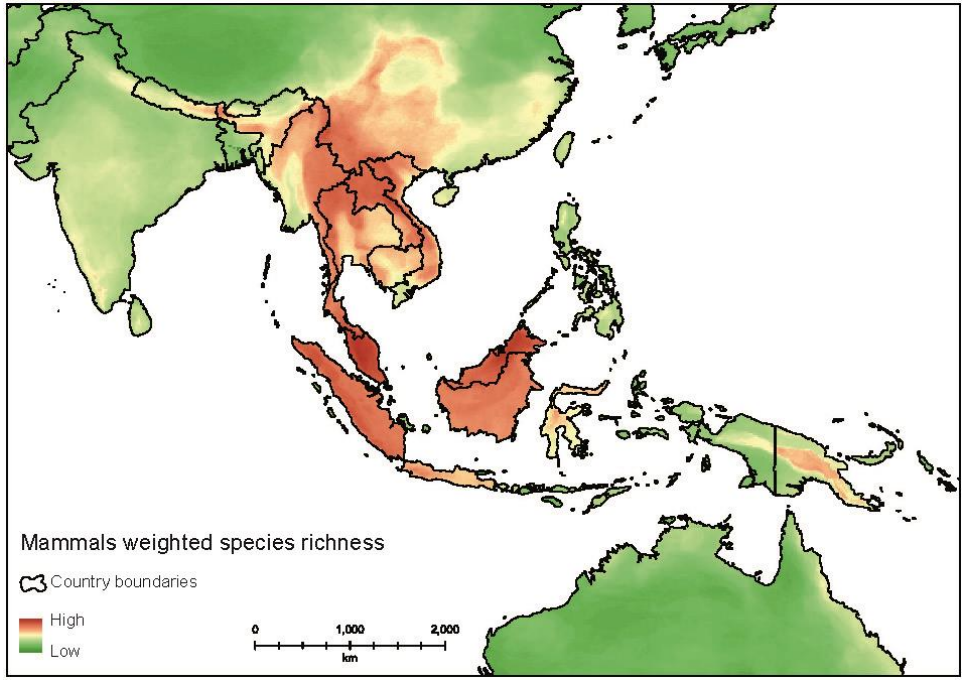
The role of changing Pleistocene sea levels



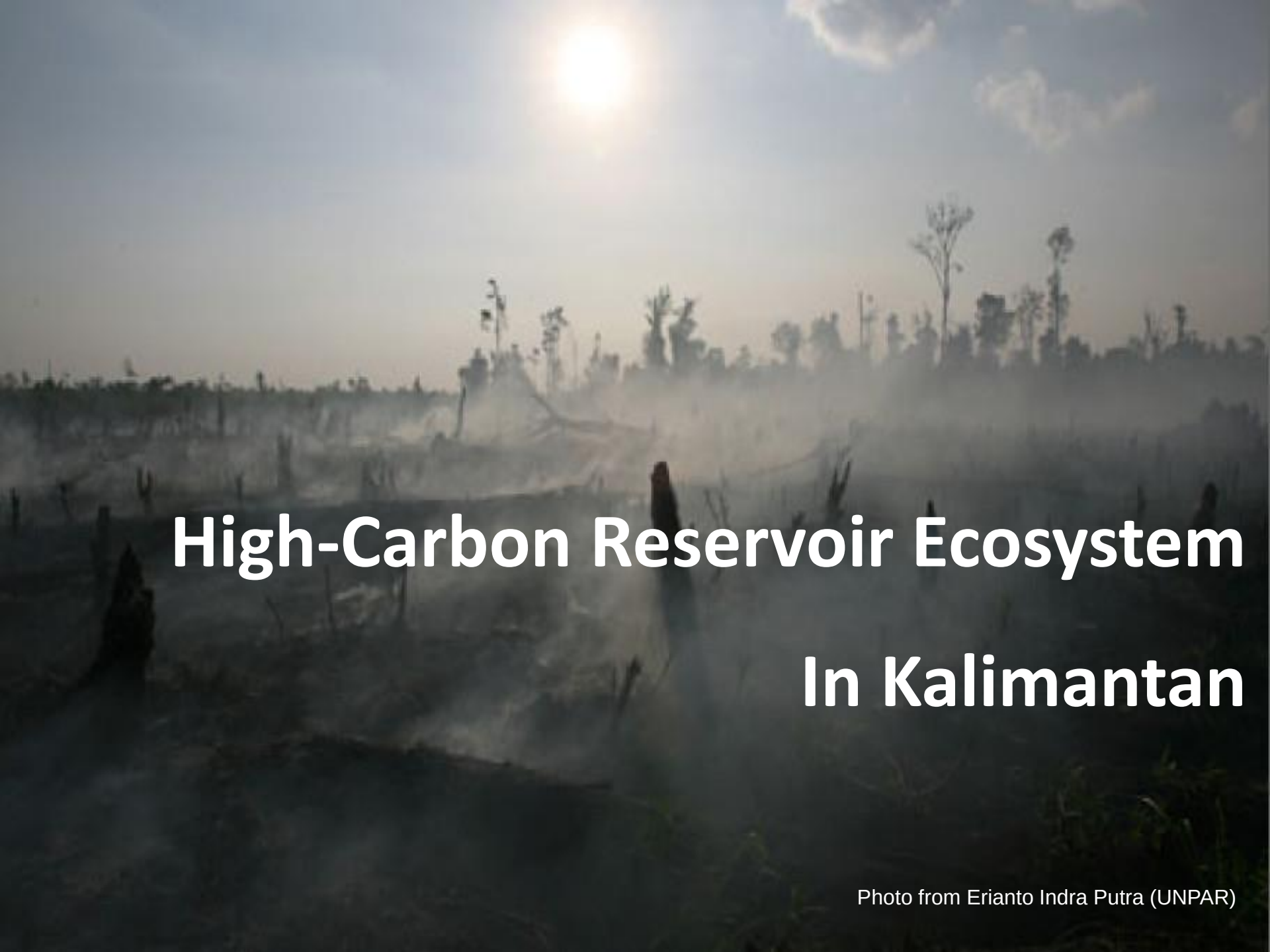
de Bruyn, M et al in review. Borneo is a major evolutionary hotspot for Southeast Asian biodiversity. Science.

Regional diversity patterns – Borneo is the most species rich





de Bruyn, M et al in review. Borneo is a major evolutionary hotspot for Southeast Asian biodiversity. Science.



High-Carbon Reservoir Ecosystem In Kalimantan

Photo from Erianto Indra Putra (UNPAR)

SATREPS:
Science and Technology Research Partnership for Sustainable Development
funded by
1) the Japan Science and Technology Agency (JST) and
2) the Japan International Cooperation Agency (JICA).

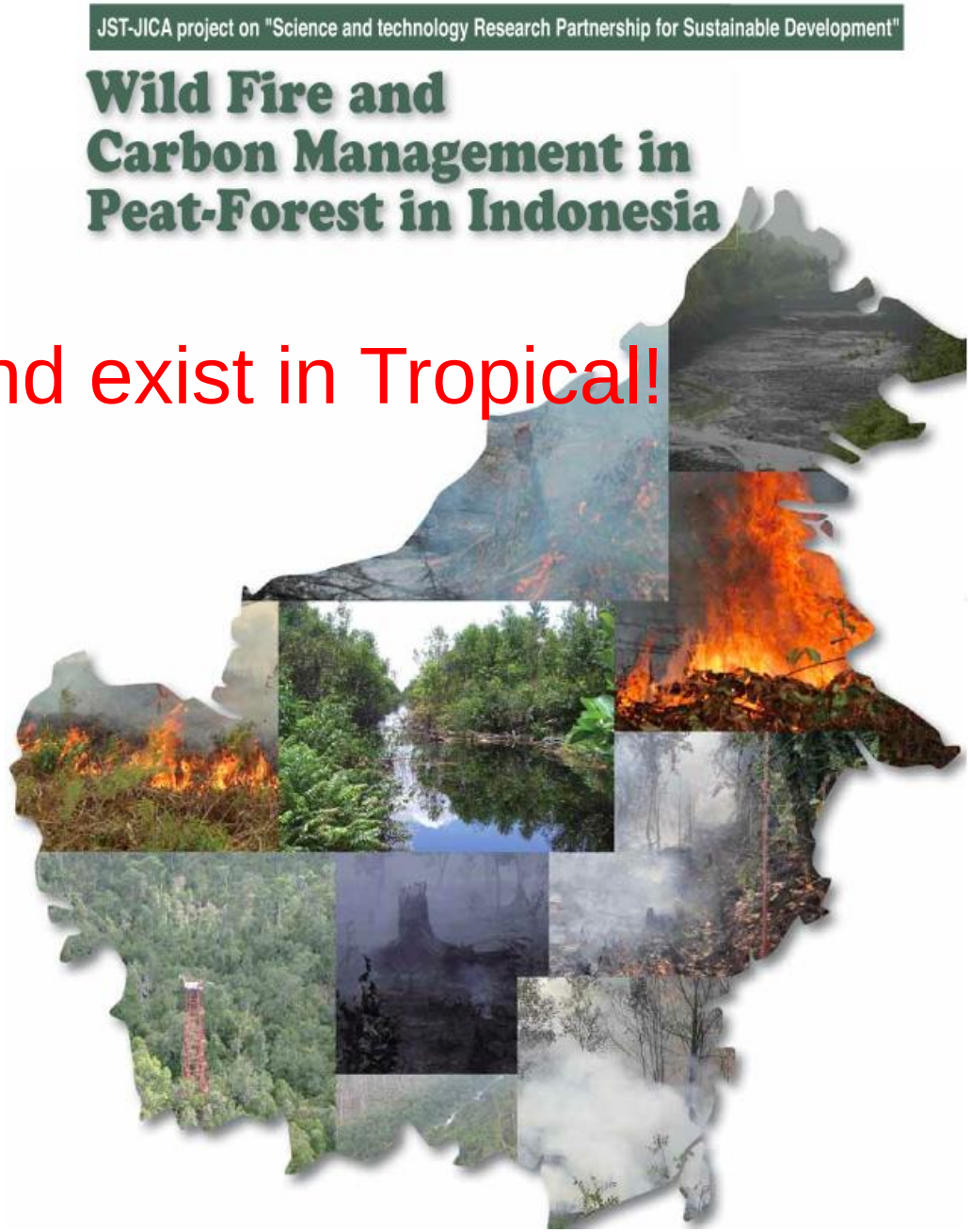
SATREPS is a Japanese government program that promotes international joint research targeting global issues, involving partnerships between researchers in Japan and researchers in developing countries.

SATREPS projects are expected to lead to outcomes with potential for practical utilization, and to enhance research capacity in the developing country.

