K&C Phase 4 – Status report

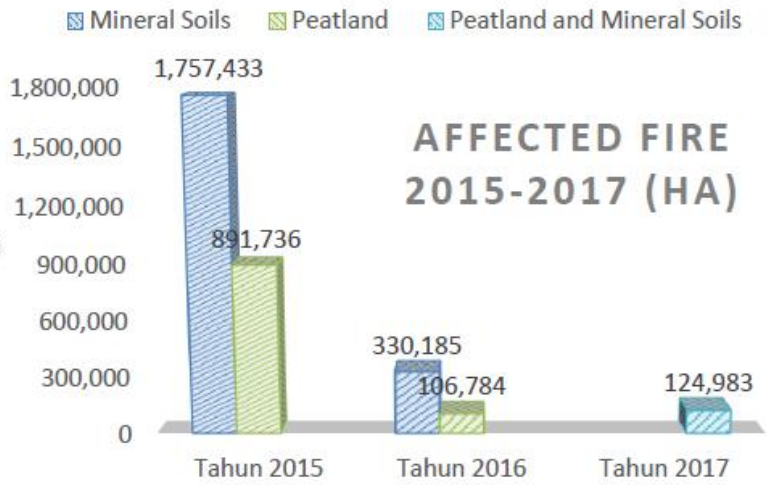
Mapping Peatland Extend And Thickness Across Indonesia *(Case study : Kuburaya, West Kalimantan and Bengkalis District, Riau, Sumatera)*

Rahmat Arief, Dede Dirgahayu, Ita Carolita, Tatik Kartika,
Haris Suka Dyatmika, Zylsal, Orbita Roswintiarti,

LAPAN

Science Team meeting #25
Tokyo, February 5th-8th, 2019

Peatland in Indonesia : An Overview



INDONESIA — **15 million ha**

7 Provinces — **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 (7Province)

2,5 million ha
104 PHU

Non Concession Area:
1.1 Million Ha
Funded by State Budget

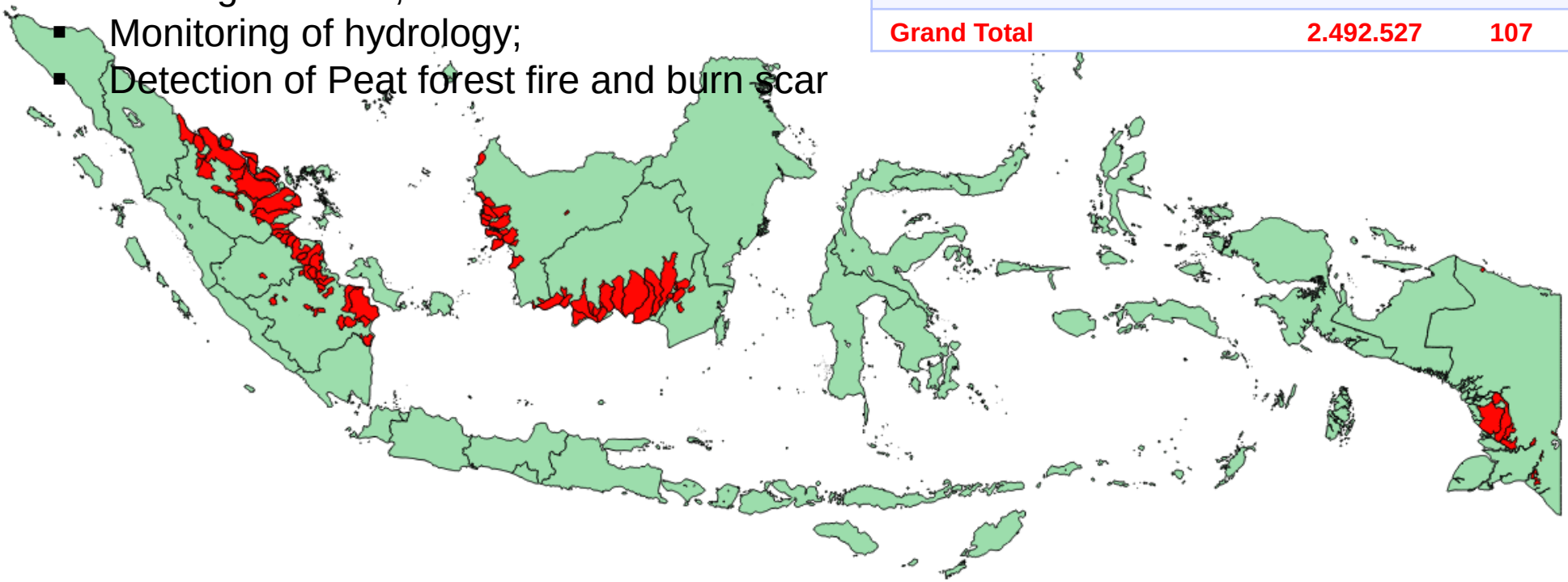
Concession Area:
1,4 Million Ha
Concession responsibility under MoEF coordination

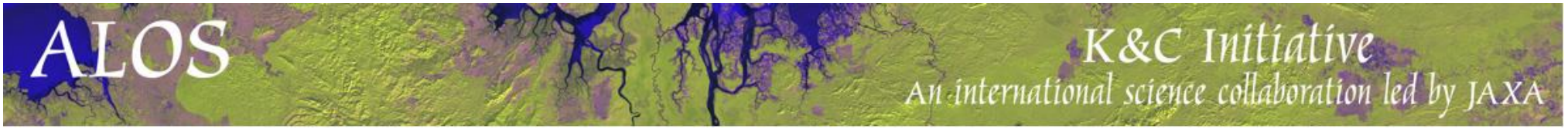
Source : BRG

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

Province	Area [Ha]	PHU
RIAU	814.732	24
JAMBI	151.663	10
SOUTH SUMATERA	615.907	25
WEST KALIMANTAN	119.634	17
SOUTH KALIMANTAN	38.761	4
CENTRAL KALIMANTAN	713.076	19
PAPUA	38.753	12
Grand Total	**2.492.527**	**107**





Not secure | sipalaga.brg.go.id

BRG SIPALAGA

SISTEM PEMANTAUAN AIR LAHAN GAMBUT
BADAN RESTORASI GAMBUT

Sabtu, 2 Februai 2019 Jam 19:40:22 PM

Didukung Oleh Badan Pengkajian dan Penerapan Teknologi

Berdasarkan Status | Berdasarkan Paket

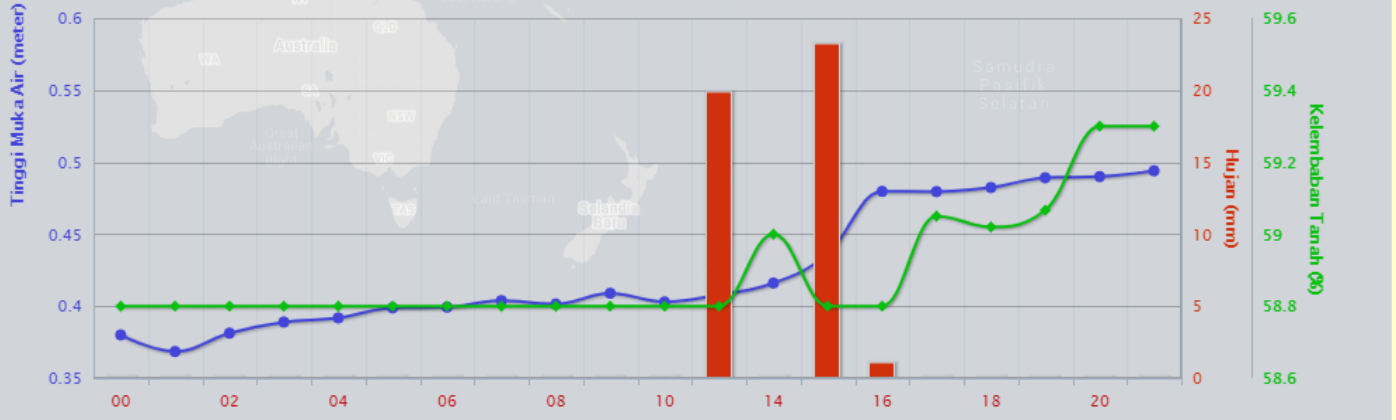
LOKASI BUKIT LITI1 KECAMATAN KAHAYAN TENGAH, KABUPATEN PULANG PISAU / -0.41 METER

