Improvement of deforestation detection algorithm using in JJ-FAST

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3. Summary

What is JJ-FAST?

- **"First SAR-based global"** early warning system for tropical forest
- "**Rainy season**" operation, not only dry season (PALSAR-2/ScanSAR)
- "77 countries" cover
- "Every ~1.5 month" monitoring
- "Free access" from PC or mobile phone

JJ-FAST history

	JFY 2016		JFY 2017		JFY 2018	
	11	12-3	4-6	7-3	4-	
Target	South America	South America Africa		South & middle America Africa, SE-Asia (77 countries)		
Deforestation Detection algorithm	**V0** (Semi-automatic)			**V1** (Automatic)	**V2** (Automatic)	
Num. of data used	**2**				**10**	**15**
Polarization	HV				HV, HH HH/HV	
Minimum detection size	5ha				**3ha**	

Project finish March, 2021?

Effectiveness of "L-band HH" polarization

Place : Brazilian Amazon (Sinop～Juina)

Date : Feb. 19 – March 2, 2018

Rainy season in Brazil, **6 – 16 days** after PALSAR-2 ScanSAR observation)

PALSAR-2 observation

Jan. 19, Feb. 2, 16 2018 for Path 126., Jan. 15, 28 Feb. 22 2018 for Path 125

Num. of site visited

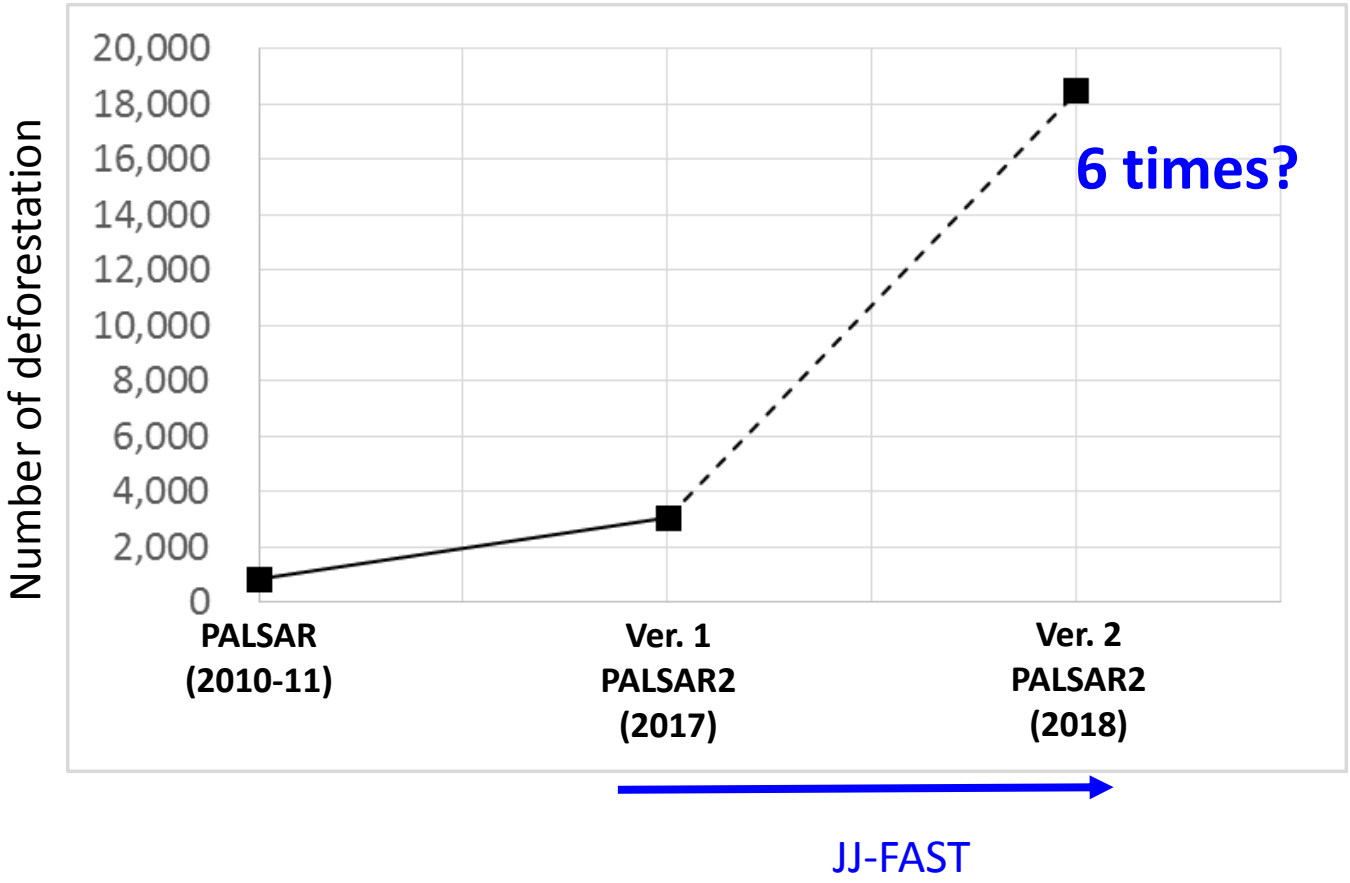
12 site (**7 of 12** were sites detected by **HH pol**.)