SATREPS For the Earth, For the Next Generation

Japan Science and Technology Agency

http://www.jst.go.jp/global/english/about.html

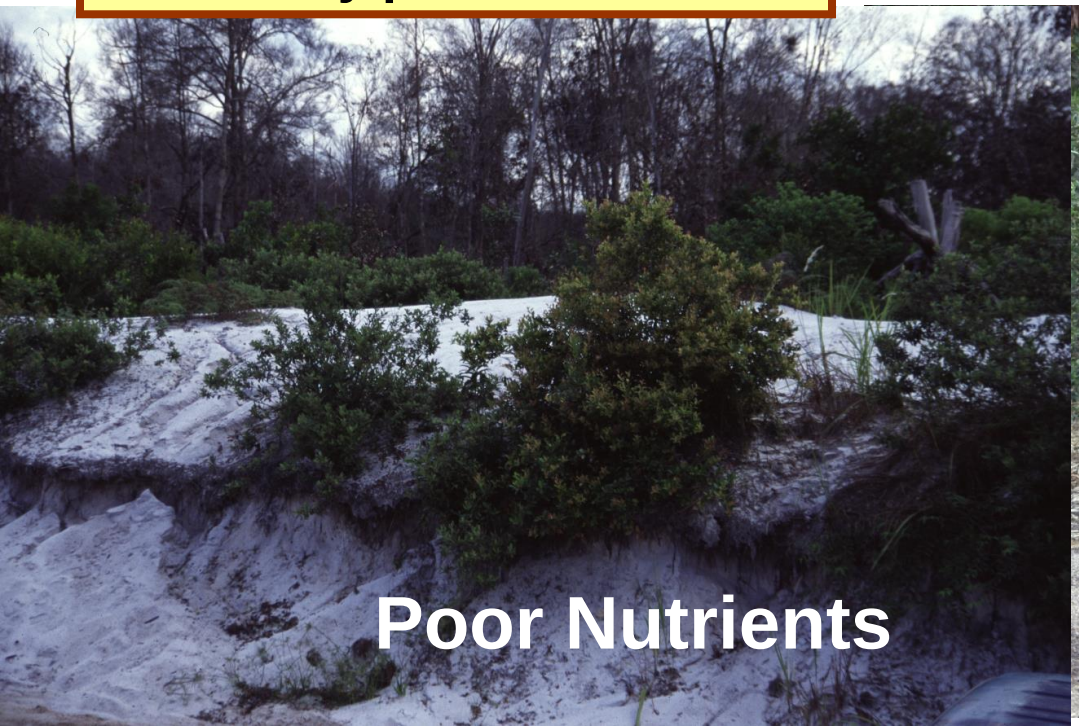


Peatland exist in Tropical!

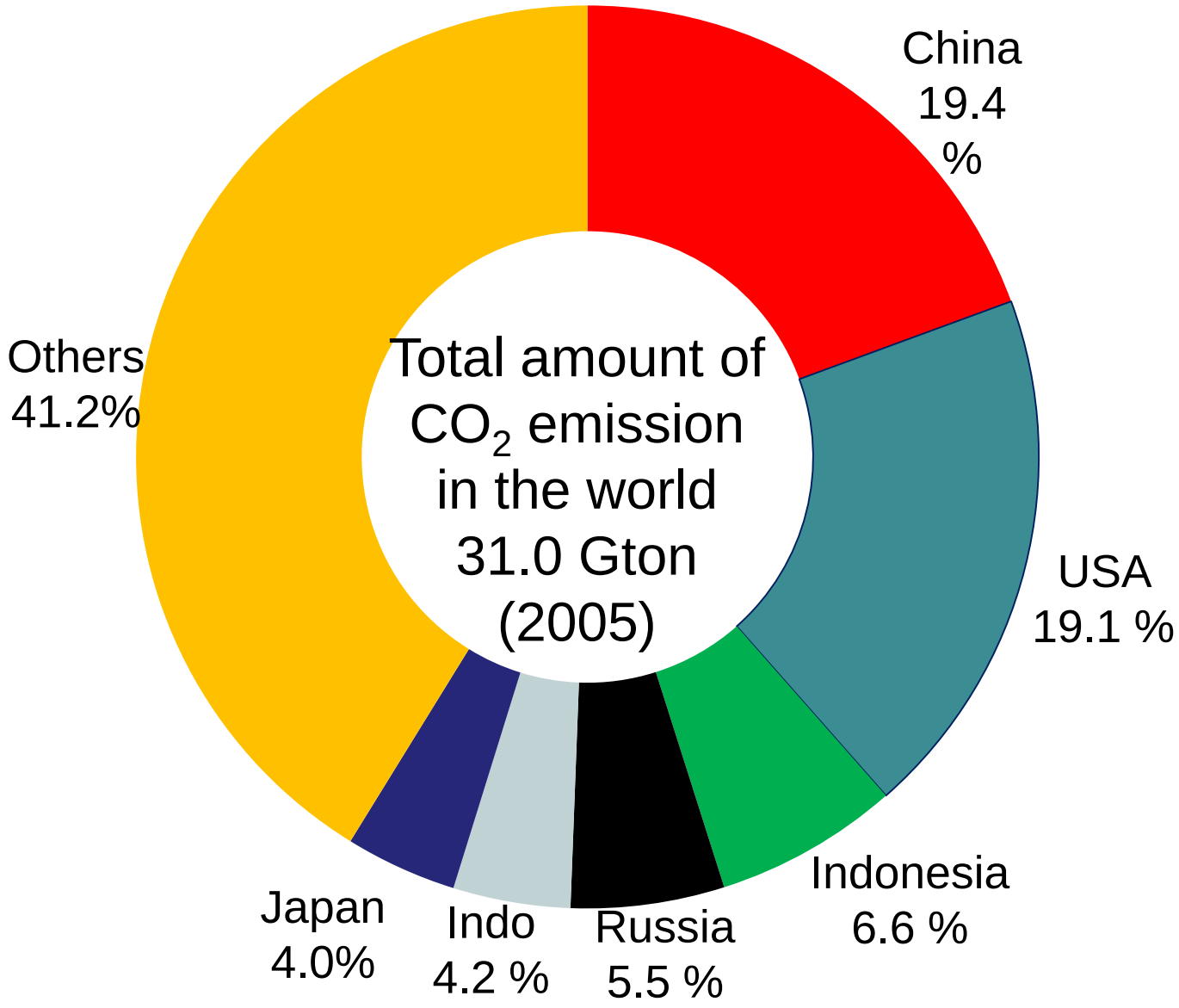
http://www.census.hokudai.ac.jp/html/JSTJICA/index.html

Peat Soil

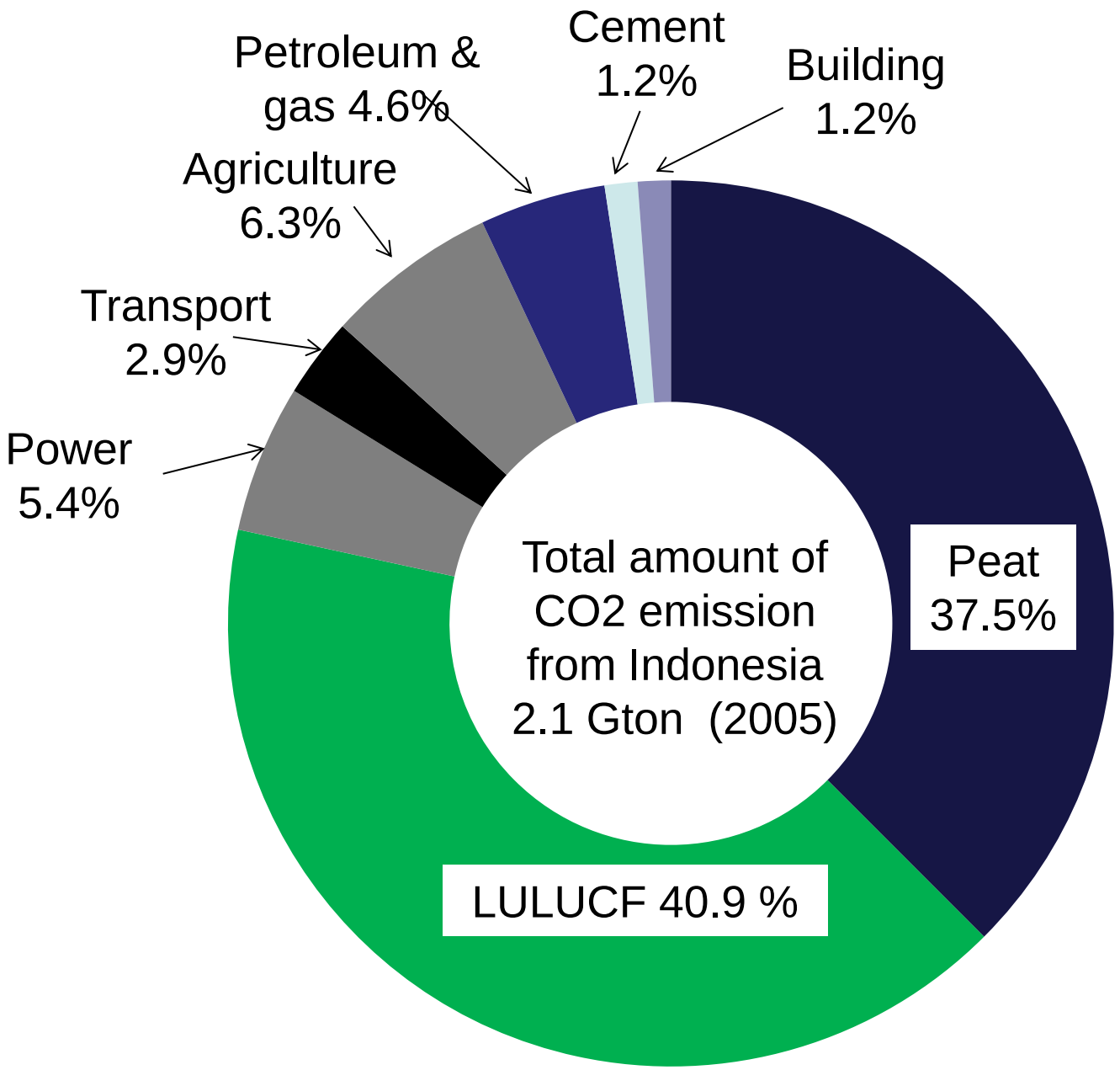
Sandy podzolic soil



Acid Sulfate Soil



Source: http://www.eia.doe.gov/iea/carbon.html



Source: Indoneisa's green house gas abatement cost curve (DNPI. 2010)