Tinggi Muka Air | Kelembaban Tanah | Curah Hujan | Grafik Gabungan

GRAFIK DATA RATAAN SETIAP JAM STASIUN PADANG SUGIHAN 3 (SM) PADA SELASA, 05 FEBRUARI 2019

Download

Stasiun	BRG_160214_03
Lokasi	PADANG SUGIHAN 3 (SM)
Kecamatan	AIR SUGIHAN
Kabupaten	OGAN KOMERING ILIR
Provinsi	SUMATERA SELATAN
Tanggal Akhir	SELASA, 05 FEBRUARI 2019
Jam	21
Tinggi Muka Air	0.49 meter
Kelembaban Tanah	59.3 %
Curah Hujan	0 mm
Status	AMAN



Posisi Lat : 7.108 Lon : 120.866 / Zoom : 3

Legenda Peta | Roadmap | Hybrid | Terrain | Relief | Style

Project objective

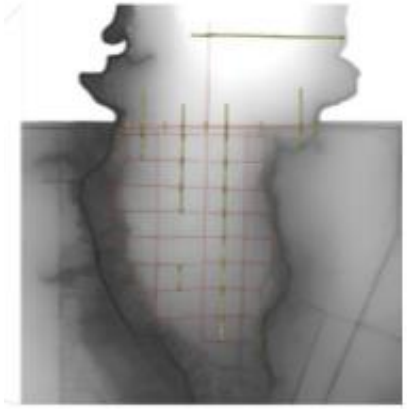
The main objective is to demonstrate the innovative applications for peatlands monitoring and rehabilitation focused on:

- 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)

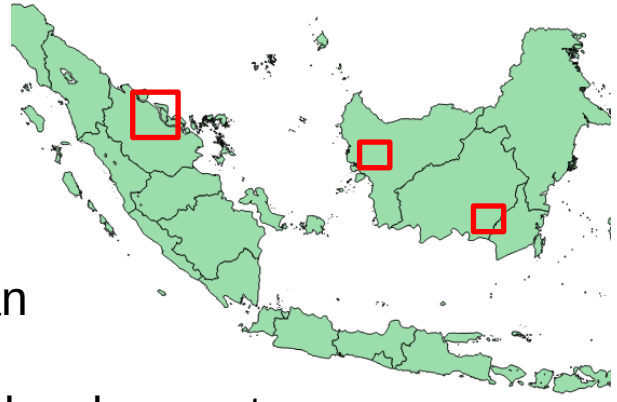
Study Area

Bengkalis, Riau

Kubu raya, West Kalimantan



Mawas,
Central Kalimantan



Area for a model development

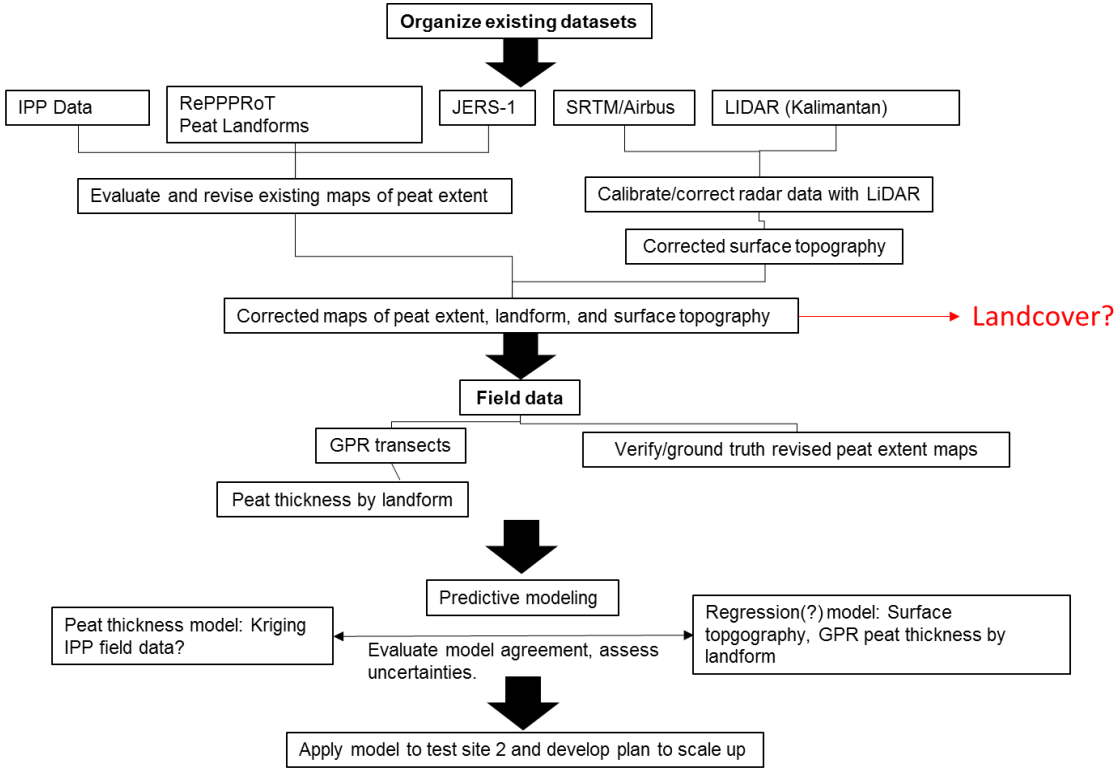
Methodology

- 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.*

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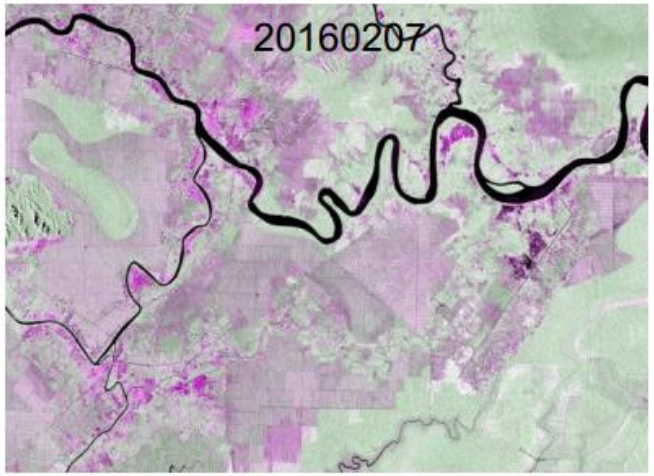
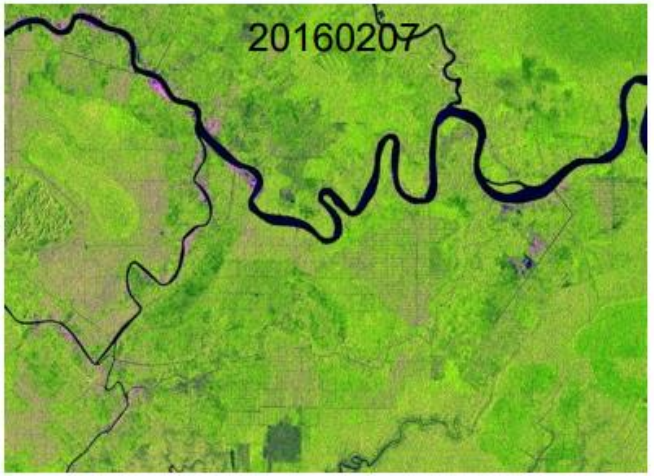
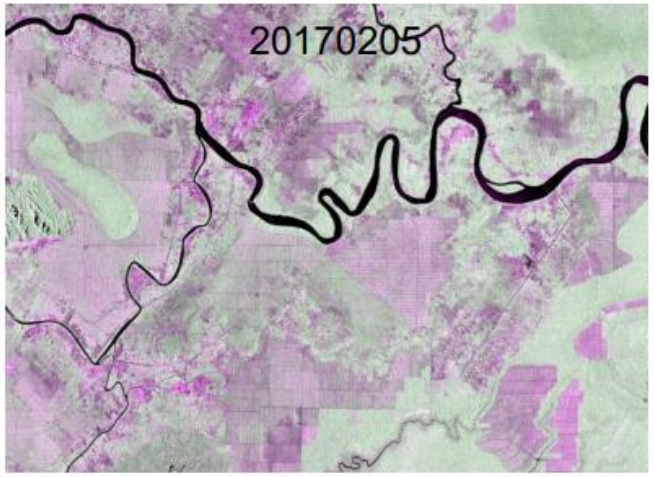
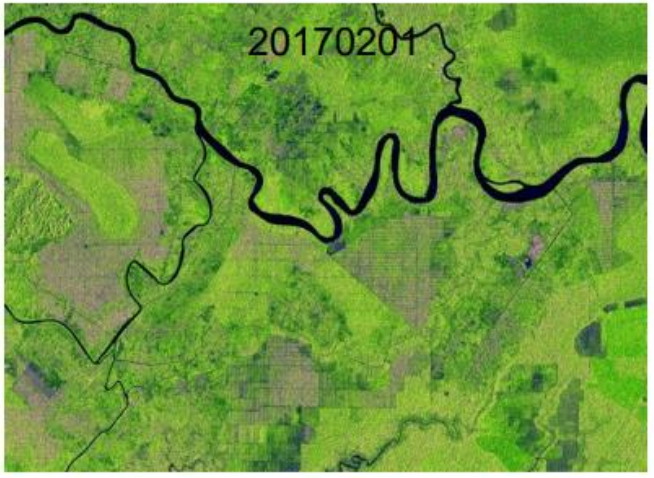
Processing of wide-area coverage satellite in the study area Kubu Raya, West Kalimantan