Effectiveness of "L-band HH" polarization

After the field experiment in 12 sites in the rainy season,

- ✓ **2,600 ha** assigned as illegal deforestation.
- ✓ Four farms were fined.
- ✓ The fines total R $13.7 million (**US$ 3,500,000!**)

Number of deforestation detection in Brazil



Number of deforestation detection are increasing

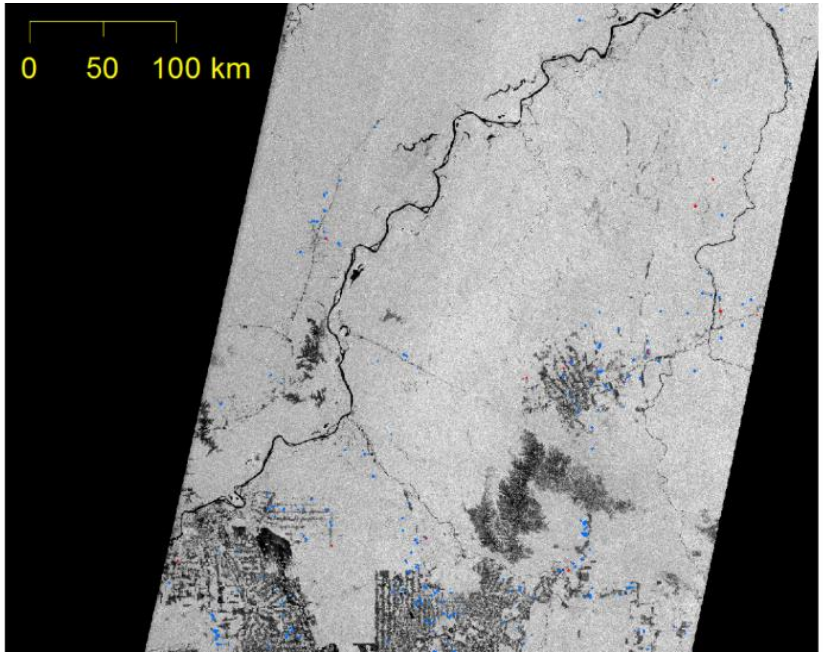
Two major problems

(Current deforestation detection algorithm in JJ-FAST)

1. Many un-detected deforestation sites left
2. Minimum detection size of 3ha is not enough

Site : Brazil/Porto Velho
Target term : Sept. 20-Nov. 10, 2018
Num. of data used : 11
Validation data : GLAD

Detected polygons	Correct polygons	Validation polygons	User's acc.	Prod.'s acc.
332	265	705	79.8	37.6



GLAD: Global land analysis & discovery https://glad.umd.edu/

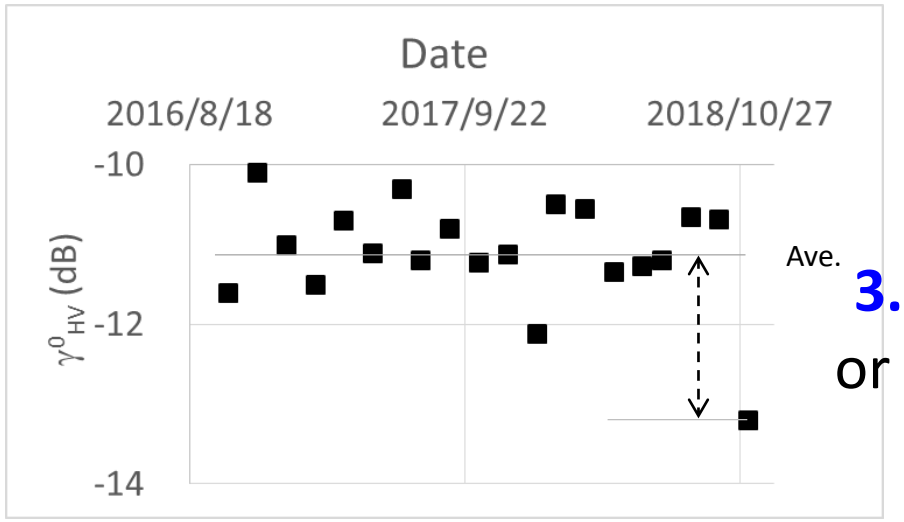
2 Improvement 1

Number of data used : 15 -> 20

Smaller threshold level.