Main Project Sites

→Monitoring was started from 1997

Central Kalimantan, Indonesia

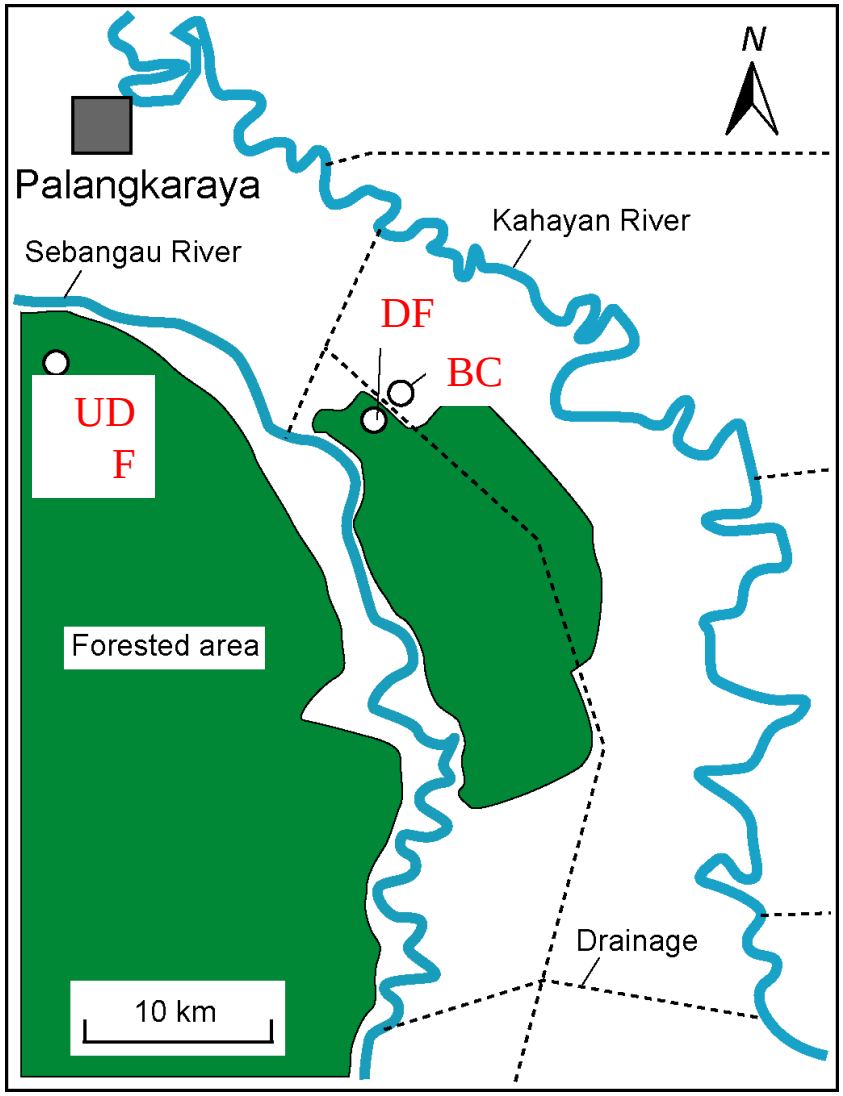
Peatland area in Mega Rice Project site

CO_2 observation towers at

UDF : (Un-drained Peat)

DF : (Drained Peat)

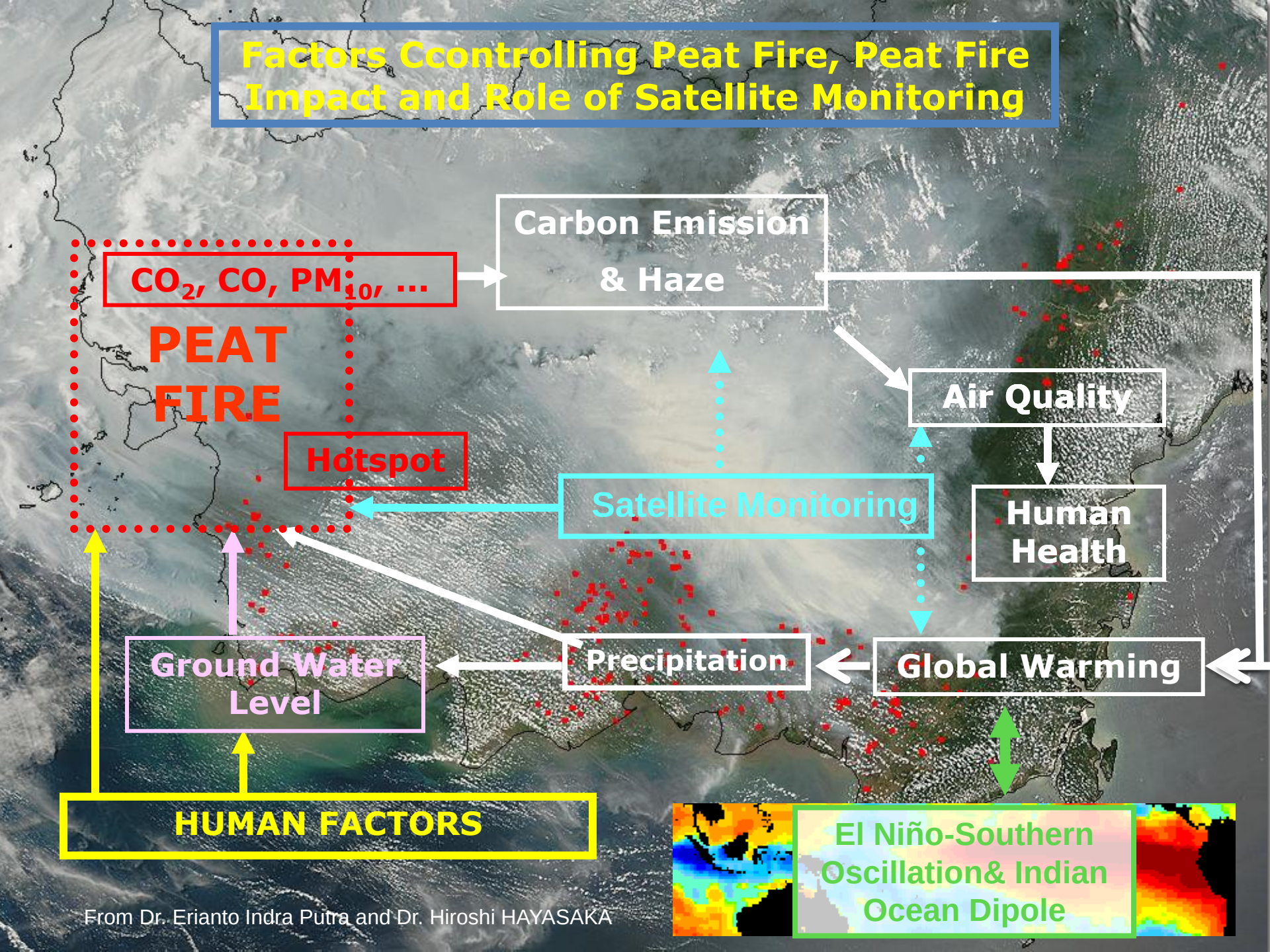
BC : (Burnet Peat)



Various Study Topics:

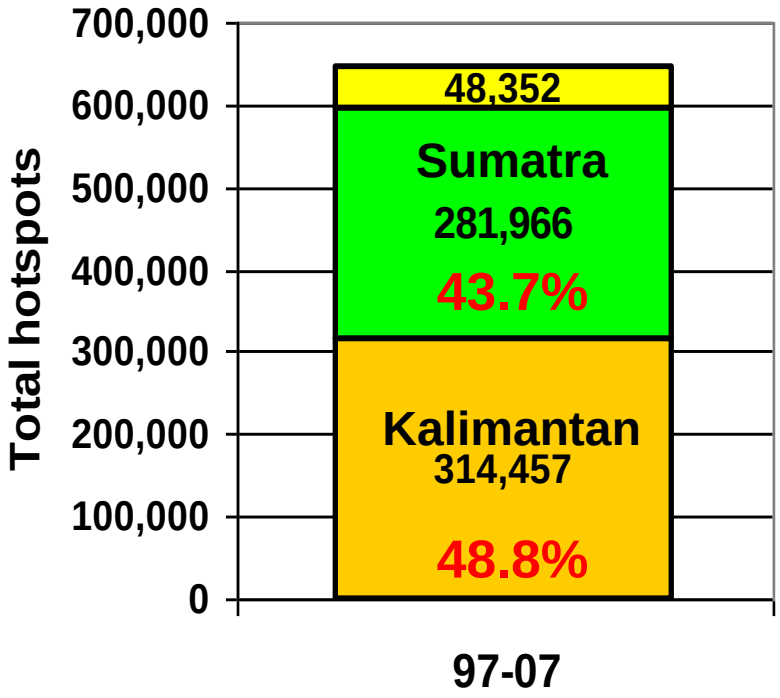
- GHG Flux (CO_2, CH_4, N_2O) measuring
- Fire Detection and Protection
- Water Table Monitoring and Management
- Peatland Ecology
- Soluble Carbon Monitoring
- Peatland Subsidence Monitoring
- etc.

Factors Ccontrolling Peat Fire, Peat Fire Impact and Role of Satellite Monitoring

