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Post-K&C – First Report

Tropical Peat Watch demonstrator Indonesia

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In collaboration with LAPAN

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L-band radar is uniquely suitable (a) to monitor flooding under vegetation canopies, such as tropical peat swamp forests, (b) to assess variations in peat soil moisture and (c) to detect excess drainage along canals.

Research objectives

- Efforts will be made to better quantify relationships between soil moisture, canopy cover and PALSAR-1/2 radar backscatter level, partly using data from networks of ground water level gauges.
- 2. Hydrological models for ombrogenous peat (domes) will be studied to describe the temporal dynamics of the hydrological patterns observed and to identify areas at risk.

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System development objectives

 Development and demonstration of a prototype peatland monitoring system (mainly based on PALSAR-1/2, JERS-1 and Sentinel-1) to potential users and stakeholders in Indonesia and internationally, such as through the Global Peatland Initiative (GPI) and the International Tropical Peatland Center (ITPC).

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Project area(s) – its geographic location(s) and special characteristics.

First year: Provinces Riau and Central-Kalimantan; Second and third year: Entire Borneo, Sumatra, Papua; Third year: Optional extension to (1) Peru and (2) Congo Basin



- 1. Pastaza-Marañón foreland basin, Peru: lat 3S-7S; long 77W-73W (16 tiles)
- 2. Cuvette Centrale wetlands, Congo: lat 4N-5S; long 15E-25E (90 tiles)
- 3. Indonesia: Sumatra (61 tiles), Borneo (89 tiles) and Papua (58 tiles)

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Indicate how the project aims to supported one or more of *the 4 K&C thematic drivers* (Carbon cycle science, Climate Change, International Conventions, Environmental Conservation)

Carbon cycle science: While peatlands cover 3% of the Earth's land mass, they contain as much carbon as all terrestrial biomass combined, twice as much as all global forest biomass, and about the same as in the atmosphere.

Top 3 countries with tropical peat:

Indonesia, mainly Borneo, Sumatra and Papua: ± 49 Gt C
Peruvian Amazon: ± 20 Gt C
Cuvette Centrale swamp forest in the Congo Basin: ± 30 Gt C

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K&C thematic drivers

Climate Change: Indonesia makes efforts to restore degraded peatlands by "re-wetting", blocking canals and promoting paludiculture (sustainable wet agriculture and forestry on peatlands). This will decrease global emissions caused by oxidation and fire.

Emission from degraded peatlands

- Only 15% of the world's peatlands are drained
- Global emissions from drained peatlands: ± 0.5 Gt C per year (or ± 5%)
- Indonesia: ± 0.2 Gt C per year
- Peatland fires (mainly Russia and Indonesia) cause huge additional emissions
- Indonesia 2015: 900,000 ha (or 3.5%) of peatlands were on fire

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K&C thematic drivers

International Conventions: Many peatlands in Indonesia are Ramsar sites

Environmental Conservation: Habitats of endangered species such as the orangutan and Sumatran tiger, are threatened by peatland deforestation

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Results and significant findings

Describe project outcomes and significant findings (several slides OK!)

Comments and suggestions to JAXA (if any)

K&C Initiative



Baseline overview and project areas





JERS-1 SAR time series

Mawas site: Low disturbance peat swamp forest

Sec.1

SUL TO COUL

Mawas site: Low disturbance peat swamp forest

2006-2008 PALSAR-1 backscatter and ground water level along 22 km transect









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Overview of new results. Relationship between (L-band HH) backscatter and relative water levels for a range of conditions







Historical analysis of <u>all</u> JERS-1 (1992-1998), PALSAR-1 (2006-2011) and PALSAR-2 (2014-present) data

Animation of three era's JERS-1 (15): 1994-1998 PALSAR-1 (22) 2006-2010 PALSAR-2 (39) 2014-2019

/1997 El Niño event /2006 El Niño event /2015 El Niño event



Historical analysis of all JERS-1 (1992-1998), PALSAR-1 (2006-2011) and PALSAR-2 (2014-present) data

Animation of three era's JERS-1 (15): 1994-1998 PALSAR-1 (22) 2006-2010 /2006 El Niño event PALSAR-2 (39) 2014-2019

/1997 El Niño event /2015 El Niño event

Some general features of importance JERS-1: Often shows pre-disturbance situation; Some data quality issues PALSAR-1: PALSAR-2: More solar activity results in pronounced Faraday rotation

What else can be noted?

Pre-disturbance peat is often locally very wet

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After the 1997 and 2006 El Niño's these areas are smaller This may be attributed to major disturbances After the 2015 EI Niño's these areas have never been wet!

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kman, 21 Jan 20

After the 1997 and 2006 El Niño's these areas are smaller This may be attributed to major disturbances

Deforestation monitoring with ASAR APV

Example detection illegal road and canal development in Sebangau, Borneo



Already in 2006-2007 ENVISAT ASAR APP was demonstrated in a 200x300km area in Borneo as a unique, fast and reliable tool for operational deforestation monitoring

Note this is currently done with Sentinel-1 for Tropical Peat Watch





Zoom in to 25x27km area



Excess drainage and underground fire in peat swamp: Sebangau National Park, Central Kalimantan, 2006 El Niño



Excess drainage and underground fire in peat swamp: Sebangau National Park, Central Kalimantan, 2006 El Niño

199710

Historical analysis of <u>all</u> JERS-1 (1992-1998), PALSAR-1 (2006-2011) and PALSAR-2 (2014-present) data

Start 1997 El Niño

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Disturbance 1997 El Niño

5.17

199801

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C Start 2015 El Niño KC26, Dirk Hoekman, 21 Jan 2020



Disturbance 2015 El Niño

R. C.m

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1-2

Fire damage development during the 2015 El Niño as observed by the Sentinel-1 NRT monitoring system









1998-01 > < 2016-01-08







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±1 m subsidence

Carbon emissions may be estimated when combining data sources and models.





Tropical Peat Viewe



User Consultation Workshop (Oct. 2018, Jakarta) and Service Validation Workshop (Oct. 2019, Jakarta)





Sarvision









Flood frequency: (1) waterlogging in peat forest **I**, (2) under other vegetation, including degraded peatland **I** and (3) open water **I**

Other satellite (radar and optical) can only observe the open water flooding





Sentinel-1 NRT monitoring system for road & canal development







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Features in yellow boxes are hardly visible in SPOT-6/7, however clearly appear in automated Sentinel-1 radar detection





Sentinel-1 NRT monitoring system for deforestation and degradation; Plantation development on shallow peat, Borneo

0<u>5</u>10 km

Near real-time monitoring period 2015-2019

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Deliverables and other output

Describe planned output of your project.

Project deliverables:

Maps of forest type, flood, drought and excess drainage Methodological development

- TPW system design
- □ Peer-reviewed publications:

First results in 2 papers planned for 2020

- □ Non-peer-reviewed publications (conference papers, reports etc.)
- Other results

Technology transfer to LAPAN

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PALSAR/PALSAR-2 data access

Please list the PALSAR/PALSAR-2 data you have (1)requested and (2) obtained.

2174 path data products requested; 430 approved for FY2019 (not yet received)

20-60 standard images for FY2019? When/how can they be ordered?

Have you had sufficient data to complete your research (according to your K&C agreement)?

If not, which key data sets are missing?

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