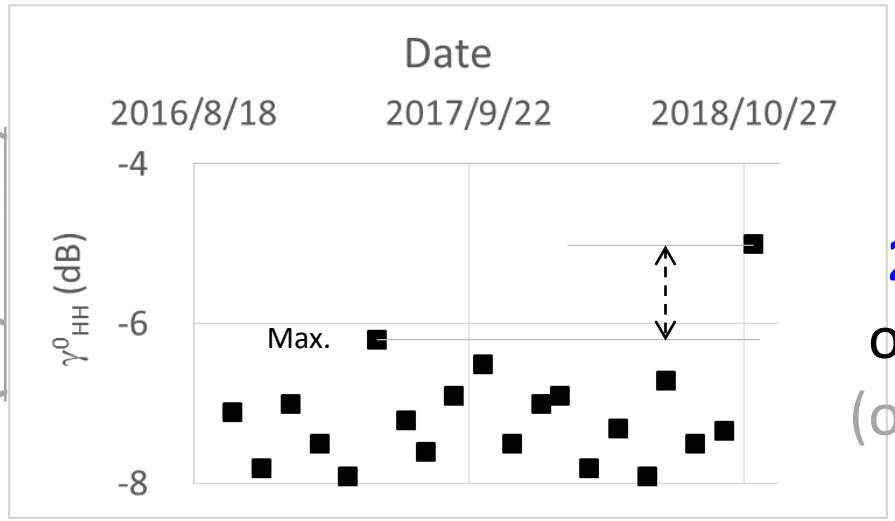
15 ➡ 20 data

HV pol.



3.0 dB? or 2.0 σ? ➡ **2.5 dB?** or 2.0 σ?

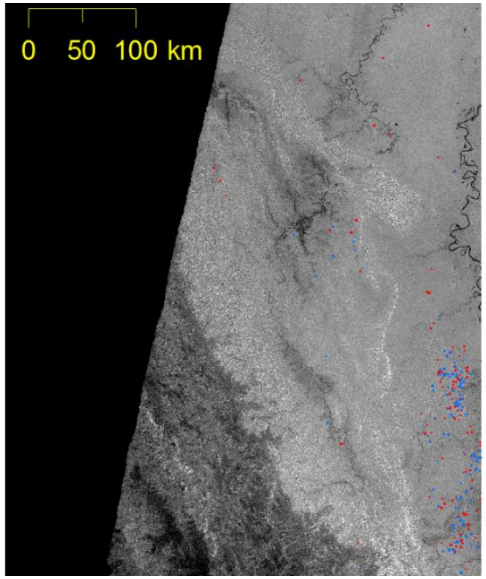
HH pol. (HH/HV ratio)



2.0 dB? or 2.0 σ? (or 3.0 σ?) ➡ **1.0 dB?** or 2.0 σ? (or 2.5 σ?)

Accuracy estimation

Place : Pucallpa/Peru
Target term : Sept. 27-Nov. 8, 2018
Num. of data used : 15, 20
Validation data : GLAD & visual inspection



Current

Suggested

	Pol.	Threshold values		15data			20data		
		dB	σ	Detected polygons	Correct polygons	user's acc.	Detected polygons	Correct polygons	user's acc.
Current algorithm	**All**			**129**	**110**	**85**	110	99	90
	HV_mean	3	2	0	**0**	nan	0	0	nan
	HH	2	2	120	103	86	103	92	89
	HH/HV	2	3	15	12	80	13	12	92
Suggested algorithm	**All**			273	209	77	**232**	**197**	**85**
	All (Visual inspection)						232	211	**91**
	HV_mean	2.5	2	0	0	nan	0	**0**	nan
	HH	1	2	254	194	76	211	181	86
	HH/HV	1	2.5	35	25	71	35	26	74

User's accuracies: 85%→85%, Correct polygons 1.8 times

2. Improvement 1

Number of data used : 15 -> 20
Smaller threshold level.

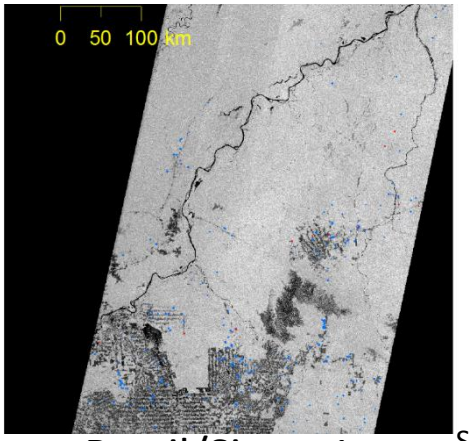
User's accuracies : Almost same
Correct polygons : 1.3～2 times

