K&C Phase 4 – Status report

Mapping Peatland Extend And Thickness Across Indonesia
(Case study: Kuburaya, West Kalimantan and Bengkalis District, Riau, Sumatera)

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Peatland in Indonesia: An Overview

Forest Fires in 2015

INDONESIA
7 Provinces
15 million ha
13 million ha

BRG Restoration MANDATE
2 Million ha in 7 province
Riau, Jambi, South Sumatera, West Kalimantan, Central Kalimantan, South Kalimantan, Papua

BRG Restoration TARGET (7 Province)
2.5 million ha
104 PHU

AFFECTED FIRE 2015-2017 (HA)
- Tahun 2015: 1.757,433
- Tahun 2016: 851,736
- Tahun 2017: 330,518
- Non Concession Area: 1.1 Million Ha Funded by State Budget
- Concession Area: 1.4 Million Ha Concession responsibility under MoEF coordination

Source: BRG
Priority areas in 7 provinces

- Mapping of Peatland
- Mapping of Forest cover change
- Mapping of soil moisture
- Mapping of Peat depth
- Detection and reconstruction planning of drainage canals;
- Monitoring of hydrology;
- Detection of Peat forest fire and burn scar

<table>
<thead>
<tr>
<th>Province</th>
<th>Area [Ha]</th>
<th>PHU</th>
</tr>
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<tbody>
<tr>
<td>RIAU</td>
<td>814.732</td>
<td>24</td>
</tr>
<tr>
<td>JAMBI</td>
<td>151.663</td>
<td>10</td>
</tr>
<tr>
<td>SOUTH SUMATERA</td>
<td>615.907</td>
<td>25</td>
</tr>
<tr>
<td>WEST KALIMANTAN</td>
<td>119.634</td>
<td>17</td>
</tr>
<tr>
<td>SOUTH KALIMANTAN</td>
<td>38.761</td>
<td>4</td>
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<tr>
<td>CENTRAL KALIMANTAN</td>
<td>713.076</td>
<td>19</td>
</tr>
<tr>
<td>PAPUA</td>
<td>38.753</td>
<td>12</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>2,492.527</strong></td>
<td><strong>107</strong></td>
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</tbody>
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K&C Initiative
An international science collaboration led by JAXA
The main objective is to demonstrate the innovative applications for peatlands monitoring and rehabilitation focused on:

- Development of an empirical model relating surface topography to peat depth in West Kalimantan (case study: Kuburaya, West Kalimantan)
- Identification of soil moisture in peatlands across Indonesia (case study: Bengkalis, Rau, Sumatera)
Study Area

Bengkalis, Riau

Kubu raya, West Kalimantan

Mawas, Central Kalimantan

Area for a model development
Methodology

- **Asumtion**: Link peat depth within each Landform to other variables:
  - Thickness vs. multiple variables:
    - Landform type
    - Surface topography
    - Distance to river
    - Distance to canal

- **Requirements for this approach:**
  - Accurate surface topography data across wide areas (calibrate SRTM/Airbus DEMS to LiDAR)
  - Accurate and abundant measurements of peat depth for model development and evaluation (use GPR and ERI)

*Using surface topography to map peat thickness assumes a predictable (or constant) subsurface elevation (i.e. MSL +2m). We will test this assumption by landform.*
Processing of wide-area coverage satellite in the study area Kubu Raya, West Kalimantan
Processing of wide-area coverage satellite data needed to map peat depth

Landsat and Spot imagery for the Bengkalis area.

In the imagery, we note the land cover/land use changes in Bengkalis area from forest to plantation and paddy field area.
The development of an empirical model of peat depth

Lacking LiDAR data to collect such data at Bengkalis, Riau and Kuburaya, West Kalimantan

- pursued a modeling analysis demonstration at the Mawas site in Central Kalimantan
- Thickness vs. multiple variables:
  - Landform type
  - Surface topography
  - Distance to river
  - Distance to canal
PALSAR2 in Mawas Kalimantan

Kalimantan, Indonesia

Mawas, Central Kalimantan

PALSAR2 HH/HV/HV
(Sept 2014/Jan 2015)

Source: Hoekman
The relationship between peat thickness and several independent variables shown by landform type.