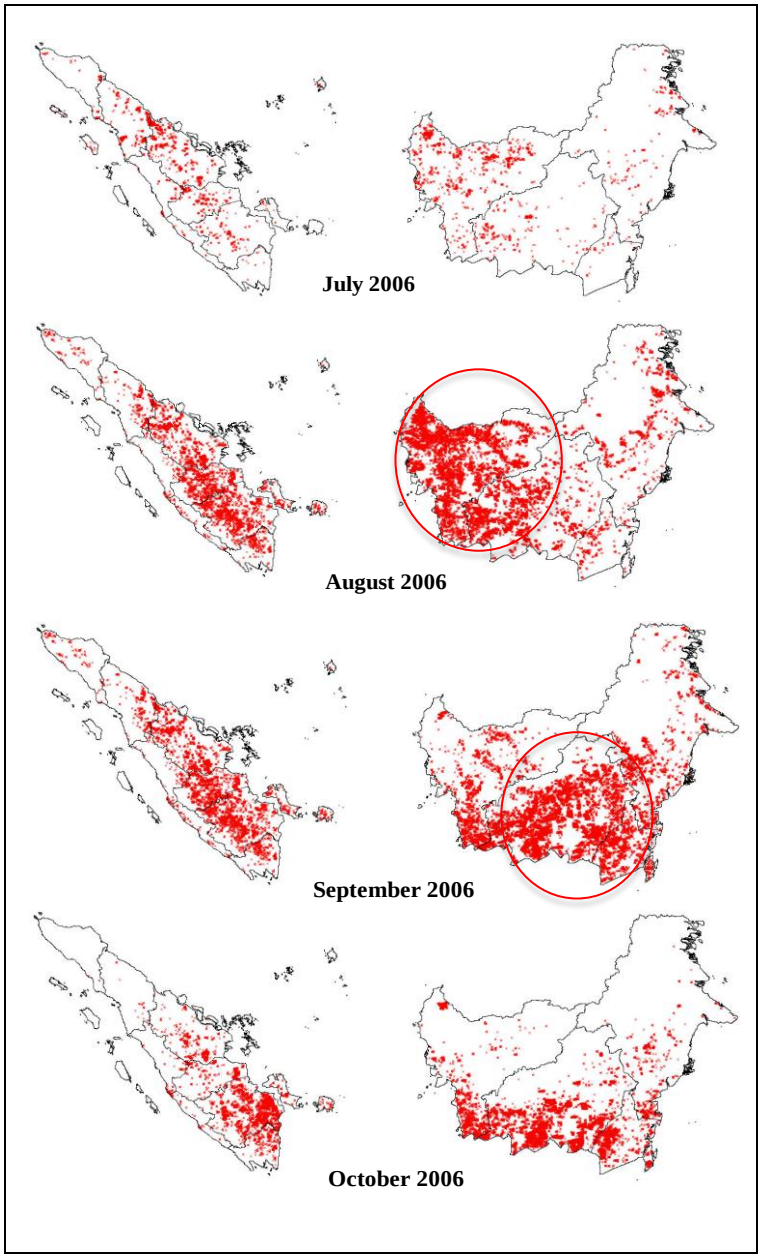


From Dr. Erianto Indra Putra and Dr. Hiroshi HAYASAKA

Recent hotspots (fires) trends

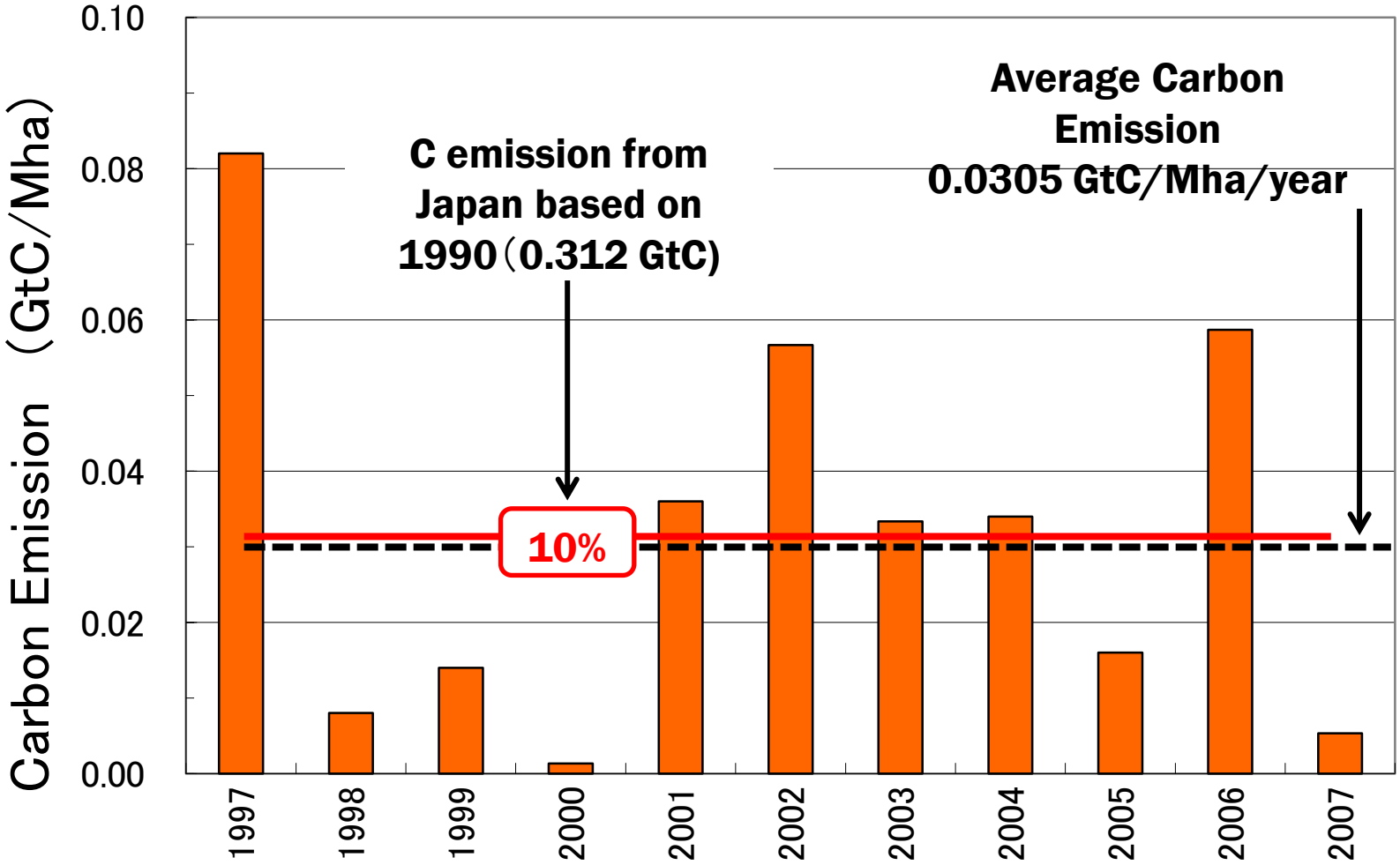


Recent fires in Indonesia occurred mainly in Kalimantan and Sumatra



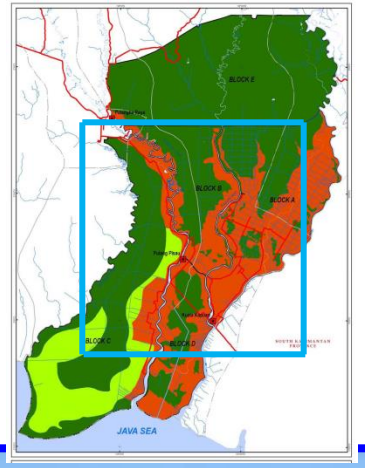
From Dr. Erianto Indra Putra and Dr. Hiroshi HAYASAKA

Carbon Emission (GtC/Mha) by Wild (mainly peat) Fire from Mega Rice Project area in Central Kalimantan

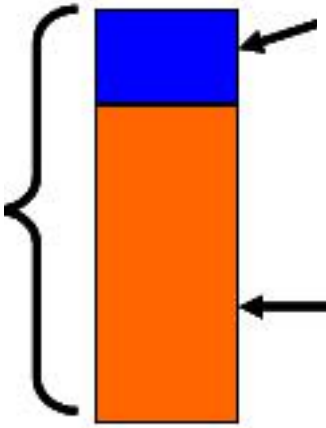


By Hidenori Takahashi, 2013

COP15 Poster



Amount of carbon dioxide emitted annually from the tropical peatland per 1 million ha.
(Indonesia has 20 times the size of this tropical peatland.)

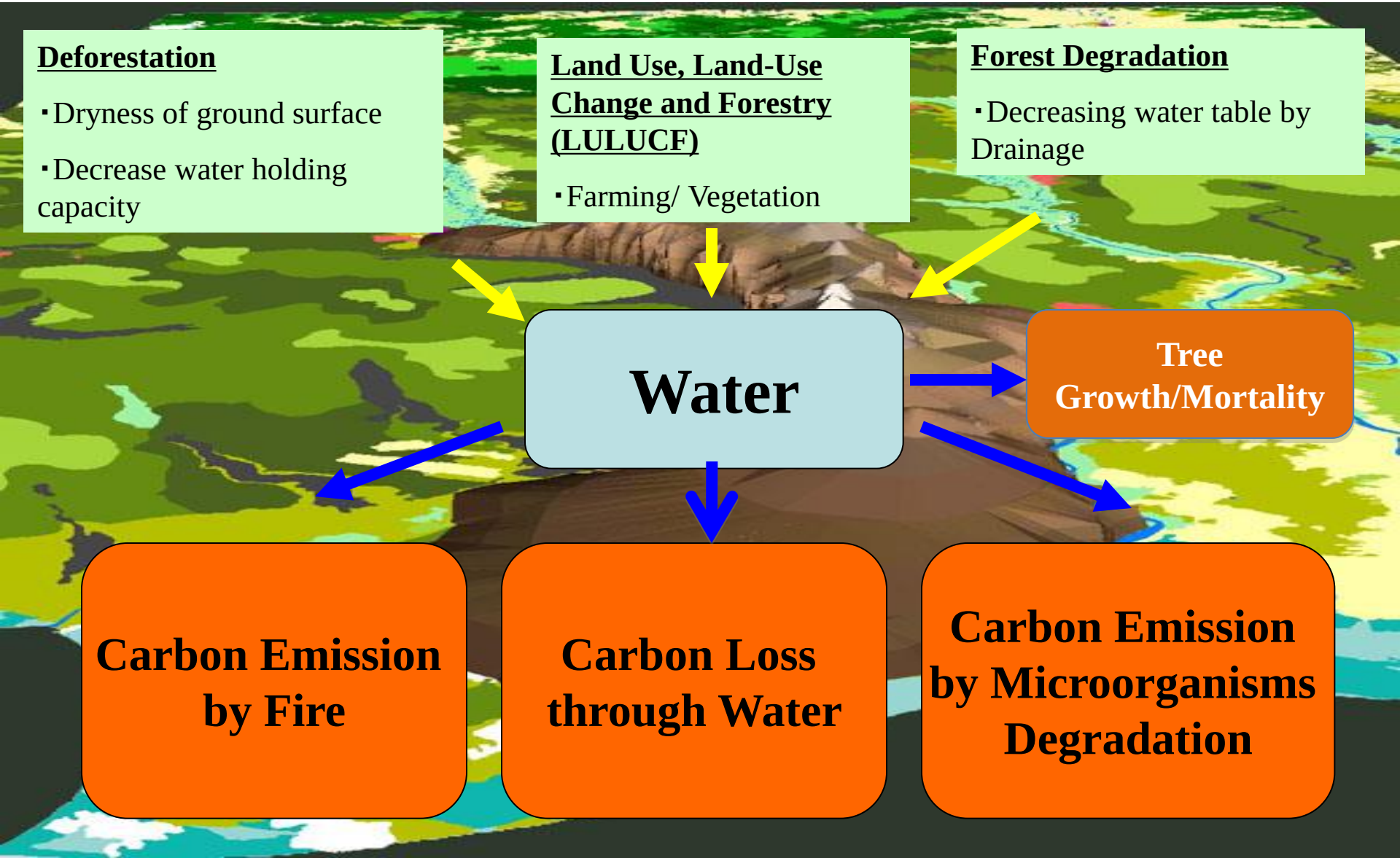


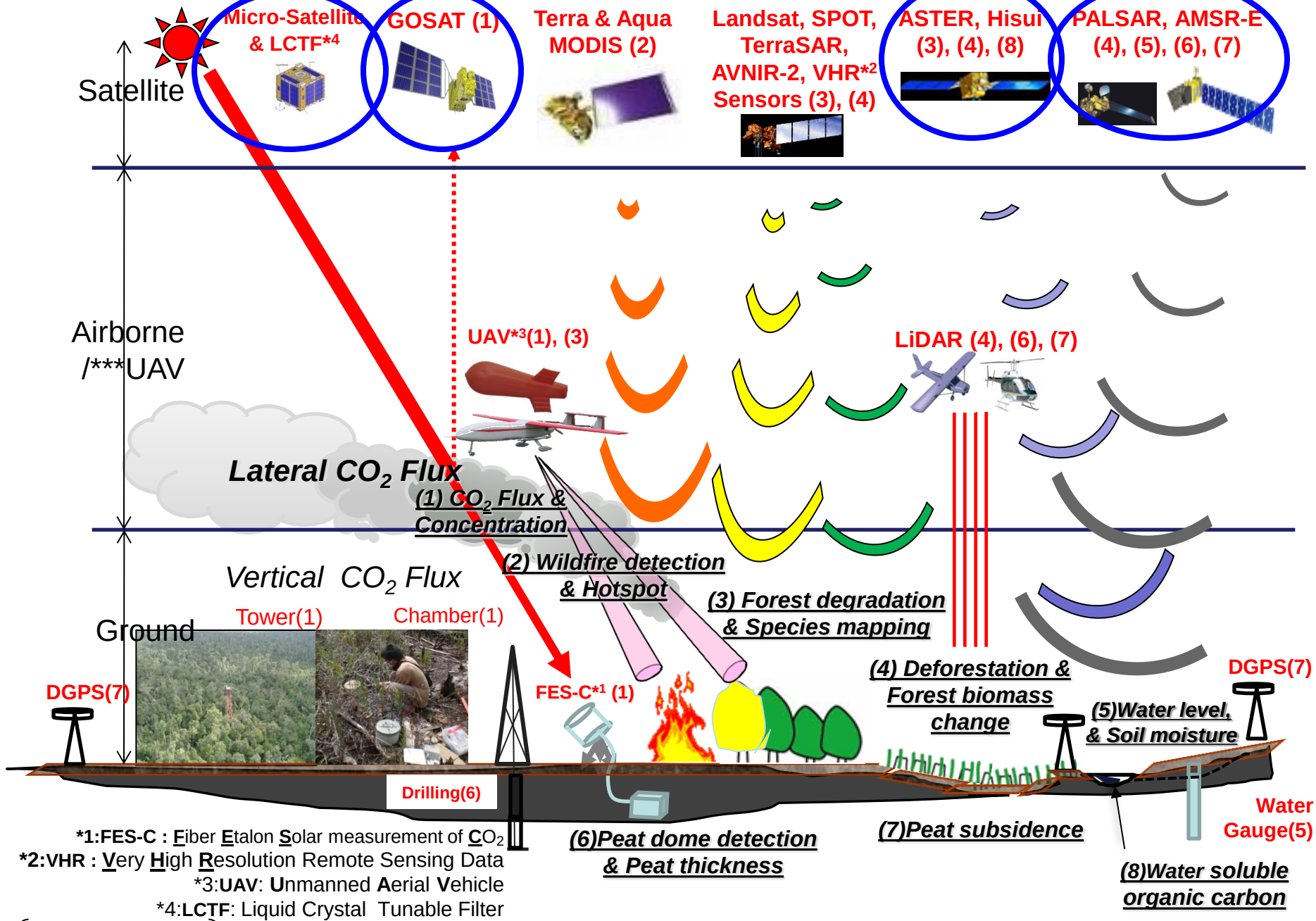
About 13% of the total emission from Japan in 1990.