Sites	Num. of data used	User's accuracies	Correct polygons
Peru /West Pucallpa	15 → 20	85 → 85(91)	110 → 197 (1.8)
Brazil/ Porto Velho	11 → 11	80 → 71(77)	265 → 536 (2.0)
Brazil/ Sinop 1	15 → 20	65 → 61(95)	68 → 88 (1.3)
Brazil/ Sinop 2	15 → 20	59 → 55(86)	103 → 147 (1.4)
Brazil/ Sinop 3	15 → 20	54 → 59(70)	91 → 144 (1.6)
Cambodia	15 → 20	37 → 45(73)	33 → 42 (1.3)
Africa/Mozambique	15 → 15	21 → 17(100)	11 → 14 (1.3)

() Estimated by visual inspection

() Increase rate

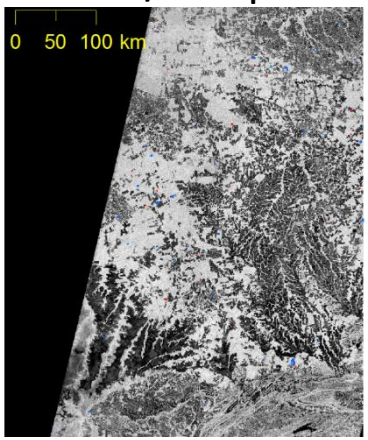
Brazil/Porto Velho