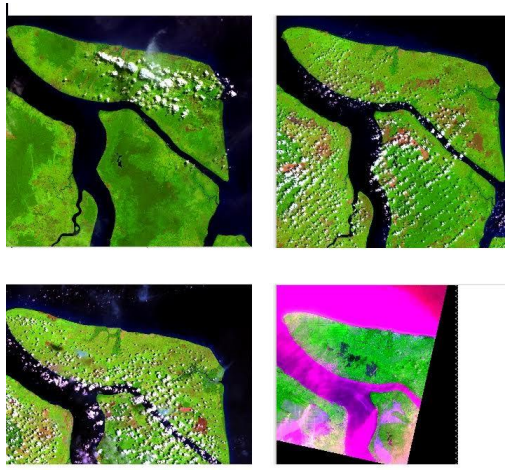
ALOS2
PALSAR2

RGB
composite

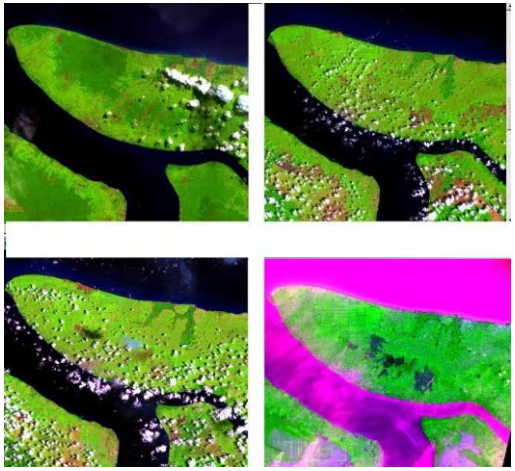
Processing of wide-area coverage satellite data needed to map peat depth

Landsat and Spot imagery for the Bengkalis area.

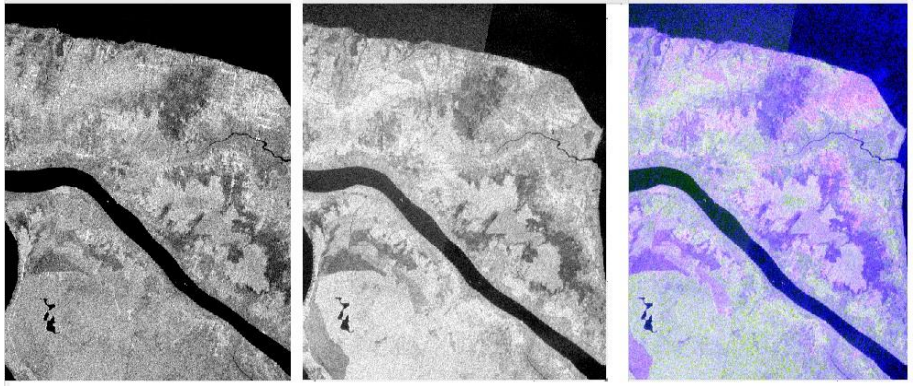
In the imagery, we note the land cover/land use changes in Bengkalis area from forest to plantation and paddy field area.



Landsat 2015-16



SPOT6 2014



HH, HV, RGB (HH, HV, HV/HH),

ALOS2 PALSAR2 2017

The development of an empirical model of peat depth

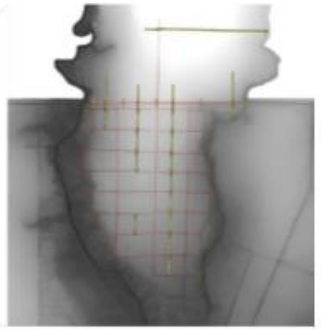
Lacking LiDAR data to collect such data at Bengkalis, Riau and Kuburaya, West Kalimantan

➔ 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

Mawas, Central Kalimantan



DEM LIDAR

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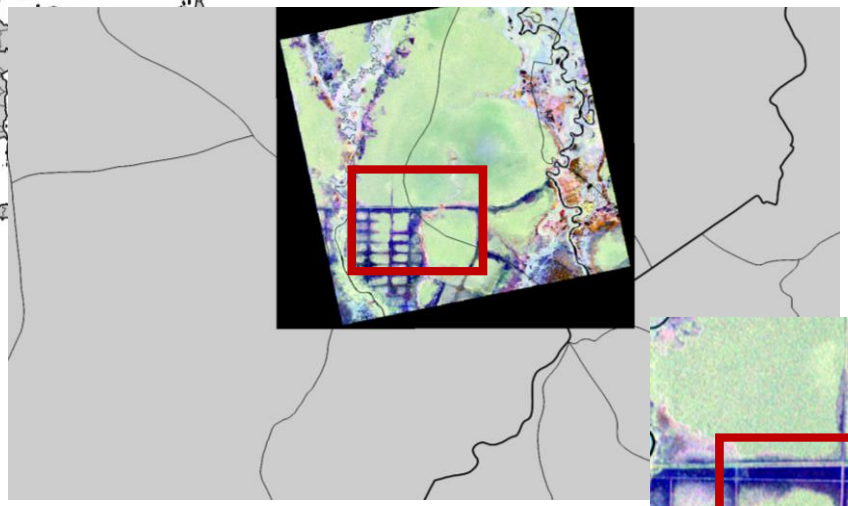
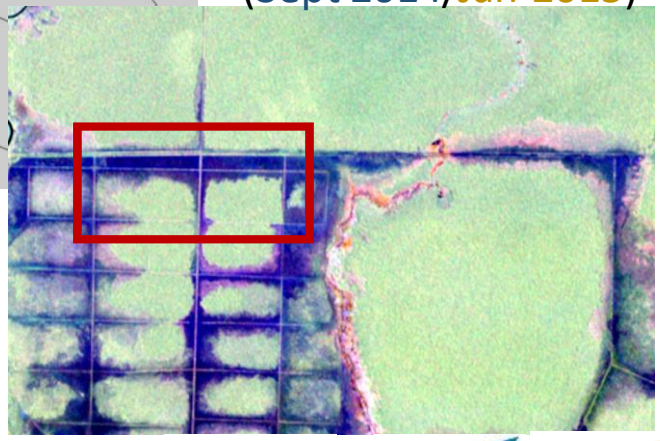
PALSAR2 in Mawas Kalimantan

Kalimantan, Indonesia

Mawas, Central Kalimantan



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



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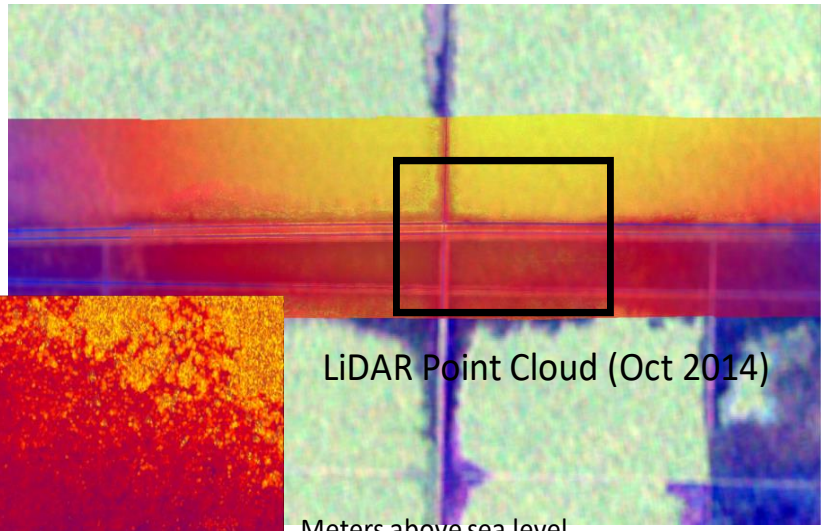
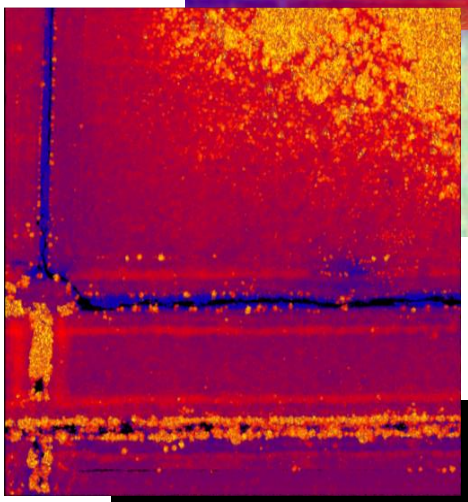
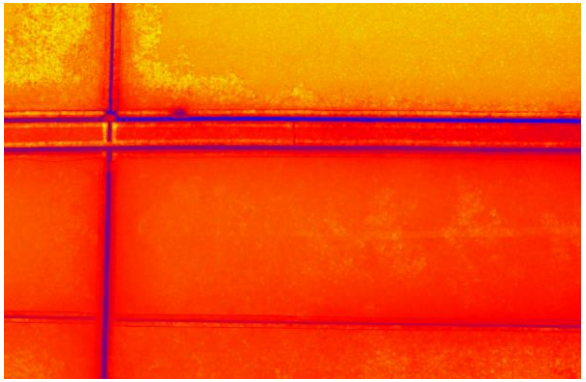
PALSAR2 & LiDAR DTM (Oct 2014)



