Side Event Workshop of COP19
JAPAN Pavilion (Level 1 Zone D Room 47),
Warsaw, Poland, 13th November, 2013

“Evaluation of the High-Carbon Reservoirs:
Tropical Peatland by Integrated MRV System”

Topics:
1) Mapping on Carbon Stock and Carbon Flux in Tropical Peatland by Integrated MRV System (Prof. Mitsuru Osaki, Japan)
2) Introduction to Indonesia Japan - Project for Development of REDD+ Implementation Mechanism (IJ-REDD+ Project) (Dr. Gun Gun Hidayat, Indonesia)
3) Innovating on Wide-ranged Ecology Research by Hyper-sensor (Mr. Kazuyo Hirose, Japan)
4) Innovating on Earth/Climate Changing Observation by LCTF (liquid crystal tunable filter) on Microsatellite (Prof. Yukihiro Takahashi, Japan)
“Evaluation of the High-Carbon Reservoirs: Tropical Peatland by Integrated MRV System”

Mapping on Carbon Stock and Carbon Flux in Tropical Peatland by Integrated MRV System

Prof. Mitsuru Osaki, Research Faculty of Agriculture, Hokkaido University, Japan
Introduction

Photo from Erianto Indra Putra (UNPAR)
Amount of Carbon in Tropical Peat (GtC (%))

- Indonesia: 44.5Gt (100)
  - West Papua: 10.3Gt (23.0)
  - Kalimantan: 15.1Gt (33.8)
  - Sumatra: 18.3Gt (41.1)
- Other tropical area: 25.7Gt (30.7)
- Other Southeast Asia: 13.6Gt (16.2)
- Others: 1.51Gt (2.0)

(Tropical area: 83.8Gt (100), Other South-East Asia: 13.6Gt (16.2)
Indonesia: 44.5Gt (53.1)

(From Maria Strack ed., 2008: Peatlands and Climate Change. International Peat Society, 223pp.)
Total amount of CO$_2$ emission

- **China**: 19.4%
- **USA**: 19.1%
- **Indonesia**: 6.6%
- **Japan**: 4.0%
- **Russia**: 5.5%
- **Others**: 41.2%

Total amount of CO$_2$ emission in the world: 31.0 Gton (2005)

Source: [http://www.eia.doe.gov/leia/carbon.html](http://www.eia.doe.gov/leia/carbon.html)

Total amount of CO$_2$ emission from Indonesia: 2.1 Gton (2005)

- **LULUCF**: 40.9%
- **Peat**: 37.5%
- **Petroleum & gas**: 4.6%
- **Cement**: 1.2%
- **Building**: 1.2%
- **Transport**: 2.9%
- **Power**: 5.4%

Source: Indonesia’s green house gas abatement cost curve (DNPI 2010)
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.)
Project Design for Mapping on Carbon Stock & Emission in Tropical Peatland

Photo from Oriento Indri Putra (UNPAR)
Main Project Sites

- Monitoring was started from 1997

- Central Kalimantan, Indonesia
- Peatland area in Mega Rice Project site

CO₂ observation towers at
UDF: (Un-drained Peat)
DF: (Drained Peat)
BC: (Burnet Peat)

Various Study Topics:
- GHG Flux (CO₂, CH₄, N₂O) measuring
- Fire Detection and Protection
- Water Table Monitoring and Management
- Peatland Ecology
- Soluble Carbon Monitoring
- Peatland Subsidence Monitoring
- etc.
Key elements for integrated Monitoring-Sensing-Modeling (MSM) system of Carbon in peatland

1. Atmospheric Elements
   - CO₂ Flux
   - CO₂ Flux & Concentration

2. Above Ground Elements
   - Wildfire detection & Hotspot
   - Forest degradation & Species mapping
   - Deforestation & Forest biomass change

3. Water Elements
   - Water level, & Soil moisture
   - Water soluble organic carbon

4. Below Ground Elements
   - Peat thickness & Peat dome detection
   - Peat subsidence
   - Forest Biomass

5. Atmo. Elements
   - CO₂ Flux & Concentration

6. Below Ground Elements (Below Ground Carbon Stock)
   - Drilling
Key Elements of Tropical Peatland MSM System
Integrated Monitoring-Sensing-Modeling (MSM) system: Carbon Stock

Photo from Erianto Indra Putra (UNPAR)
Seasonal fluctuation of GWL is different; moderate at deep peat, while greater at shallow peat.

This might reflect the vegetation physiologically.
Idea of Peat Depth Classification

In Tropical Peat Swamp Forest, type of forest stand and its phenology are corresponded to Peat Depth, in terms of seasonal groundwater level fluctuations. Its difference produce spatial trends of plant activity in each season.

To detect these, Supervised classification were conducted using multi-temporal satellite scene with Peat Depth Database as training data.

Index of Plant Activity: NDVI

Target Period: Early 90’s

Relatively Undisturbed Condition (Before Mega Rice Project)
Estimated Map of Peat Thickness

Root Mean Square Error (RMSE) = 1.64 m

Distribution Map of C-density (Shimada et al. 2001)

Ground-truth peat thickness (m)
- 0 - 2
- 2 - 4
- 4 - 6
- 6 - 8
- 8 - 12.2

C-pool = 4.2 Gt

3.1 Mha = 4.2 Gt

1.4 Gt Mha⁻¹
Classified map

- Classification were conducted within the area below
  - 1) Estimated Swamp Forest extent built from Landsat image (1994) and SRTM DEM
  - 2) PalangkaRaya & Pulang Pisau Regency where include core research area of SATREPS

- We are still trying to collect peat drilling data with depth infomation to rebuild the map

- Category 1: \( \leq 0.5m \)
- Category 2: 0.5–2.0m
- Category 3: 2.0–4.0m
- Category 4: 4.0–6.0m
- Category 5: 6.0–8.0m
- Category 6: \( > 8.0m \)
Integrated Monitoring-Sensing-Modeling (MSM) system:

**Carbon Flux by Oxidation**
(directly measurment)

Photo from Erianto Indra Putra (UNPAR)
Large increases were found in the dry seasons of 2002, 2004 and 2006, El Niño years, because of shading by dense smoke and the enhancement of oxidative peat decomposition due to low GWL.
A negative linear relationship for each site
→ Enhancement of oxidative peat decomposition under low GWL

Slope: UF > DF > DB → Undisturbed peatland is more sensitive.

Annually mean GWL is a robust indicator to assess annual CO$_2$ balance.
Oxidative peat decomposition vs. GWL in burnt site

Burnt peatland

With 6 automated chambers

Fires

Heterotrophic respiration (oxidative peat decomposition)

Little vegetation

Peat decomposition (RS)

From a simple relationship,

GWL lowering by 0.1 m

Additional peat decomposition of 89 gC m\(^{-2}\) y\(^{-1}\)

Hirano et al., 2013 (GCB)
Integrated Monitoring-Sensing-Modeling (MSM) system:

Carbon Flux by Oxidation (indirectly measurement by subsidence method)

Photo from Erianto Indra Putra (UNPAR)
Subsidence and GHG emissions

Photo: Jyrki J, Johor Bahru, Malaysia