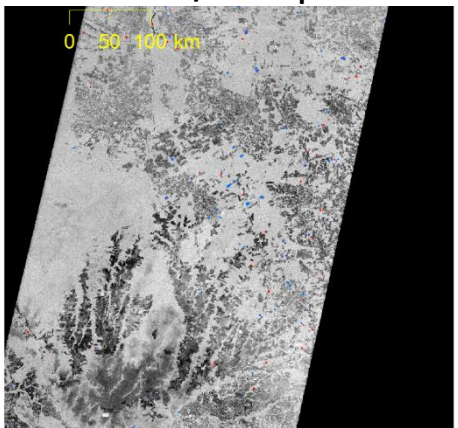
Current

Suggested

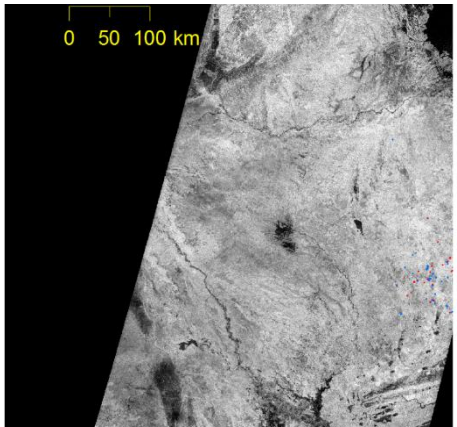
Brazil/Sinop 1



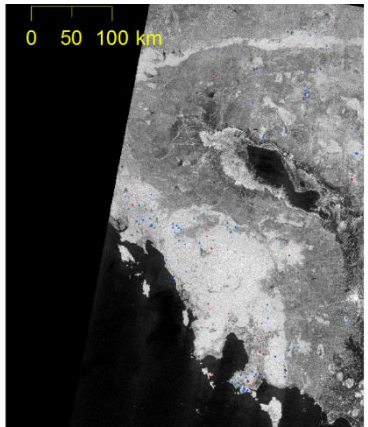
Brazil/Sinop 2



Mozambique

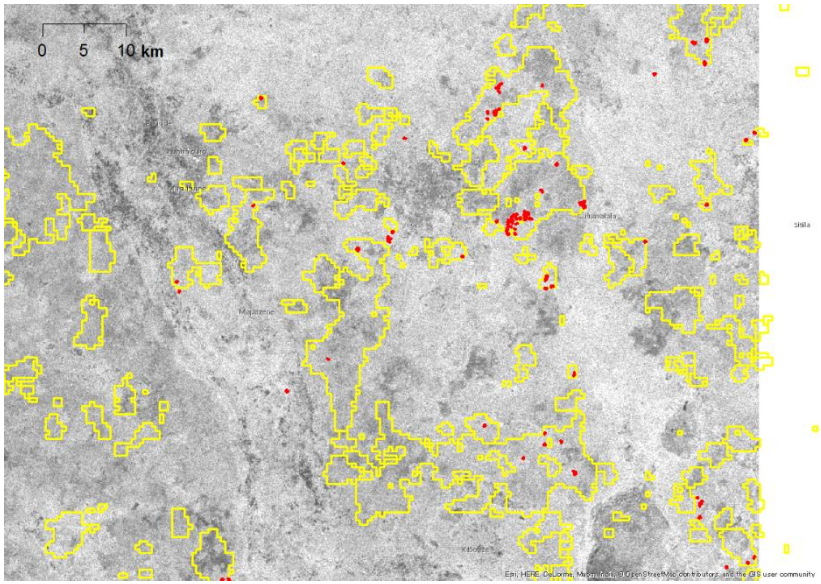


Cambodia



Forest fire detection in dry forest with JJ-FAST

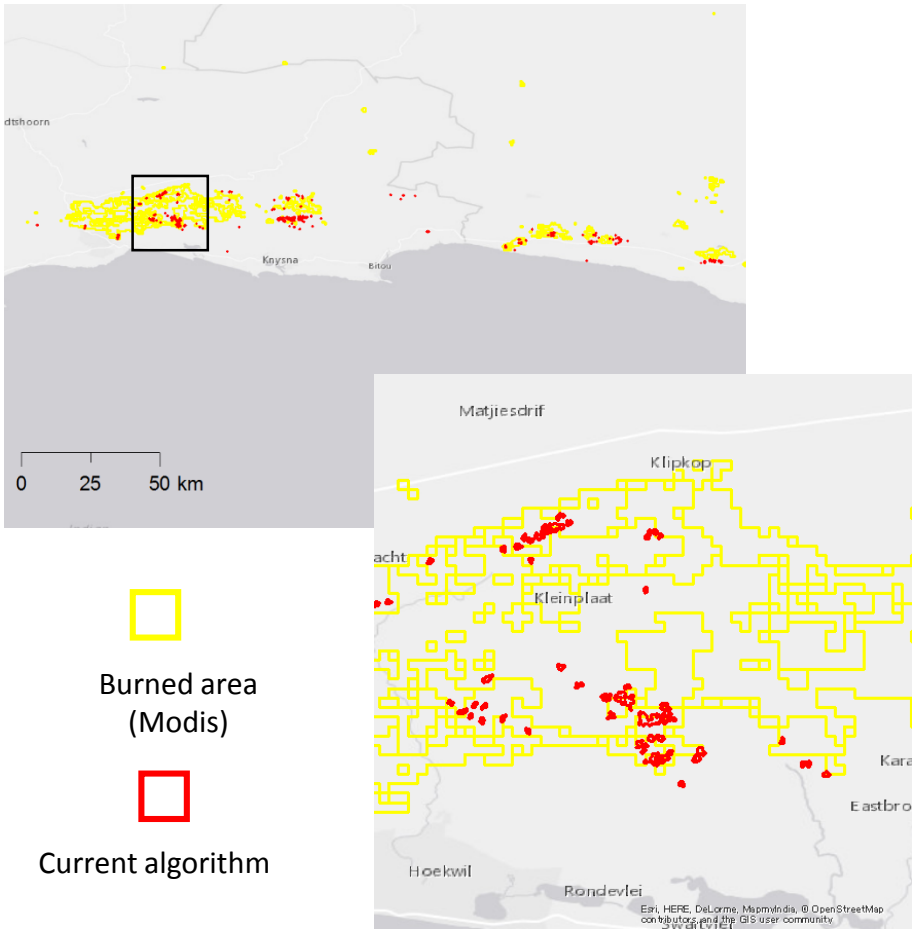
Place : Mozambique
Target term : Aug. 13-Nov. 5, 2018



Burned area (Modis)

Suggested algorithm

Place : South Africa
Target term : Nov. 11-Dec. 23, 2018



Burned area (Modis)