LiDAR Point Cloud (Oct 2014)

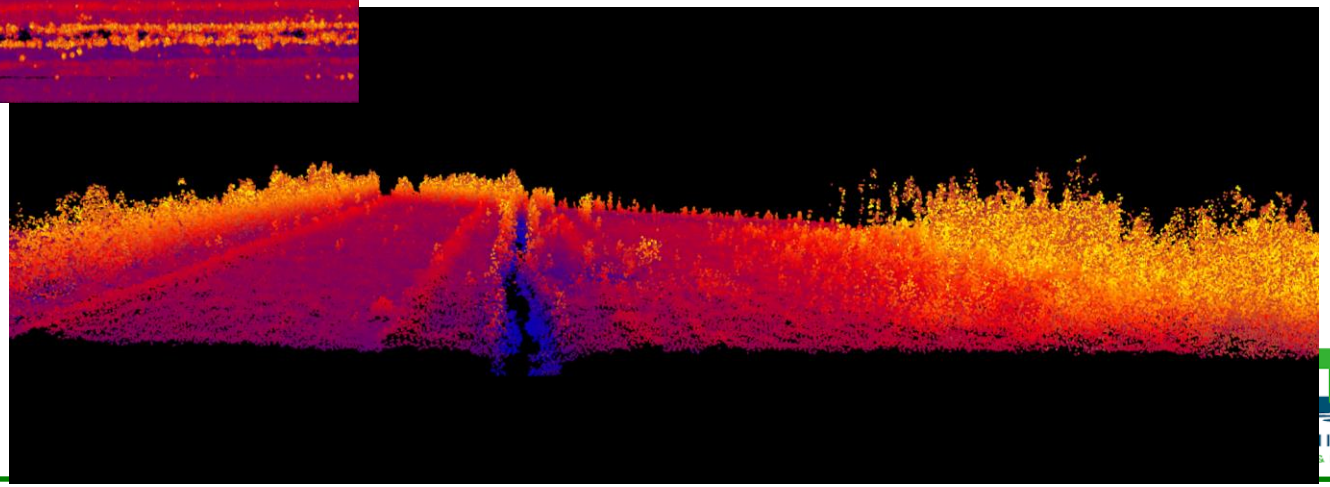
Meters above sea level
4
8
10



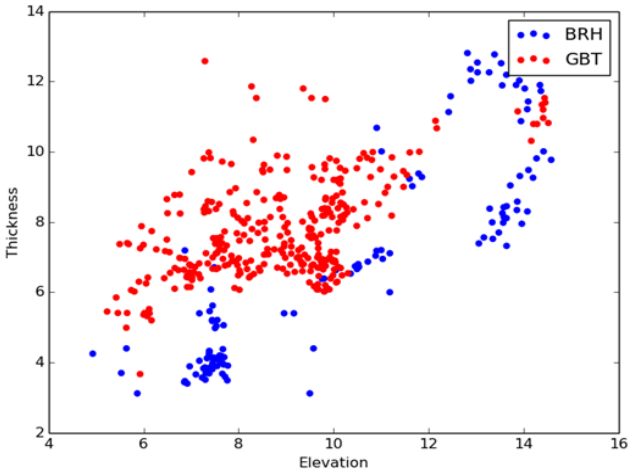


Meters above sea level
4
8
10

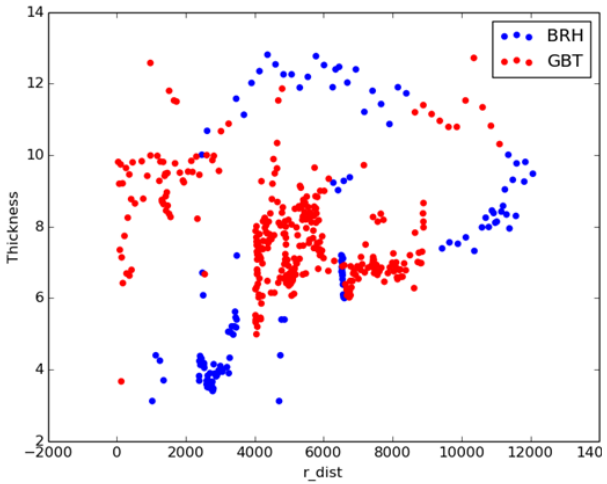
PALSAR2 & Lidar DTM Oct 2014



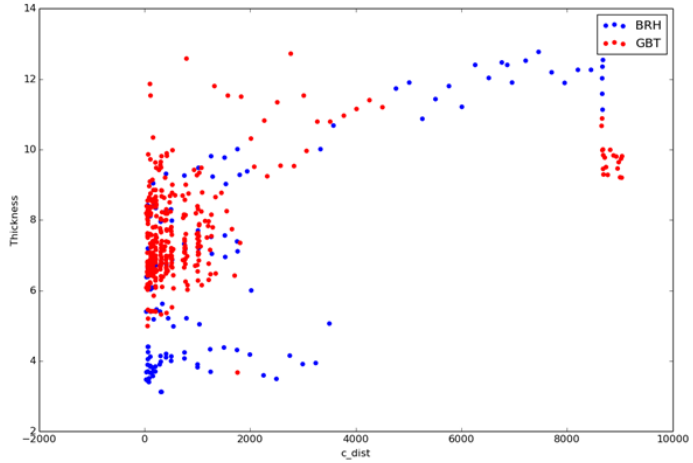
The relationship between peat thickness and several independent variables shown by landform type.



Thickness vs. 2011 LiDAR elevation (m)

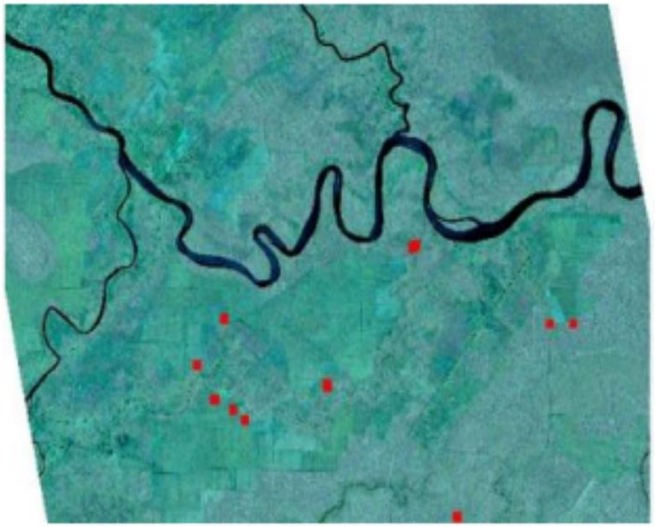


Thickness vs. Distance From nearest river (m)