Amount of carbon dioxide emitted by microbial degradation (About 3 % of the total emission from Japan in 1990.)

Amount of carbon dioxide emitted by peat fire (About 10 % of the total emission from Japan in 1990.)

What Factors Regulate Carbon in Tropical Peat?





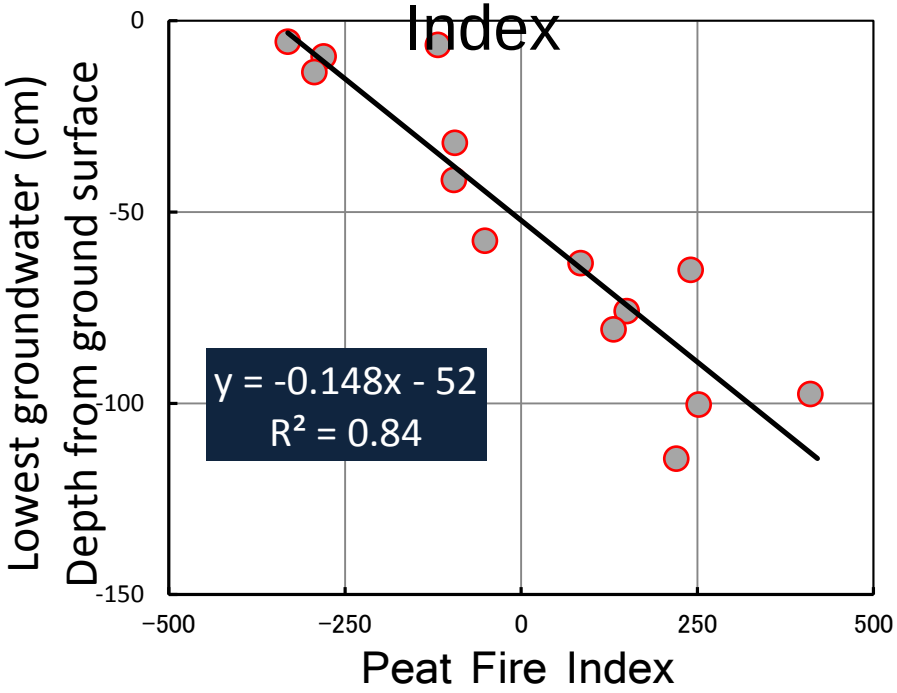
*1:FES-C : Fiber Etalon Solar measurement of CO_2
*2:VHR : Very High Resolution Remote Sensing Data
*3:UAV: Unmanned Aerial Vehicle
*4:LCTF: Liquid Crystal Tunable Filter

Red: Instrument
Black: Target

Key Elements of Tropical Peatland MRV System

Takahashi Model

The lowest GWL in dray season and Peat Fire Index



correlation

Fire occurrence

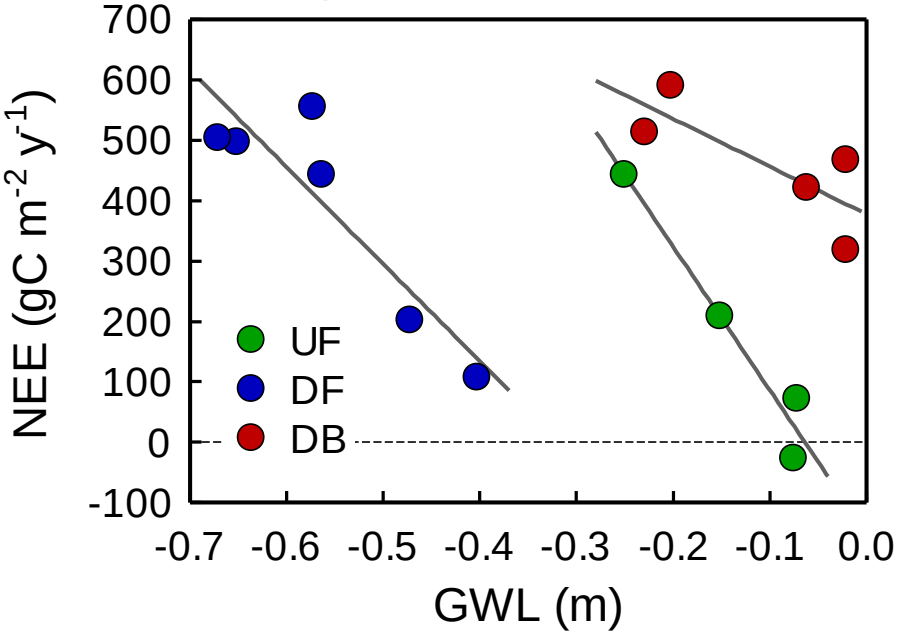
(Takahashi)

Summary

1. Peat boundary selection
2. GWT by Takeuchi model
3. CO2 emission by Hirano model
4. Fire occurrence by Takahashi model

Hirano Model

Annual NEE vs. Annually Mean GWL



UF *NEE*=-2376*GWL*-151

DF *NEE*=-1609*GWL*-510

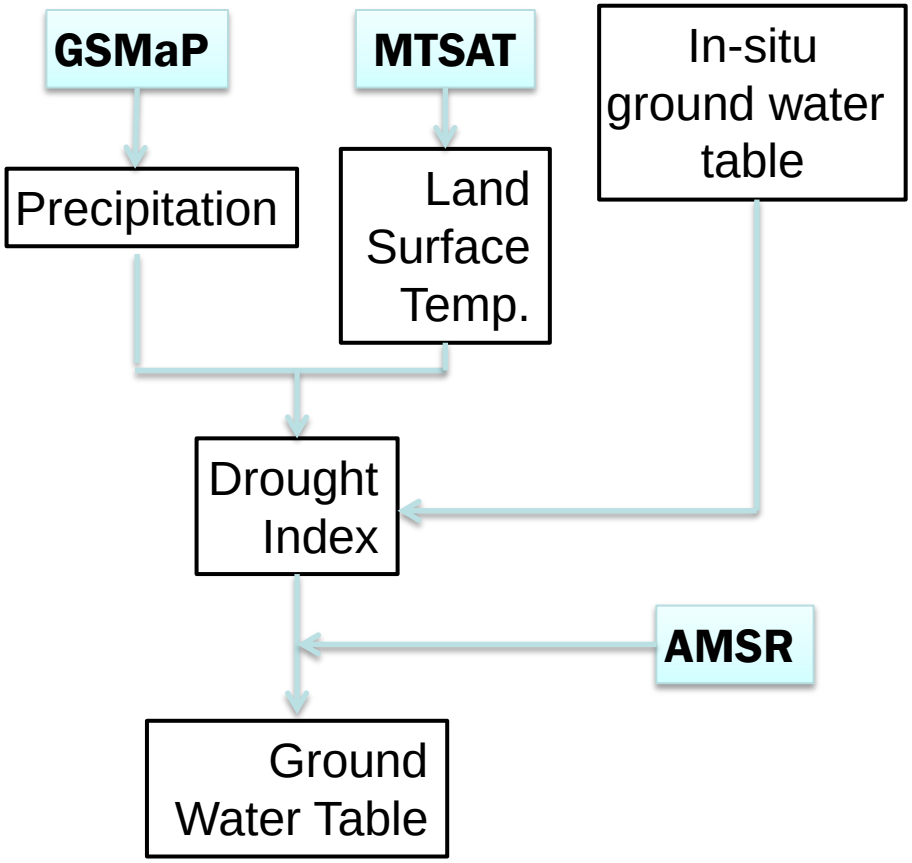
DB *NEE*=-789*GWL*-378

NEE: Net Ecosystem CO2 Exchange

Hirano et al.(2012), GCB

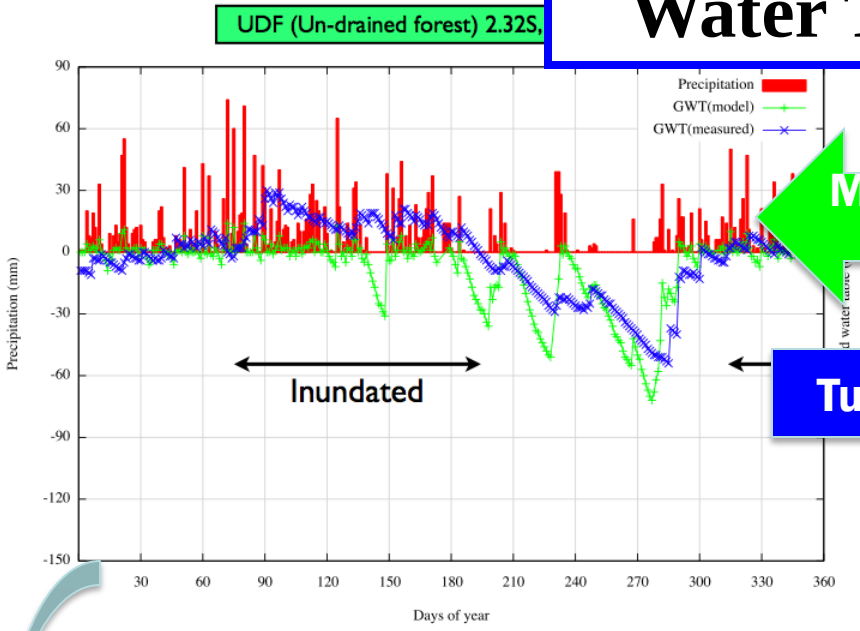
Takeuchi Model

GWT estimation by Remote Sensing Data



Takeuchi, Hirano, Anggraini and Roswintiarti (2010)