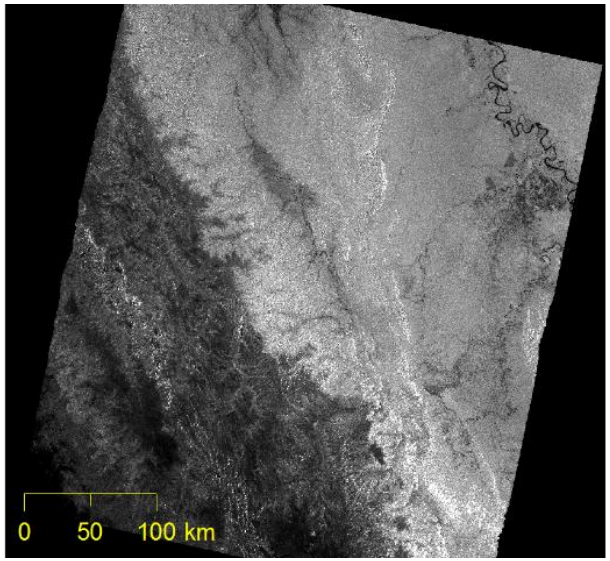
Current algorithm

Severely burned areas can be detected by JJ-FAST algorithm

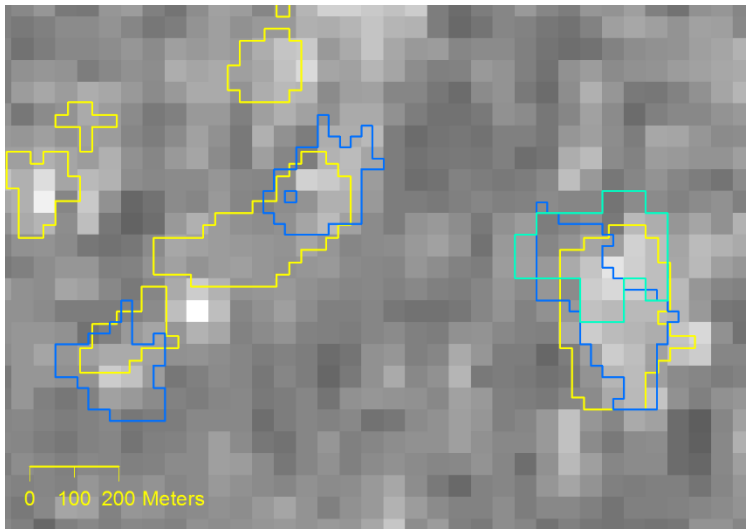
2. Improvement 2

Image resolution : 50m –> 25m

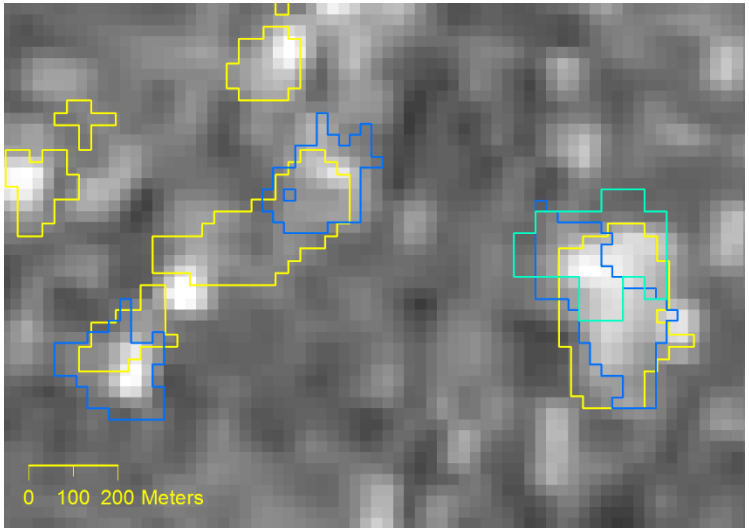
Target term : Sept. 27, 2018~Nov. 8
Place : Peru (West Pucallpa)
Num. of data used : **26**
Validation data : GLAD
Processing : Specan (25m, 50m),
Full aperture (25m)
(Current: Specan 50m)



Specan 50m



Specan 25m



Specan(50m) Specan(25m) GLAD

Accuracy estimation

Minimum detection size					3 ha			1 ha		
Algorithm	Num. of Data used	Processing	Spatial resolution	Polari.	Num. of polygons		user's acc.	Num. of polygons		user's acc.
					detected	Correct		detected	Correct	
Current	15data	Specan	50m	All	196	**161**	**82**	354	247	70
				HV	2	1	50	7	3	43
				HH	173	146	84	286	210	73
				HH/HV	39	30	77	102	70	69
Suggested	26data	Specan	25m	All	445	**375**	**84**	707	**563**	**80**
				HV	2	1	50	7	6	86
				HH	419	358	85	648	527	81
				HH/HV	70	59	84	156	121	78