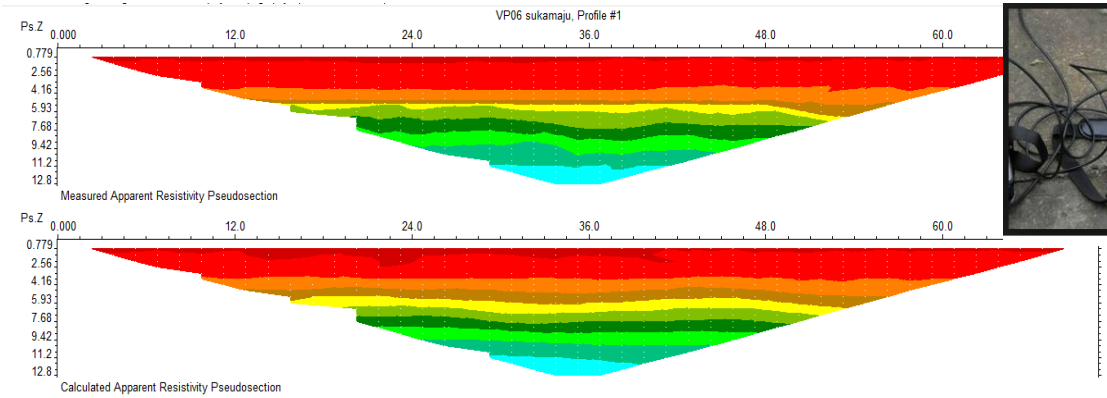


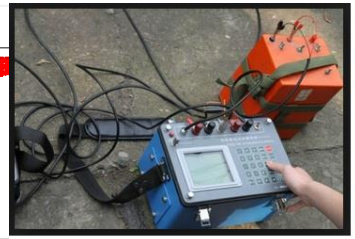
Thickness vs. Distance From nearest canal (m)

Data Collection



ERI
(Electrical Resistivity Imaging)





Depth of peat soil by ERI and GPR

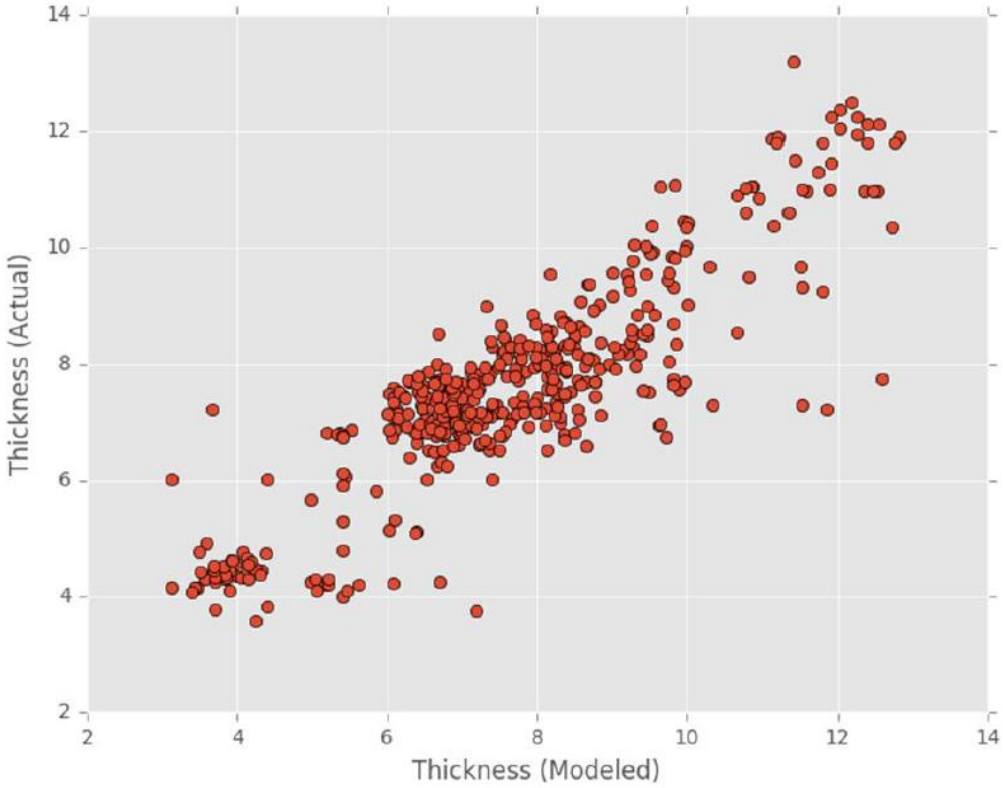
X	Y	DEPTH (cm)	NOTE
109.6162500	-0.5199444	185	Electrode No.25
109.6162778	-0.5201667	193	Electrode No.36
109.6161111	-0.5196944	160	Electrode No.12
109.6697222	-0.4198056	185	Electrode No.25
109.6829444	-0.4200556	193	Electrode No.36
109.6697222	-0.4195556	1 0	Electrode No.12
109.5916389	-0.3792500	110	Electrode No.24
109.5918333	-0.3790278	105	Electrode No.36
109.5913889	-0.3794167	105	Electrode No.12
109.5928056	-0.3782778	10	Check Point C1
109.5928056	-0.3785556	25	Check Point C2
109.5910833	-0.3801111	60	Check Point C3
109.5900556	-0.3806944	80	Check Point C4
109.5899722	-0.3806111	150	Check Point C5
109.4868333	-0.4644167	230	Electrode No.24
109.4868333	-0.4646944	250	Electrode No.37
109.4867778	-0.4641389	210	Electrode No.12
109.4756111	-0.4589444	160	Electrode No.23
109.4760833	-0.4592778	167	Electrode No.37
109.4760833	-0.4586667	150	Electrode No.12
109.4935556	-0.4698333	220	Electrode No.24
109.4935278	-0.4701111	250	Electrode No.36
109.4935278	-0.4695278	275	Electrode No.12
109.4817500	-0.4169722	130	Electrode No.24
109.4816667	-0.4171944	128	Electrode No.36
109.4815556	-0.4173889	28	Electrode No.48
109.4818333	-0.4167778	1 0	Electrode No.12
109.4819167	-0.4165556	1 0	Electrode No.1
109.4658889	-0.4412778	160	Electrode No.24
109.4657778	-0.4414722	170	Electrode No.36
109.4660000	-0.4410556	140	Electrode No.12
109.5412500	-0.4531667	145	Electrode No.48
109.5411667	-0.4529167	65	Electrode No.36
109.5410833	-0.4526389	60	Electrode No.24
109.5408889	-0.4522778	160	Electrode No.13
109.5404722	-0.4507222	164	Check Point
109.5912100	-0.3795800	150	GPR

Result of the predicted model

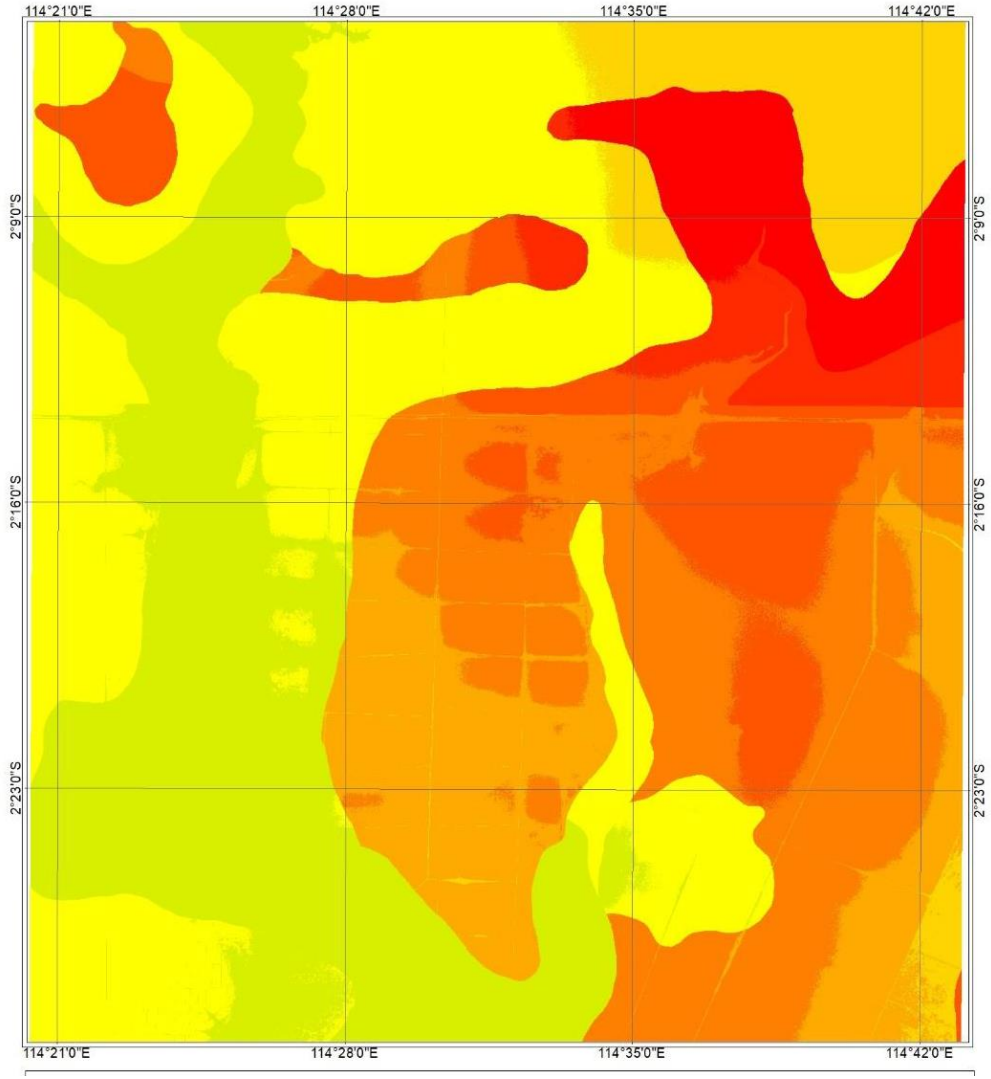
Using an Artificial Neural Network, a non-parametric modeling technique, the team created a bestfit model relating a series of independent variables to peat thickness in Mawas, Central Kalimantan