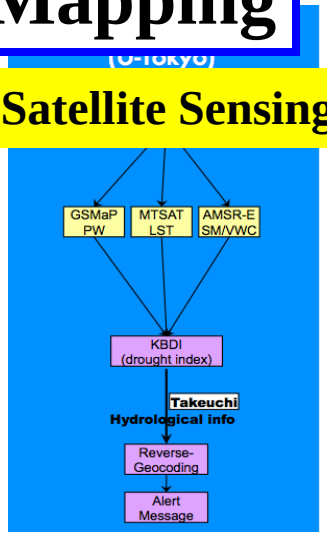
Water Table Mapping



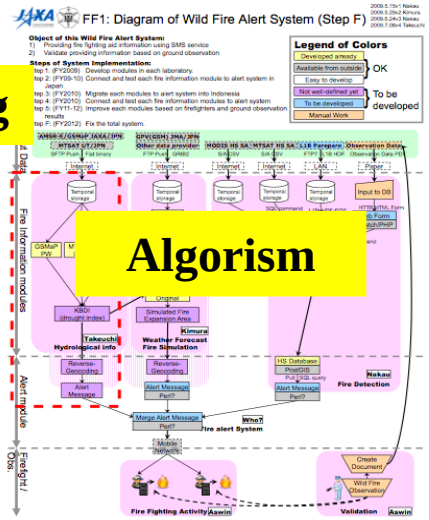
Modelin g

Tuning

Satellite Sensing

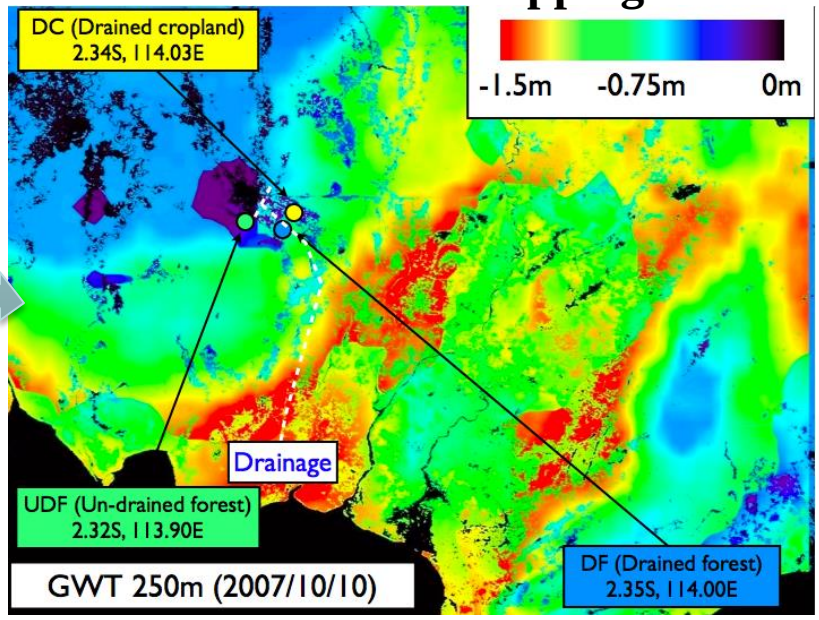


Algorism



By Wataru Takeuchi, University of Tokyo, Japan

Water Table Mapping



Input

Coefficiency between Water Table Level and

1) CO2 emission by Oxidation

2) CO2 emission by Fire Factors

Output

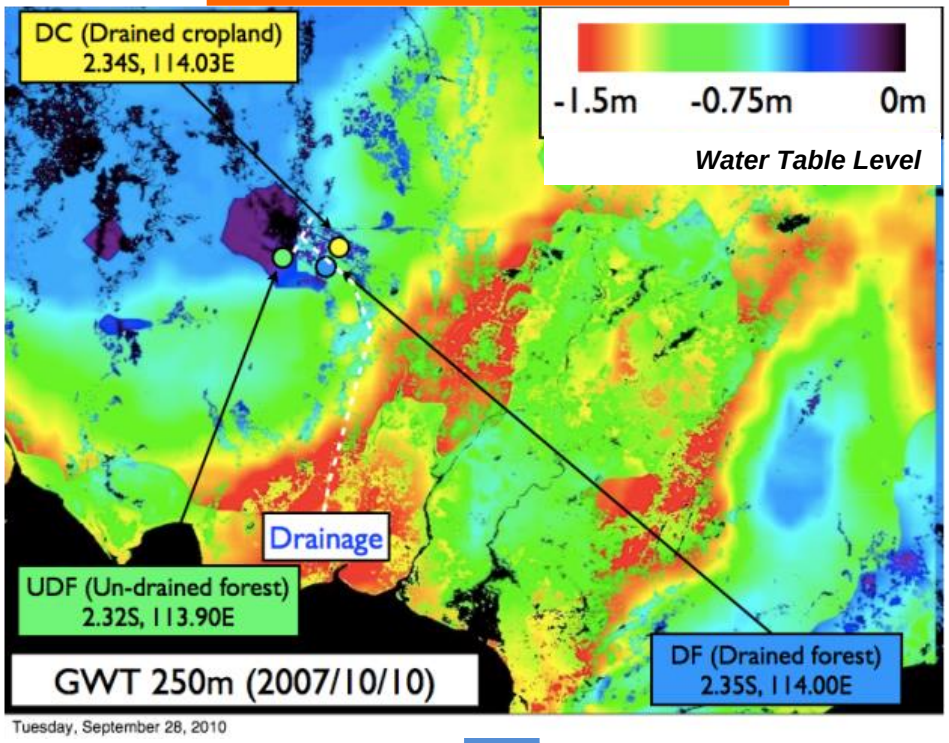
Mapping of

1) CO2 emission by Oxidation

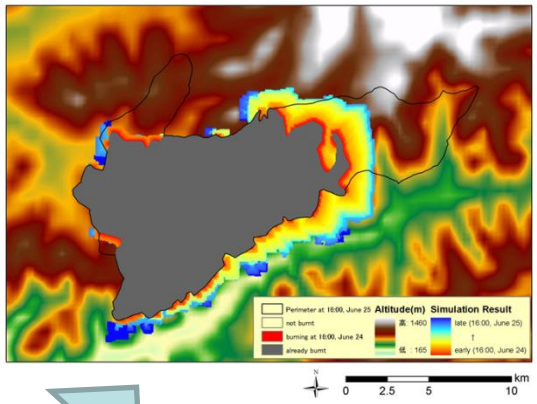
2) CO2 emission by Fire Factors

CO_2 Flux Simulator in Below Ground:

Model of Water Tabe Level



Simulator of Fire Expansion



(examples)

CO_2 flux simulators in Below Ground

CO_2 flux and Carbon loss estimates from correlation with water table (or water content in soil) and other elements such as;

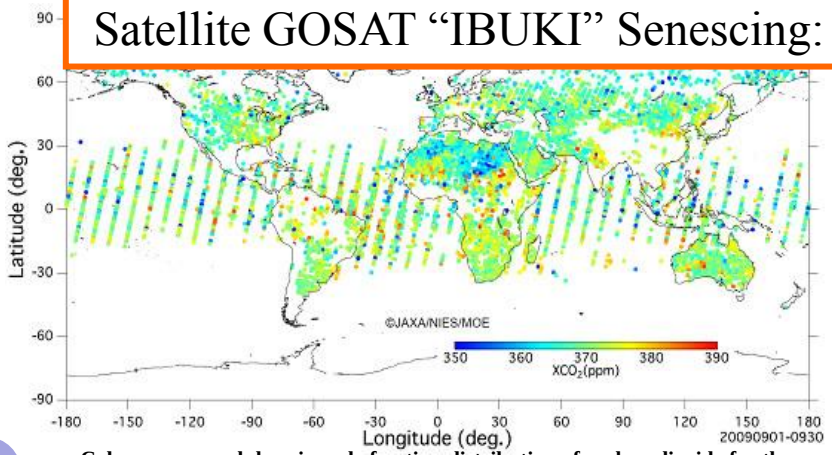
1) Carbon Emission by Fire
2) Carbon Loss through Water
3) Carbon Emission by Microorganisms Degradation

Top-down
• satellite
• airplane
• inverse model

Integrated, practical carbon budget map

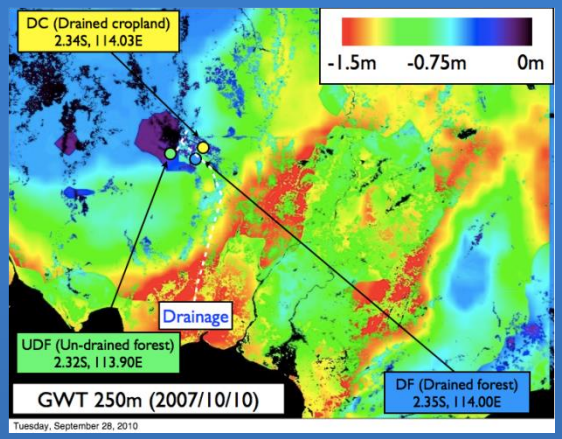
Bottom-up
• field survey
• flux obs.
• process model

Satellite GOSAT "IBUKI" Senescing: CO2

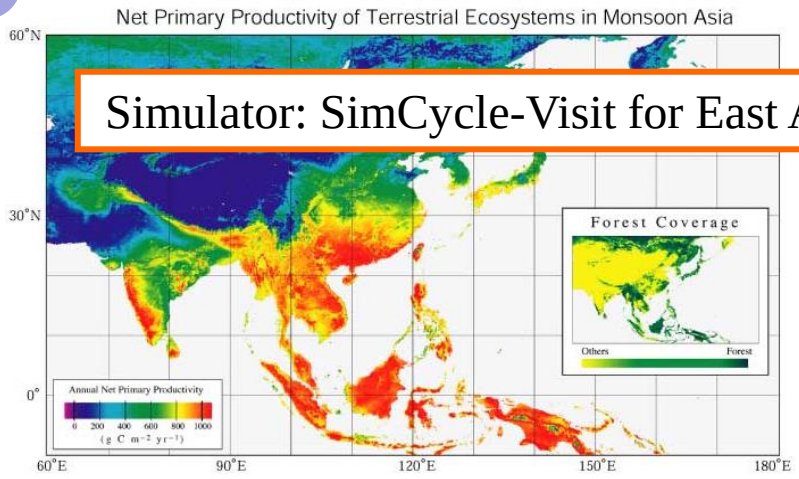


Column averaged dry air mole fraction distribution of carbon dioxide for the month of September, 2009, obtained from IBUKI observation data (unvalidated) By JAXA

