

# **Validation of 25m-resolution Global PALSAR-2/PALSAR Forest/Non-forest Map**

**Takuya ITOH<sup>1</sup>, Masanobu Shimada<sup>2</sup>, Takeo Tadono<sup>2</sup>,  
Takeshi Motooka<sup>2</sup>, Masato Hayashi<sup>2</sup>,  
Risako Dan<sup>1</sup>, Osamu Isoguchi<sup>1</sup>, Tsutomu Yamanokuchi<sup>1</sup>**

<sup>1</sup> ALOS Data Analysis and Research Project Group, Remote Sensing Technology Center of Japan, Tsukuba, Japan

<sup>2</sup> Earth Observation Research Center, Japan Aerospace Exploration Agency, Tsukuba, Japan

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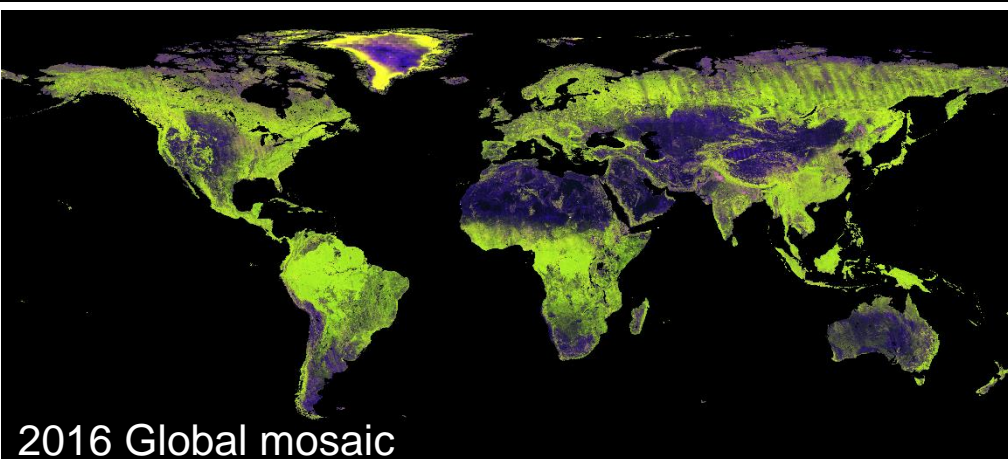
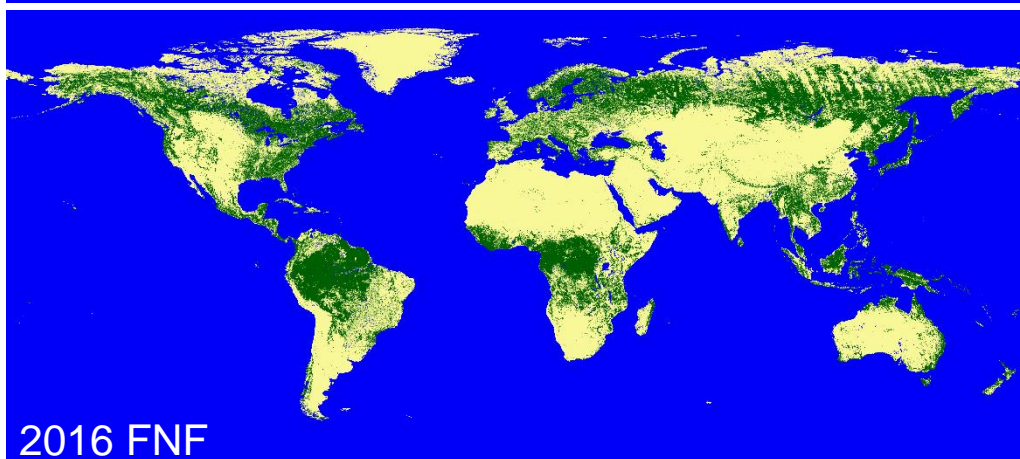
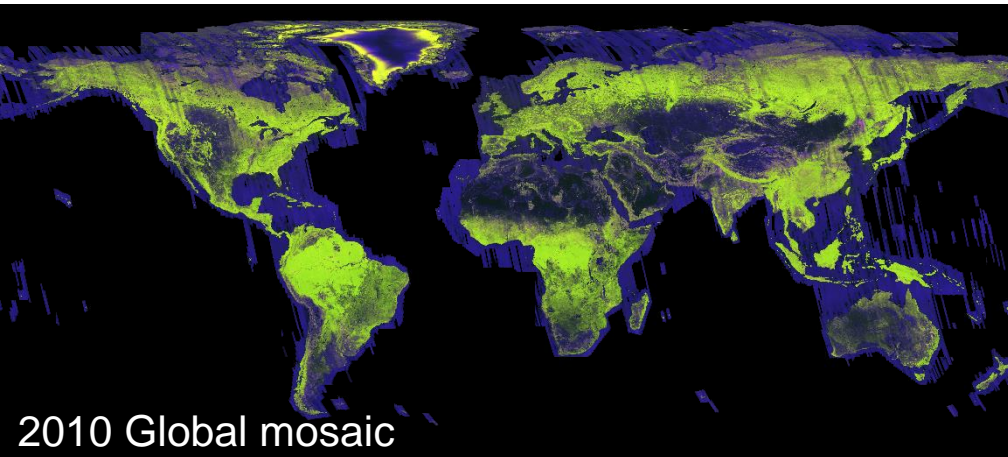
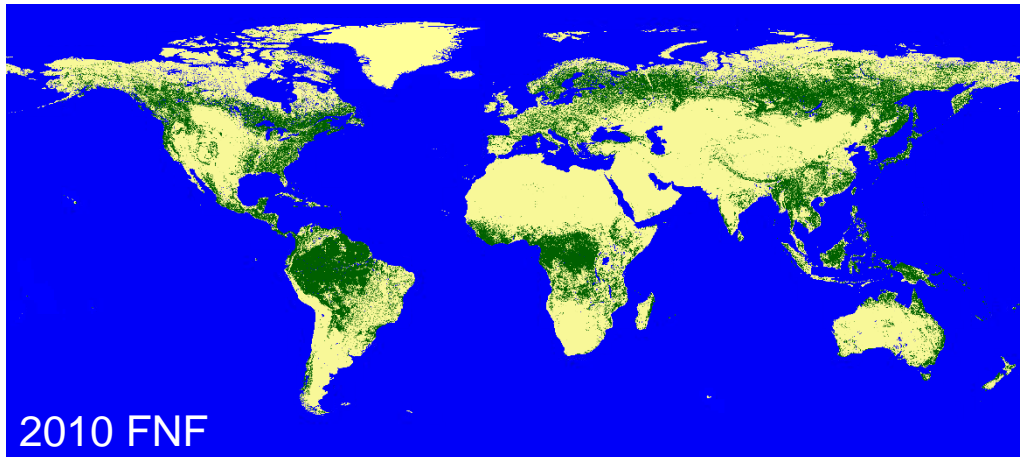
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## **1. Introduction**