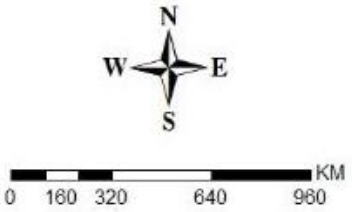
The independent variables applied include (a) distance to nearest river, (b) distance to nearest canal, (c) landform type, and (d) elevation.

The results of the evaluation of this model show a strong relationship: **R2=0.78**, RMSE=0.957 m, and RMS/mean=0.13.



PEAT THICKNESS, MAWAS, CENTRAL KALIMANTAN, INDONESIA





Legend

Thickness of peat (m)

0 - 1	> 6 - 7
> 1 - 2	> 7 - 8
> 2 - 3	> 8 - 9
> 3 - 4	> 9 - 10
> 4 - 5	> 10
> 5 - 6	

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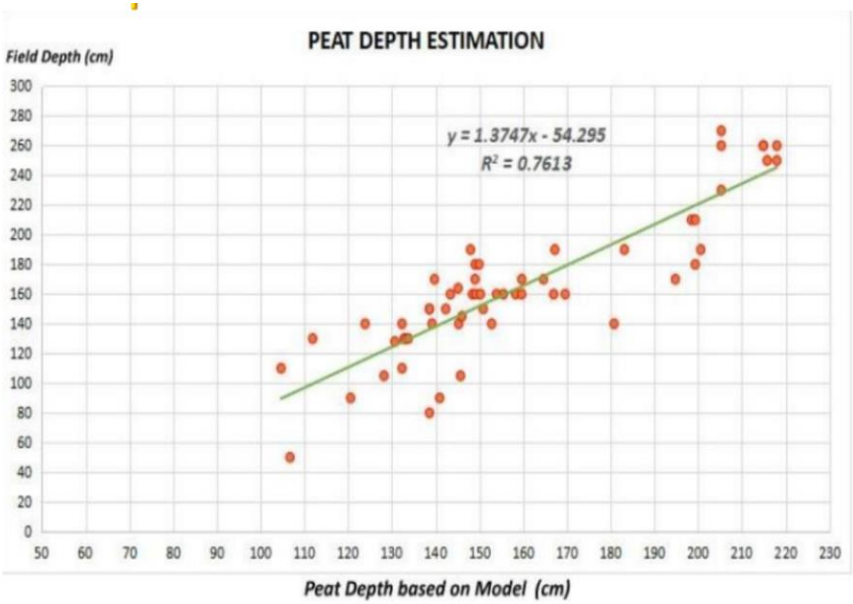
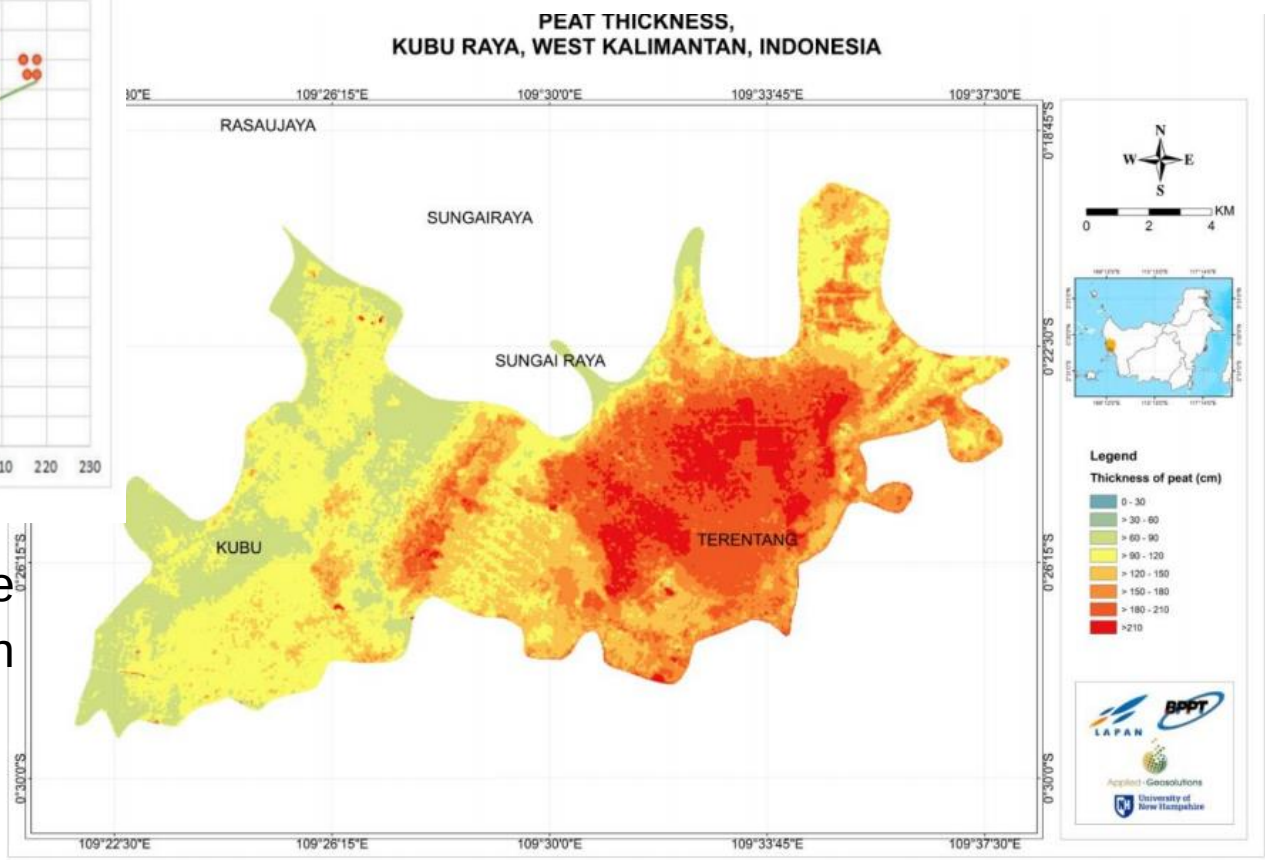
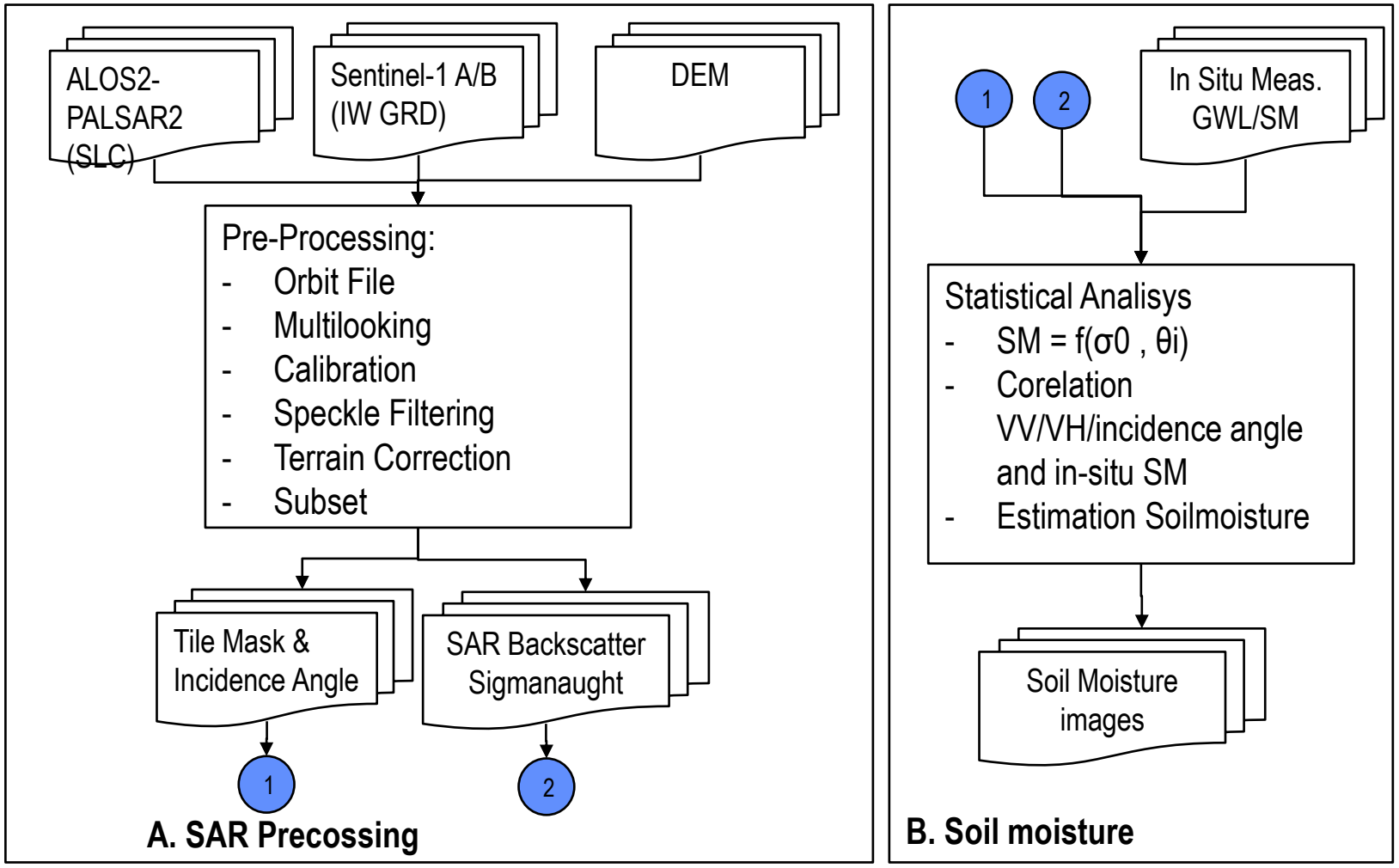
Implementation the model in the Kubu Raya, West Kalimantan