- Thickness vs. 2011 LiDAR elevation (m)
- Thickness vs. Distance From nearest river (m)
- Thickness vs. Distance From nearest canal (m)
Data Collection

ERI
(Electrical Resistivity Imaging)
Result of the predicted model

Using an Artificial Neural Network, a non-parametric modeling technique, the team created a bestfit model relating a series of independent variables to peat thickness in Mawas, Central Kalimantan.

The independent variables applied include (a) distance to nearest river, (b) distance to nearest canal, (c) landform type, and (d) elevation.

The results of the evaluation of this model show a strong relationship: \( R^2 = 0.78 \), \( \text{RMSE} = 0.957 \) m, and \( \text{RMS/mean} = 0.13 \).
PEAT THICKNESS,
MAWAS, CENTRAL KALIMANTAN, INDONESIA

Legend
Thickness of peat (m)
- 0 - 1
- > 1 - 2
- > 2 - 3
- > 3 - 4
- > 4 - 5
- > 5 - 6
- > 6 - 7
- > 7 - 8
- > 8 - 9
- > 9 - 10
- > 10
Implementation the model in the Kubu Raya, West Kalimantan

Accuracy: 31% of the variance in peat depth, with a root mean square error of 47 cm.
Workflow for mapping Soil moisture using SAR data.

A. SAR Precessing

1. ALOS2-PALSAR2 (SLC)
2. Sentinel-1 A/B (IW GRD)
3. DEM

Pre-Processing:
- Orbit File
- Multilooking
- Calibration
- Speckle Filtering
- Terrain Correction
- Subset

Tile Mask & Incidence Angle

SAR Backscatter Sigma0

B. Soil moisture

Statistical Analysis
- SM = f(σ0, θi)
- Correlation
  VV/VH/incidence angle
  and in-situ SM
- Estimation Soil moisture

In Situ Meas.
GWL/SM
PALSAR/PALSAR-2 data access

- requested and obtained the
ALOS2 PALSAR2 ScanSAR
(SLC)
S1A RGB Composite : R: VH, G: VV, B: VH-VV

2018-01-11
Predicted soil moisture from
Relationship between VH and Predicted Soil Moisture (11 January 2018) on Bengkalis Island

Relationship between VV and Predicted Soil Moisture (11 January 2018) on Bengkalis Island
Relationship between VH and Predicted Soil Moisture (10 July 2018) on Bengkalis Island

Relationship between VV and Predicted Soil Moisture (10 July 2018) on Bengkalis Island

40 random samples
Dissemination

- FGD for Identification of Peatlands in Pontianak, West-Kalimantan.
Future Work: Post-KC proposal (1)

- The objectives of the Post-KC proposal are
  - to demonstrate the satellite data processing services for multi sensor satellite data such as Sentinel-1, ALOS2 PALSAR2, Landsat and MODIS for Peatland monitoring.
    - Mapping of Peatland
    - Mapping of Forest cover change
    - Mapping of soil moisture
    - Mapping of Peat depth
    - Detection and reconstruction planning of drainage canals;
    - Monitoring of hydrology;
    - Detection of Peat forest fire and burn scar
• BRG requested LAPAN to provide remote sensing data to meet this aim. (Terra/Aqua, NOAA20, Landsat8, Spot6/7, Pleaides, TerraSAR-X, Sentinel-1).

• Through the collaboration of the Kyoto and Carbon Initiative activities (KC Post proposal) LAPAN is proposing ALOS PALSAR and ALOS2 PALSAR2 data

• BRG provides In-situ measurement data (Ground water level, soil moisture, rainfall rate) and some Lidar data.

• LAPAN and WU are working together to process develop and analyse the remote sensing data for peatland monitoring applications
THANK YOU

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