## Global 25m-resolution mosaics and Forest/Non-Forest maps

JAXA created the global 25m-resolution mosaic images and the Forest/Non-Forest (FNF) maps. FNF dataset by PALSAR and PALSAR-2 covers from 2007 to 2010, and from 2015 to 2016, respectively.

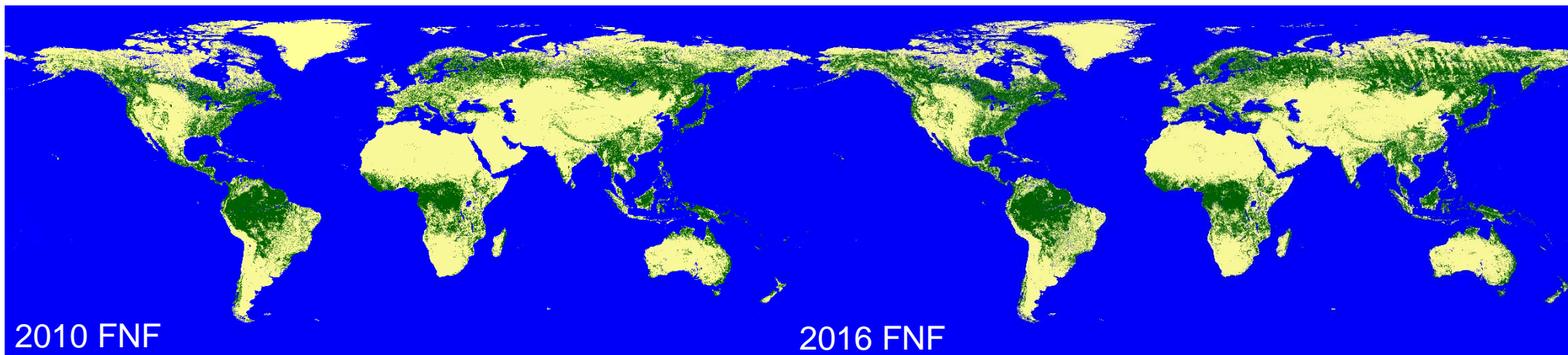




## Global 25m-resolution mosaics and Forest/Non-Forest maps

- Necessary to keep high accuracy of Forest/Non-Forest maps.
- Necessary to establish consistency between PALSAR-2 and PALSAR of FNF maps.

Therefore, validation for FNF is important and it is necessary to update classification method continuously for users.



## **2. Mosaic dataset and Forest/Non-Forest maps**

## PALSAR-2/PALSAR Mosaic Creation

### Processor(SAR imaging and mosaicking):

Sigma-SAR (developed by JAXA)

- 25m-resolution
- Orthorectified and slope-corrected
- DEM: SRTM (SRTM-3 for PALSAR, SRTM-1 for PALSAR-2 under 60 degrees latitude. ASTER GDEM was used higher than 60 degrees latitude.)

### Year of dataset:

PALSAR mosaic: 2007, 2008, 2009, 2010

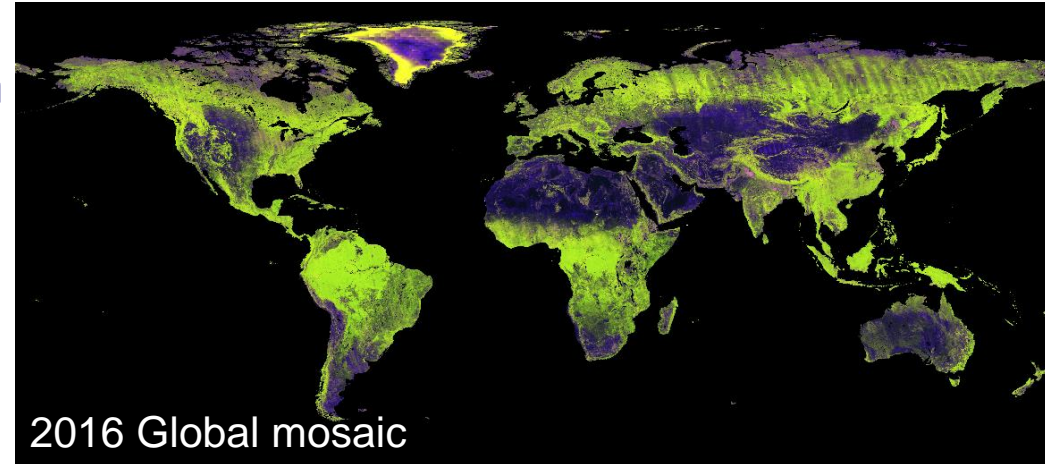
PALSAR-2 mosaic: 2015, 2016, (2017/under construction)

Processing is the same between PALSAR mosaics and PALSAR-2 mosaics

## PALSAR-2/PALSAR Mosaic Creation

### Observation date:

Basically summer season on northern hemisphere. But if there is no summer season data, which are filled using another data that observed in winter season or another year alternatively.



### Issue of data that observed not in summer season:

Intensity of backscatter between summer season and winter season especially in northern forest is different due to snow, frozen surface of tree, or frozen ground. If one mosaic contains various seasons, image classification is more difficult than mosaic that was created using only one season. Therefore, we used path image data of the same season as much as possible.



## Forest/Non-Forest Classification

### Processor for Forest/Non-Forest Classification:

eCognition(Trimble Inc.) for object-based segmentation to reduce effect of speckle noise.