Accuracy : 31% of the variance in peat depth, with a root mean square error of 47 cm.

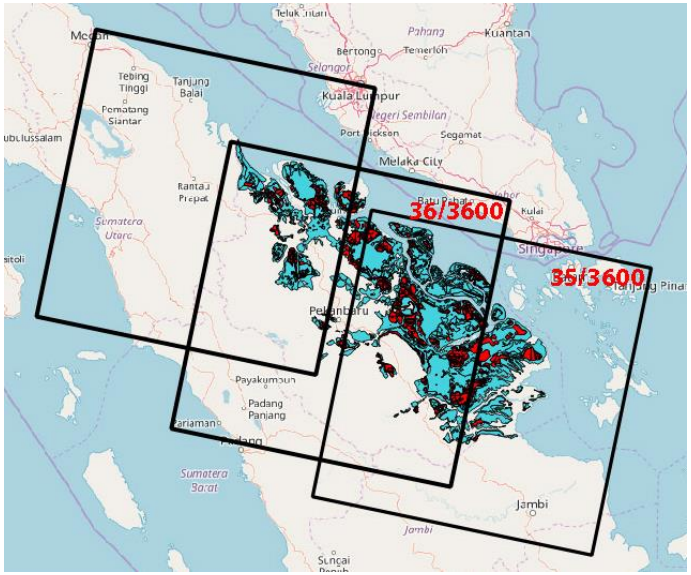


Workflow for mapping Soil moisture using SAR data.



PALSAR/PALSAR-2 data access

- requested and obtained the ALOS2 PALSAR2 ScanSAR (SLC)



Level 1.1 Full Aperture
36 / 3600 shift +1

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ALOS2064773600-150805	36	3600	15/08/05
ALOS2093753600-160217	36	3600	16/02/17
ALOS2099963600-160330	36	3600	16/03/30
ALOS2106173600-160511	36	3600	16/05/11
ALOS2112383600-160622	36	3600	16/06/22
ALOS2116523600-160720	36	3600	16/07/20
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ALOS2176553600-170830	36	3600	17/08/30
ALOS2182763600-171011	36	3600	17/10/11
ALOS2188973600-171122	36	3600	17/11/22
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ALOS2199323600-180131	36	3600	18/01/31
ALOS2201393600-180214	36	3600	18/02/14
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ALOS2207603600-180328	36	3600	18/03/28
ALOS2211743600-180425	36	3600	18/04/25
ALOS2213813600-180509	36	3600	18/05/09
ALOS2220023600-180620	36	3600	18/06/20
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ALOS2224163600-180718	36	3600	18/07/18
ALOS2228303600-180815	36	3600	18/08/15
ALOS2230373600-180829	36	3600	18/08/29
ALOS2234513600-180926	36	3600	18/09/26
ALOS2236583600-181010	36	3600	18/10/10

17

In archive SarVision	
In archive JAXA; to be ordered	
In archive JAXA; cannot be produced	

Level 1.1 Full Aperture
35 / 3600 shift +4

Scene ID	RelPath	Frame	Date
ALOS2012283600-140815	35	3600	14/08/15
ALOS2022633600-141024	35	3600	14/10/24
ALOS2035053600-150116	35	3600	15/01/16
ALOS2047473600-150410	35	3600	15/04/10
ALOS2064033600-150731	35	3600	15/07/31
ALOS2066103600-150814	35	3600	15/08/14
ALOS2076453600-151023	35	3600	15/10/23
ALOS2095083600-160226	35	3600	16/02/26
ALOS2101293600-160408	35	3600	16/04/08
ALOS2113713600-160701	35	3600	16/07/01
ALOS2117853600-160729	35	3600	16/07/29
ALOS2124063600-160909	35	3600	16/09/09
ALOS2130273600-161021	35	3600	16/10/21
ALOS2136483600-161202	35	3600	16/12/02
ALOS2142693600-170113	35	3600	17/01/13
ALOS2148903600-170224	35	3600	17/02/24
ALOS2155113600-170407	35	3600	17/04/07
ALOS2161323600-170519	35	3600	17/05/19
ALOS2167533600-170630	35	3600	17/06/30
ALOS2171673600-170728	35	3600	17/07/28
ALOS2177883600-170908	35	3600	17/09/08
ALOS2184093600-171020	35	3600	17/10/20
ALOS2190303600-171201	35	3600	17/12/01
ALOS2196513600-180112	35	3600	18/01/12
ALOS2200653600-180209	35	3600	18/02/09
ALOS2202723600-180223	35	3600	18/02/23
ALOS2206863600-180323	35	3600	18/03/23
ALOS2208933600-180406	35	3600	18/04/06
ALOS2215143600-180518	35	3600	18/05/18
ALOS2219283600-180615	35	3600	18/06/15
ALOS2221353600-180629	35	3600	18/06/29
ALOS2225493600-180727	35	3600	18/07/27
ALOS2229633600-180824	35	3600	18/08/24
ALOS2231703600-180907	35	3600	18/09/07
ALOS2235843600-181005	35	3600	18/10/05