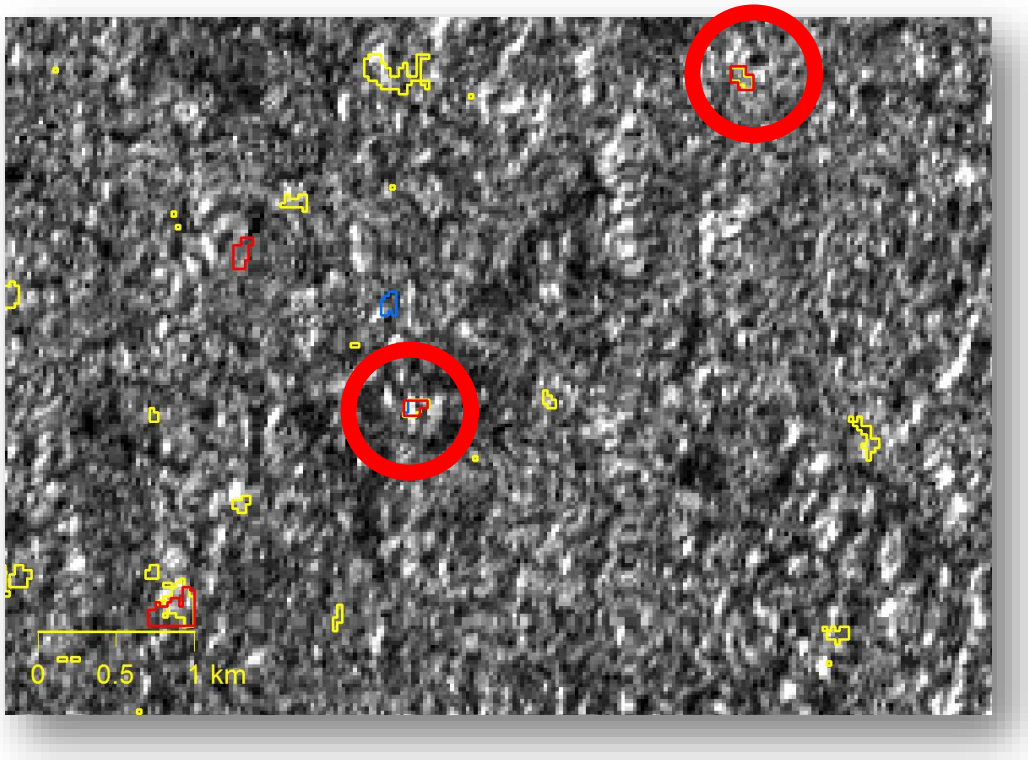
Current algorithm

Specan(25m)＋26 data

Correct polygons : **More than 2** times for 3ha
More than 3 times for 1ha

User's accuracies : almost same(1ha, 3ha)

Example for ~1ha detection



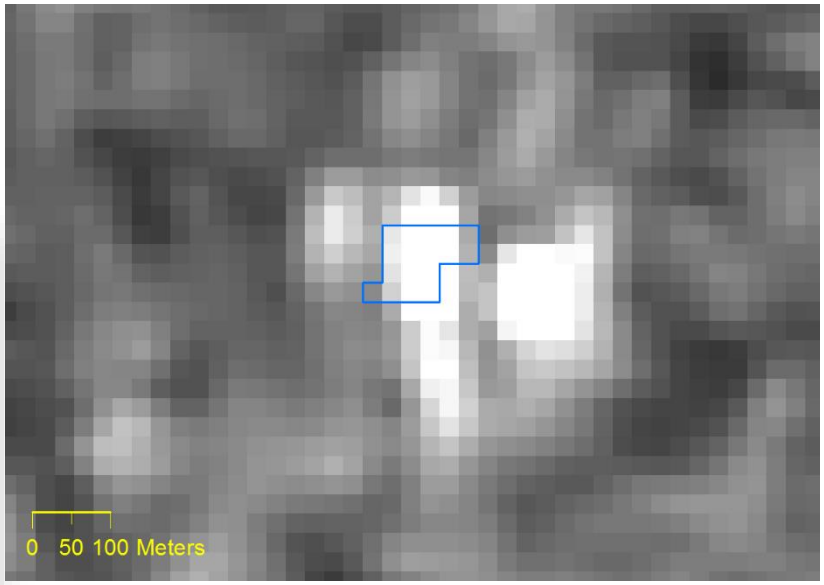
Specan(50m)

Specan(25m)

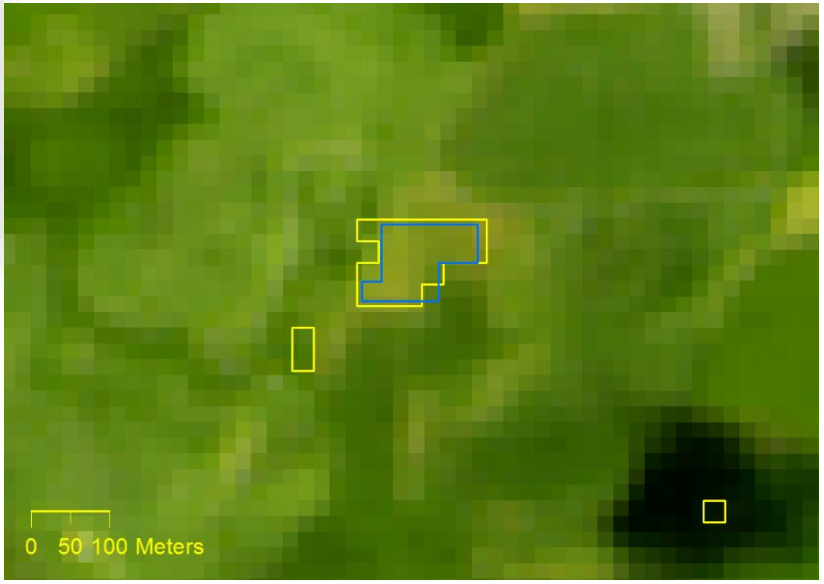
Full Aperture(25m)