Carbon-Water Simulator



Simulator: SimCycle-Visit for East Asia

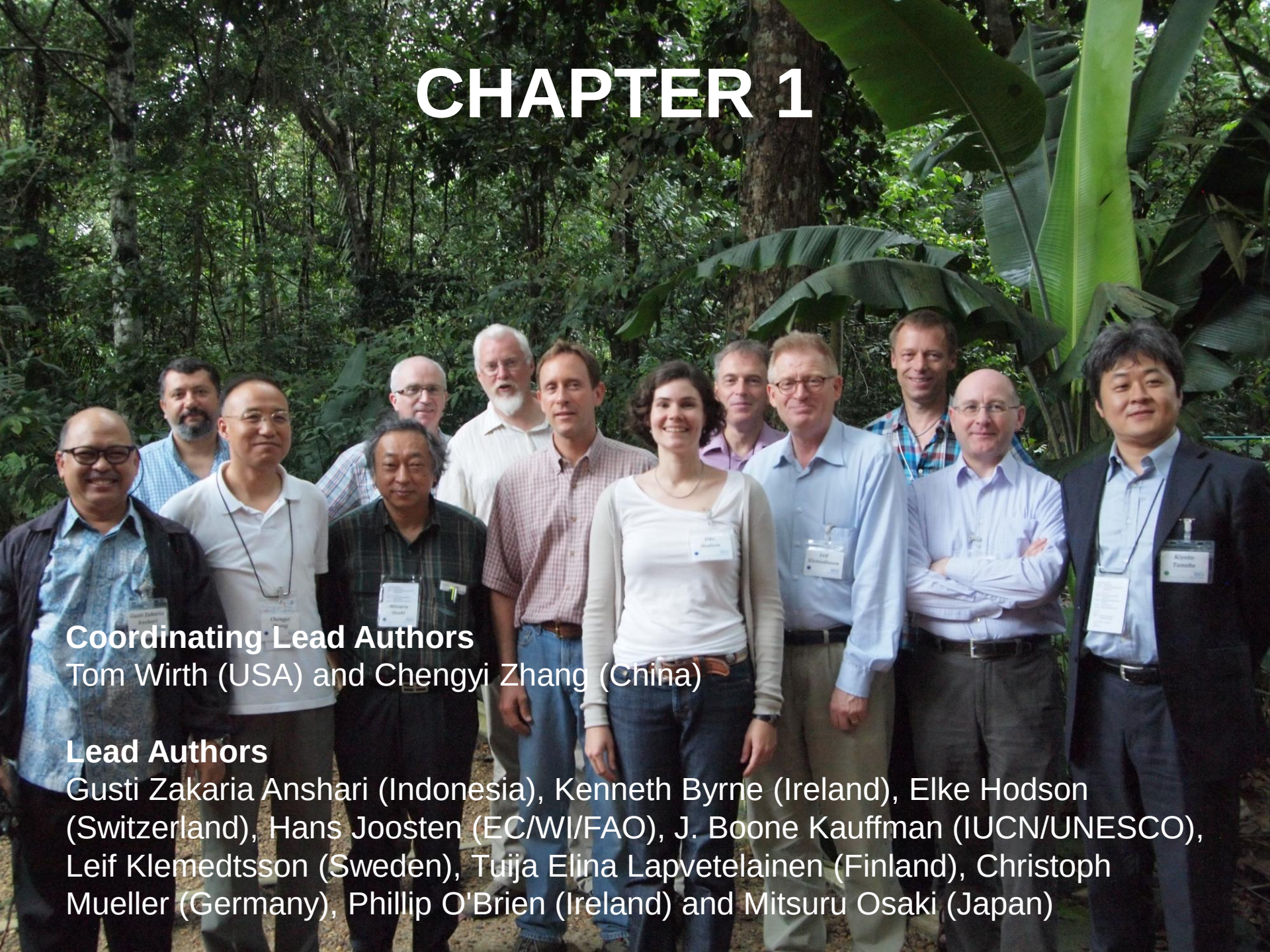


- **Carbon Emission by Fire**
- **Carbon Loss through Water**
- **Carbon Emission by Microorganisms Degradation**
- **Tree Growth/Mortality**

2013 SUPPLEMENT TO THE 2006 IPCC GUIDELINES FOR NATIONAL GREENHOUSE GAS INVENTORIES: WETLANDS

Methodological Guidance on Organic and Wet Soils across IPCC Land-use Categories

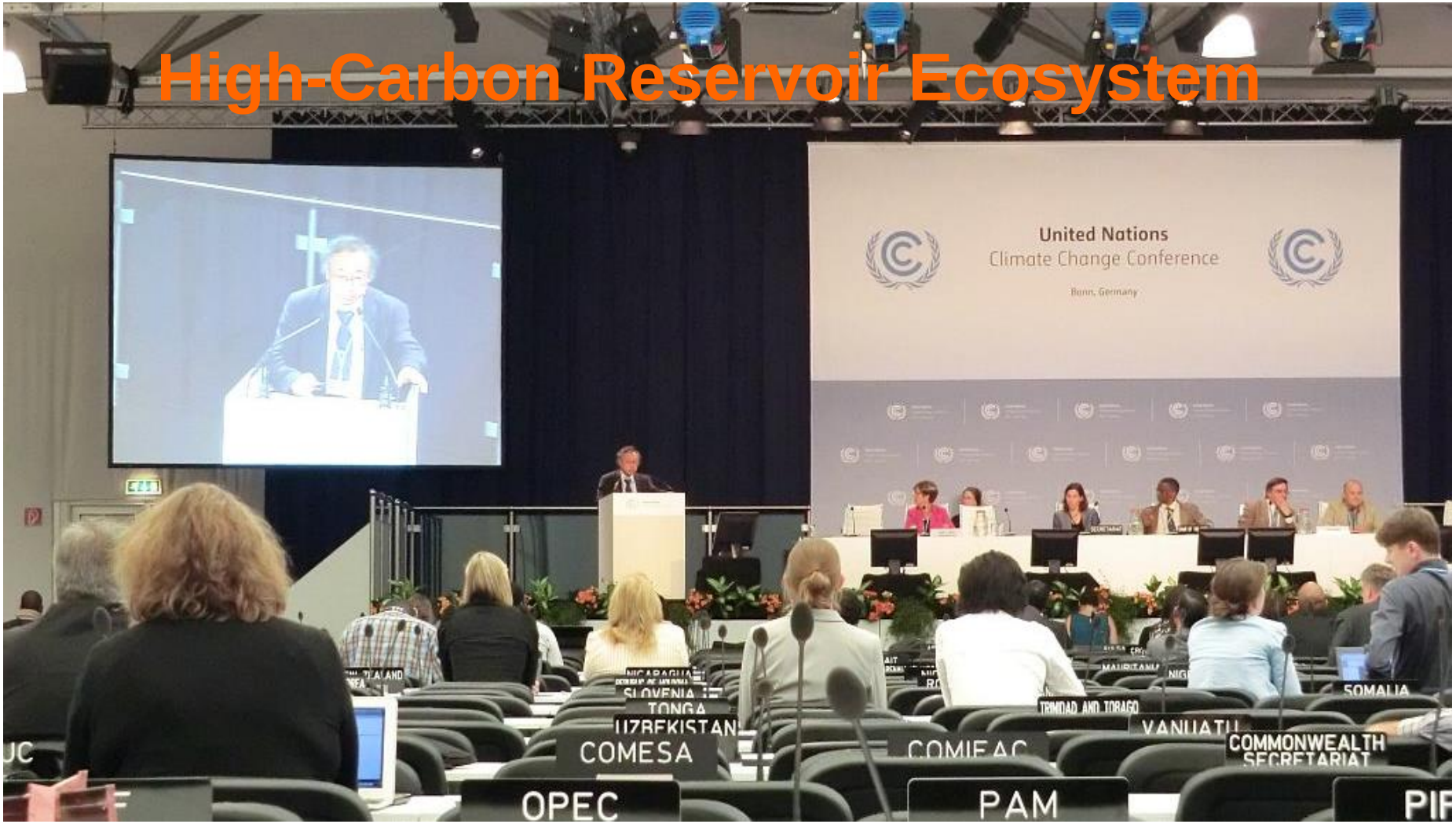
CHAPTER 1



Coordinating Lead Authors
Tom Wirth (USA) and Chengyi Zhang (China)

Lead Authors
Gusti Zakaria Anshari (Indonesia), Kenneth Byrne (Ireland), Elke Hodson (Switzerland), Hans Joosten (EC/WI/FAO), J. Boone Kauffman (IUCN/UNESCO), Leif Klemedtsson (Sweden), Tuija Elina Lapvetelainen (Finland), Christoph Mueller (Germany), Phillip O'Brien (Ireland) and Mitsuru Osaki (Japan)

SABSTA38 Research Dialog, Bonne June 2013 under UNFCCC



Plenary II: Emerging scientific findings: Ecosystems and GHG emissions and removals from sources, sinks and reservoirs, including from terrestrial ecosystems

United Nations
Climate Change Secretariat

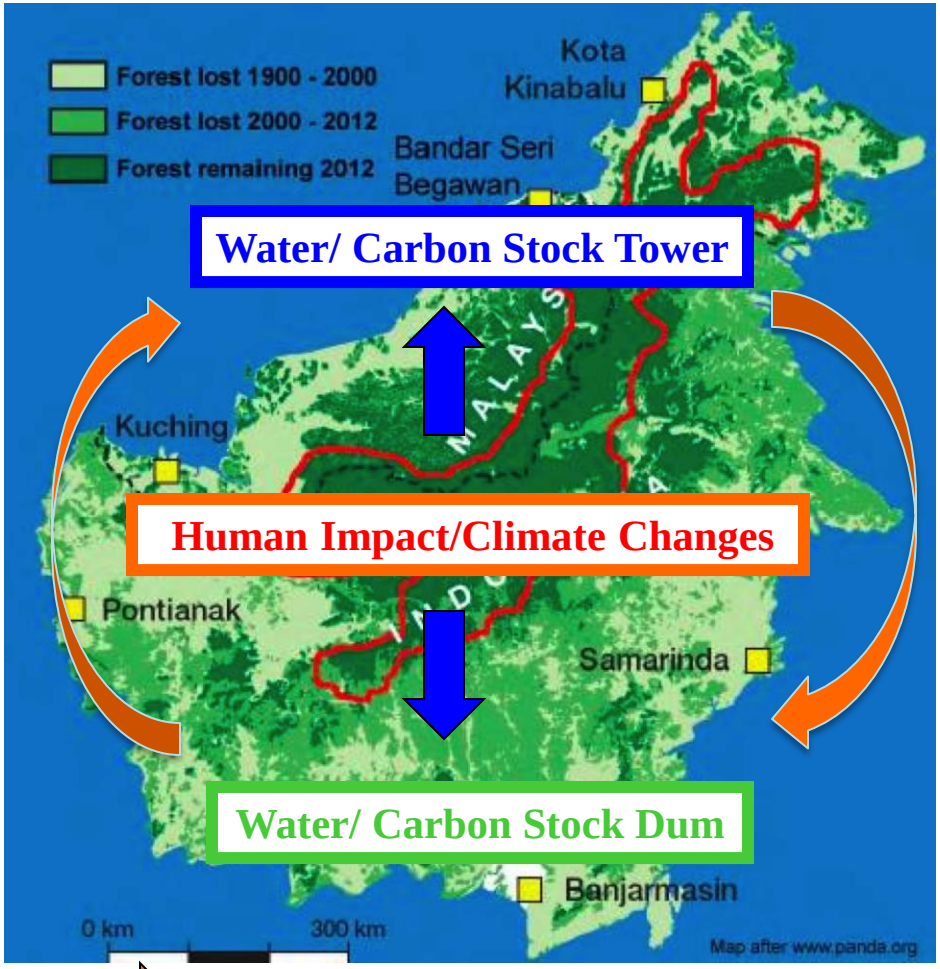
UNFCCC workshop on "Technical and scientific aspects of ecosystems with high-carbon reservoirs not covered by other agenda items under the Convention"