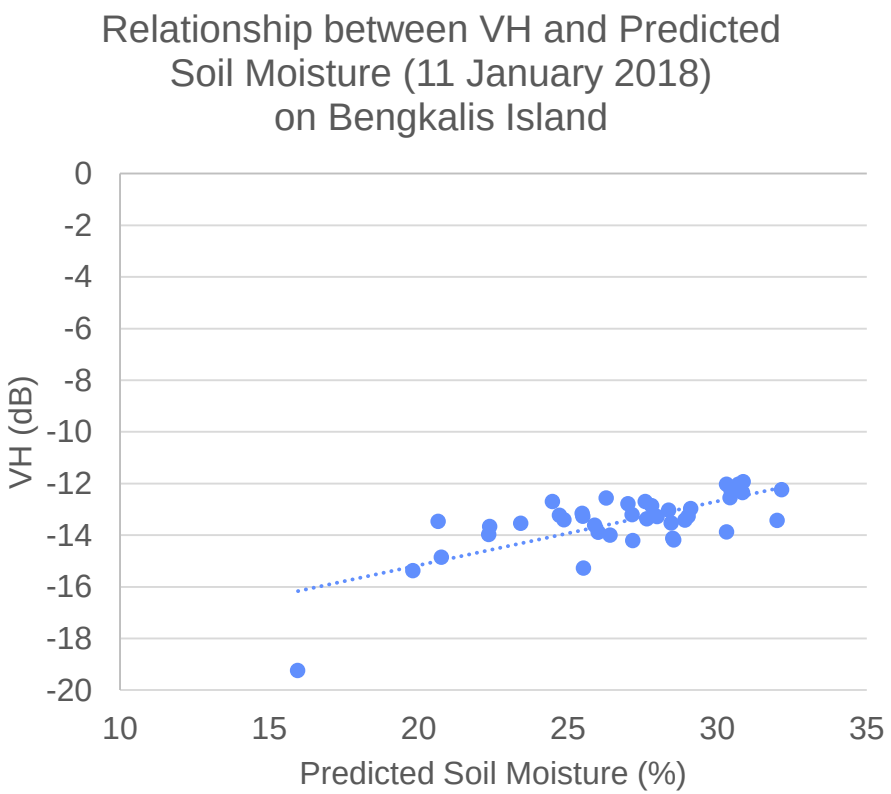
19

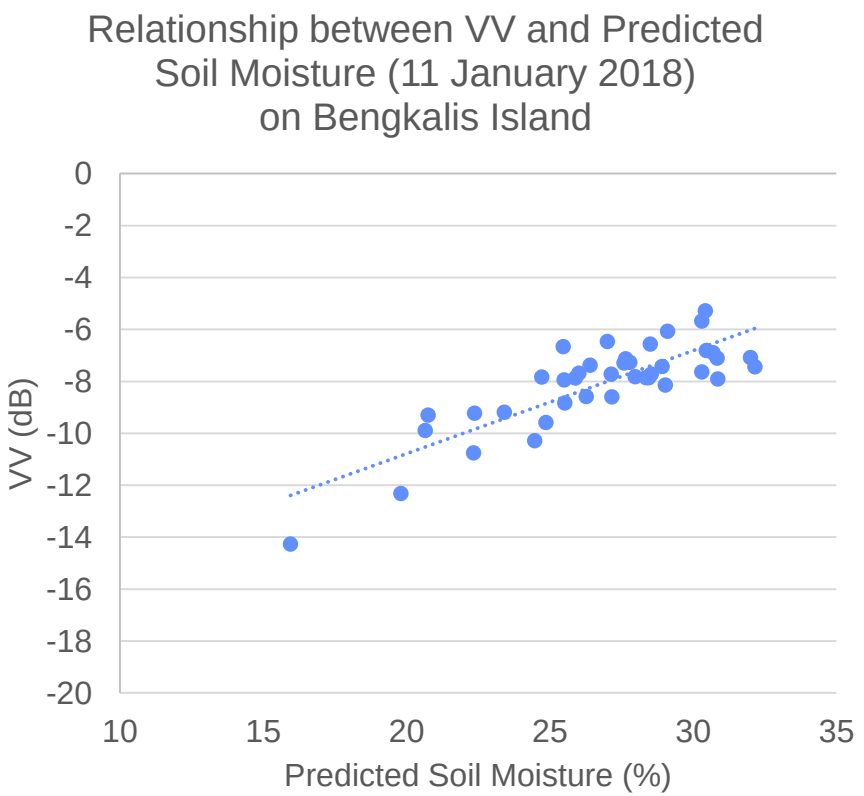
	33
	36
	1

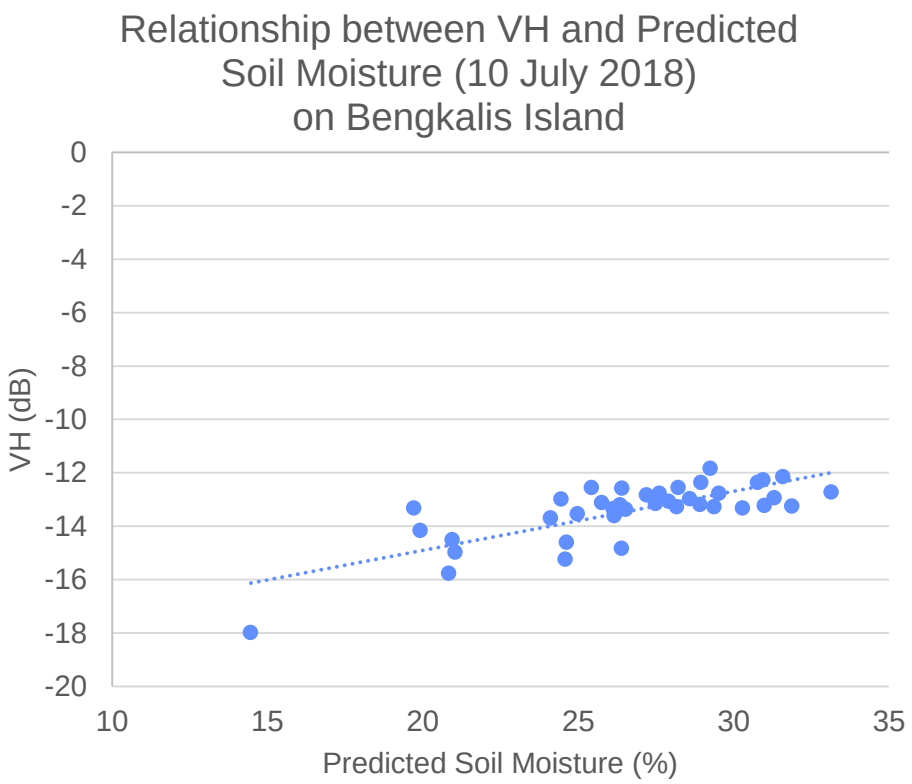
S1A RGB Composite : R: VH, G: VV, B:VH-VV

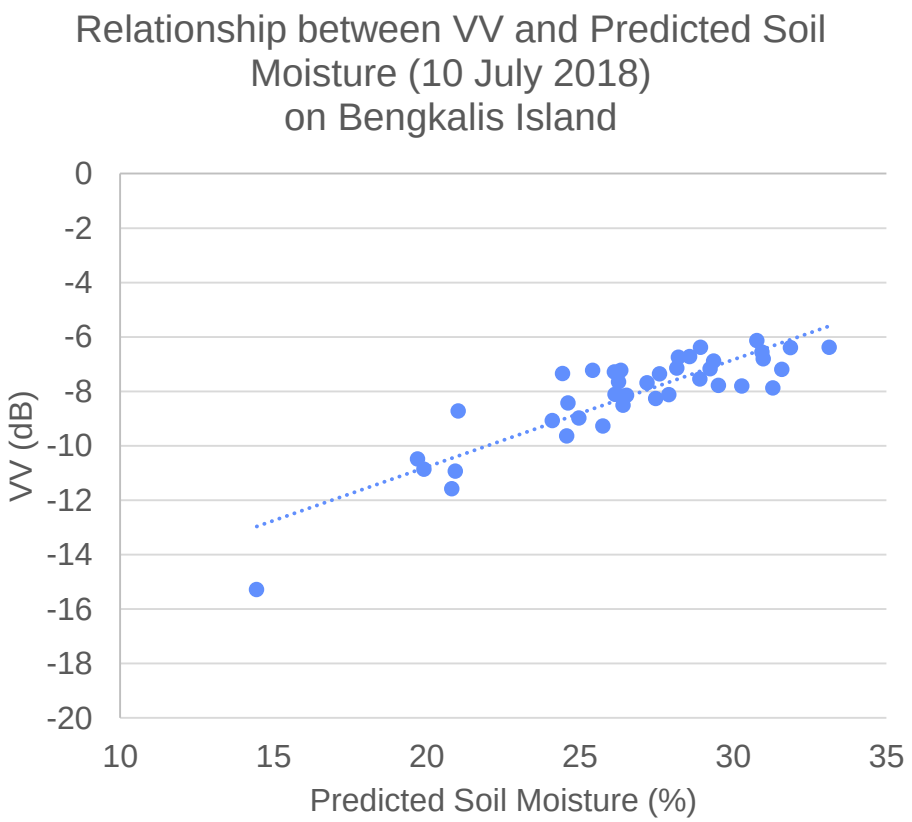
2018-01-11

Predicted soil moisture from


Relationship between VH and Predicted Soil Moisture (11 January 2018) on Bengkalis Island
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
VH (dB)
10
15
20
25
30
35
Predicted Soil Moisture (%)


Relationship between VV and Predicted Soil Moisture (11 January 2018) on Bengkalis Island
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
VV (dB)
10
15
20
25
30
35
Predicted Soil Moisture (%)





40 random samples

Disemination

- **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

Future Work : Post-KC proposal (2)

- 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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