GLAD

Nov. 8, 2018



Nov. 12, 2018



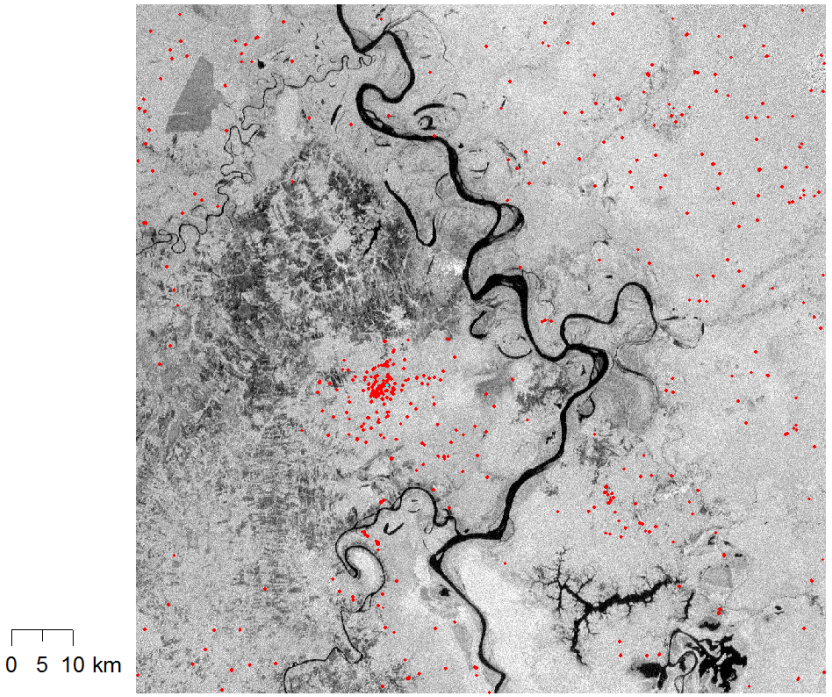
Specan(25m)

GLAD

2 Improvement 3

Process unit : A segmented polygon –> A pixel

Place : Pucallpa/Peru
Target term : Oct. 21-Dec. 2, 2017
Num. of data used : 6



Algorithm	Process unit	Num. of polygons		user's acc. (%)
		Detected	correct	
JJ-FAST	Polygon	51	21	41.2
	Pixel	447	83	18.6
Dr. Nagatani		252	68	27.0

Minimum detection Size 1 ha

Under developing

3. Summary

1. JJ-FAST current status
   - ✓ Effectiveness of "L-band HH" polarization
   - ✓ Deforestation detection number are increasing from PALSAR.
   - ✓ **Two major problems**
     1. Many un-detected deforestation sites left
     2. Minimum detection size of 3ha is not enough
2. Improvement of deforestation detection algorithm
   a. Number of data used : 15 -> 20, Smaller threshold level.
      Correct polygons : **1.3～2 times**
      User's accuracies : Almost same
   b. Image resolution : 50m -> 25m
      Correct polygons : More than 2 times for 3ha
      More than 3 times for 1ha
      User's accuracies : Almost same(1ha, 3ha)
   c. Process unit : A segmented polygon -> A pixel
      Under developing

ACKNOWLEDGMENT

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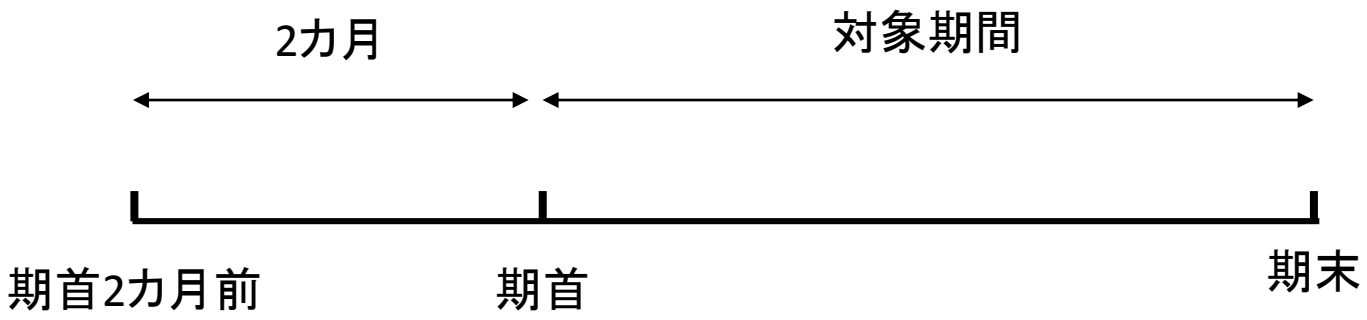
以下の2ケースも正解とする

ケース1）検証データで、期首の2か月前までに伐採があった場合



ケース2）検出された場所が、検証データで、3ha以下で検出されたポリゴンとオーバーラップした場合