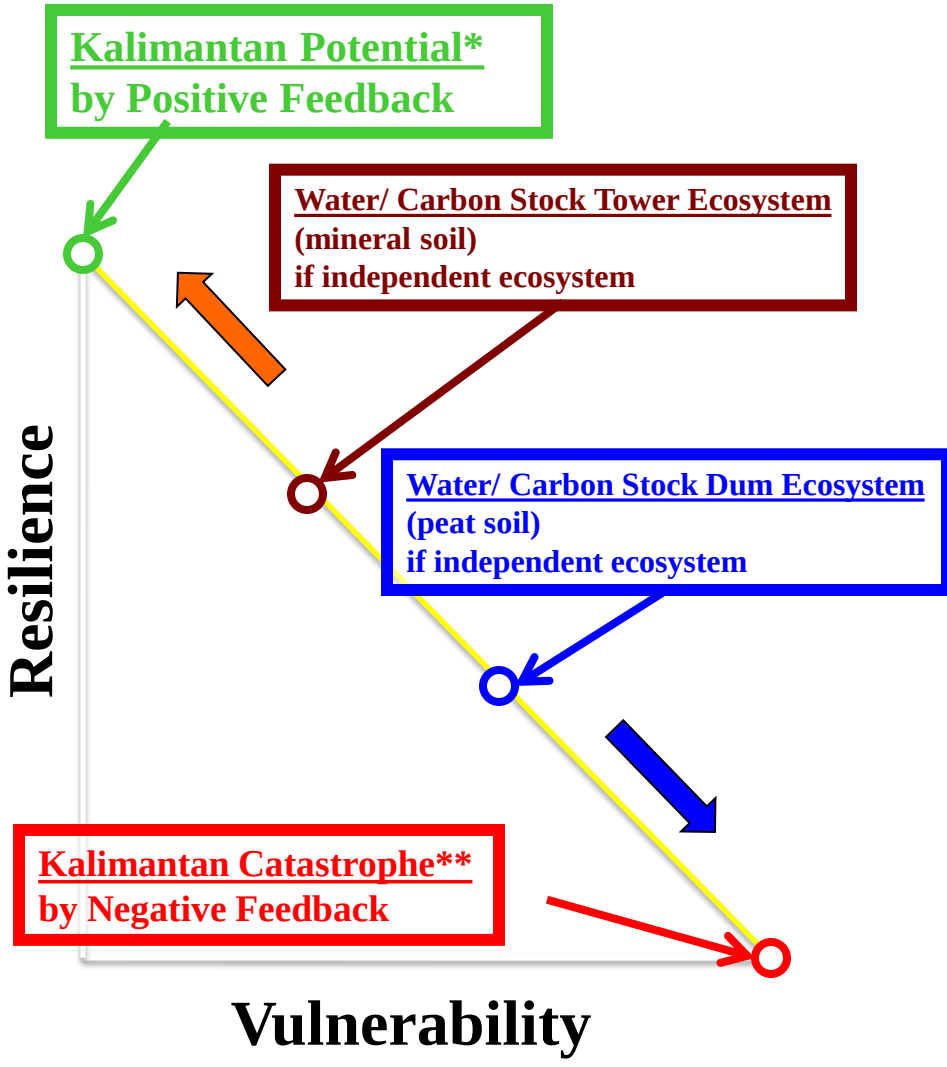
24 to 25 October 2013, Bonn, Germany

Future Cutting Edge on High-Carbon Reservoir Ecosystem

Photo from Erianto Indra Putra (UNPAR)

Mutual Interacted Ecosystem on Carbon-Water-Soil
- vulnerability and resilience-





Positive Feedback

Negative Feedback

* High Biodiversity & High Productivity/ Enrich of Water & Carbon Stock

** Low Biodiversity & Low Productivity/ Loss of Water & Carbon Stock

Project MRV Challenges for REDD+

- Baseline scenario and reference emission level
  - National
  - Sub-national level
- Methodology development and verification
  - Expensive and lengthy process in developing methodology
  - Complexity in interpreting the standards during verification
  - Community capacity in supporting MRV work
- Land tenure
  - Competing claims between local and national governments
  - Incomplete spatial planning process








Field Campaign using High-Precision Telescope

AMI (Airborne Multispectral Imager)

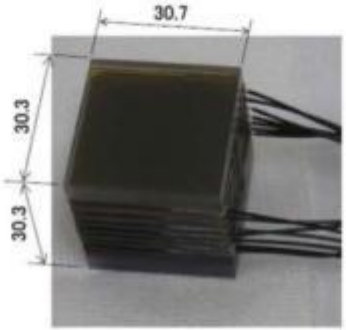
Called as LCTF (*liquid crystal tunable filter-system*)

Multispectral Camera

- Wide FOV lens
- High-sensitive CCD
- Liquid Crystal Tunable Filter (LCTF) for Visible
- 190 x 100 x 100 mm
- 1.3 kg

Camera controller

- 100-240 V AC input
- USB 2.0 interface
- 300 x 200 x 60 mm
- 2.0 kg

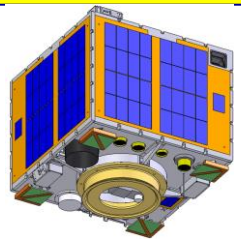


LCTF

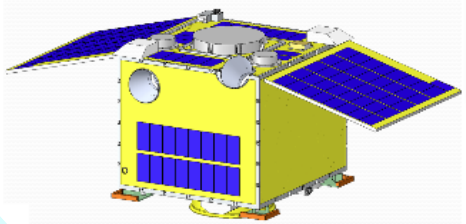
Specifications	
Wavelength range	420 - 700 nm
Band width (FWHM)	8 - 25 nm
Response time	< 0.3 sec
Frame rate	> 1 frame /sec
Number of pixels	659 x 494
Field of view	92 degree

Courtesy: Junichi Kurihara, HU

On-demand monitoring using microsatellites with HU



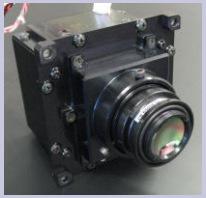
RISING-2



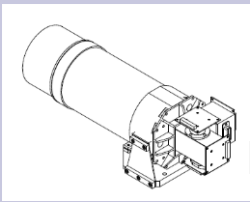
RISESAT

UNIFORM

Advanced sensors provided by HU



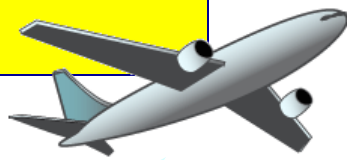
telescopic camera



IR-camera

LCTF camera

Regional measurement using UAV with HU sensors



Data downlink and analysis in Indonesia

Wild Fire

bio

CDOM

Smart Remote Sensing with Super-Constellation

Short Term (Dynamic): Fire, Tsunami, Deforestation, Weather [20 micro-satellites]

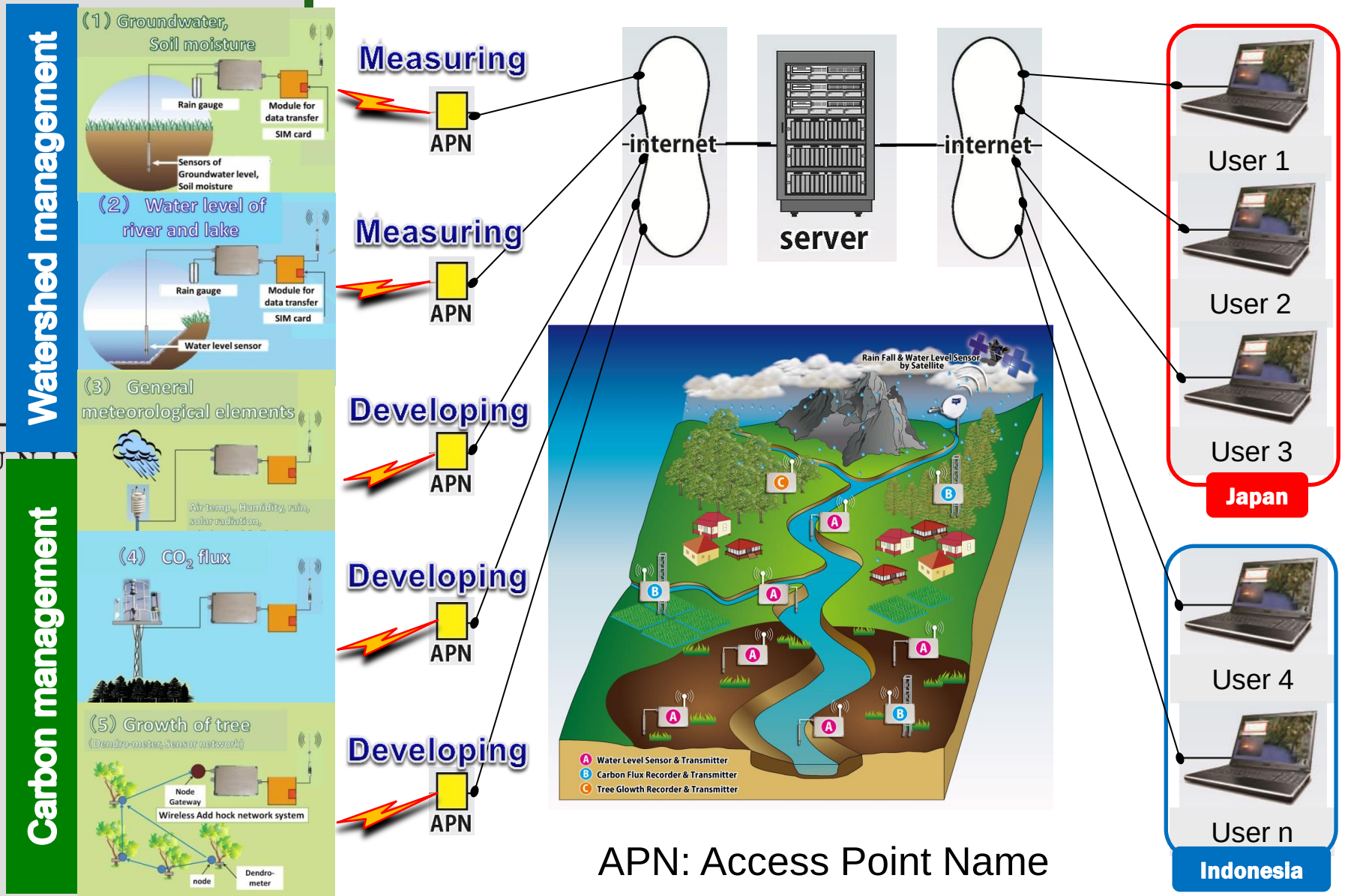
Medium Term: Forest Degradation, Biodiversity Changing, Plant Growth, Water Pollution, LULUCF, GHGs Flux, Water Cycling [Modeling and Simulation][Several micro-satellites]

Long Term (Stable): Mineral Exploration, Biomass, Biodiversity, Village Mapping [Few micro-satellites]

20 micro-satellites in equatorial orbits enables
5-min interval monitoring

by Yukihiro Takahashi

Watershed and carbon managements using data transfer network of mobile phone



APN: Access Point Name

■Indonesia CTC (Climate Technology Center) at BPPT

Indonesia CTC

Submitted proposals by countries and consortium organizations

CTC-N
(Climate Technology Center & Network)
COP 16/2010, Cancun – Mexico
by UNEP

- Costa Rica
- Norway
- USA
- Kenya
- India
- Iran
- Germany
- China

Outcomes of SATREPS

- Real Time Monitoring System
- Integrated MRV System
- Real Time CO_2 Emission Mapping


Thanks for your attention!