### Classification using features for each segments:

Classify using threshold value of mean value of HV polarized image

### How to decide threshold is:

- i. collecting region of interest(ROI) for both forest and non-forest area
- ii. calculate features for each ROI
- iii. draw histogram of forest and non-forest area
- iv. middle of the histogram is set as a threshold.

Classification method is the same between PALSAR FNF and PALSAR-2 FNF but value of threshold is different between PALSAR and PALSAR-2.

### **3. Validation results of Forest/Non-Forest maps**

## Validation using Google Earth Images

Forest/Non-Forest maps were validated using Google Earth Images. About 4,000 points for validation was collected. These points referred to Google Earth Image.

**Tab. Accuracy of Forest/Non-Forest Classification that validated using Google Earth Images:**

2015			Google Earth			
			Forest	Non-Forest	Total	User's Accuracy [%]
			[Number of points]			
PALSAR-2	Forest	[Number of points]	1263	184	1447	87.28
	Non-Forest		305	2394	2699	88.70
	Total		1568	2578	4146	-
Producer's Accuracy [%]			80.55	92.86	-	<b>88.21</b>

2016			Google Earth			
			Forest	Non-Forest	Total	User's Accuracy
			[Number of points]			[%]
PALSAR-2	Forest	[Number	1251	190	1441	86.81
	Non-Forest	of	317	2388	2705	88.28
	Total	points]	1568	2578	4146	-
Producer's Accuracy [%]			79.78	92.63	-	<b>87.77</b>

About 4,000 points for validation was collected. These points referred to Google Earth Image.

Total result of PALSAR-2 FNF that is 2015:88.21%, 2016:87.77%.

Accuracy of PALSAR FNF 2010 is also about 85%, therefore this result suggested that the accuracy is consistent from PALSAR to PALSAR-2 and are good enough at least validation using Google Earth images.

## Comparison between forest area of PALSAR/PALSAR-2 FNF map and that of FRA by FAO

Definition of forest in PALSAR/PALSAR-2 FNF maps conforms to FRA(Global Forest Resources Assessments) by FAO(Food and Agriculture Organization).

The result is comparison of forest area in PALSAR/PALSAR-2 FNF map and FRA.

**Tab. Comparison of Forest Area between PALSAR/PALSAR-2 and FRA by FAO**  
**(1) Global (the total forest area of whole earth)**

	<b>2010</b>			<b>2015</b>			<b>2016</b>		
	PALSAR(2010) [1000ha]	FRA(2010) [1000ha]	Relative Error (±) [%]	PALSAR-2(2015) [1000ha]	FRA(2015) [1000ha]	Relative Error (±) [%]	PALSAR-2(2016) [1000ha]	FRA(2015) [1000ha]	Relative Error (±) [%]
<b>Total</b>	<b>3,852,630</b>	4,015,673	<b>-4.06%</b>	<b>4,288,465</b>	3,999,134	<b>7.23%</b>	<b>4,230,023</b>	3,999,134	<b>5.77%</b>

This Tab. shows the total forest area of whole earth. The relative error between PALSAR-2 FNF and FRA in 2015 is 7.23% and in 2016 is 5.77%. It is overestimated a little. On the other hand, the relative error between PALSAR FNF and FRA in 2010 is -4.06%. It is underestimated a little. It is different trend between PALSAR FNF and PALSAR-2 despite using the same method of threshold.



## Comparison between forest area of PALSAR/PALSAR-2 FNF map and that of FRA by FAO

**Tab. Comparison of Forest Area between PALSAR/PALSAR-2 and FRA by FAO  
(2) Region of Tropical Rain Forest (Top 3 biggest forest area)**

	<b>2010</b>			<b>2015</b>			<b>2016</b>		
	PALSAR(2010) [1000ha]	FRA(2010) [1000ha]	Relative Error (±) [%]	PALSAR-2(2015) [1000ha]	FRA(2015) [1000ha]	Relative Error (±) [%]	PALSAR-2(2016) [1000ha]	FRA(2015) [1000ha]	Relative Error (±) [%]
Indonesia	103,811	94,432	9.93%	111,155	91,010	22.13%	116,439	91,010	27.94%
SouthAmerica	811,082	843,995	-3.90%	746,399	833,881	-10.49%	777,676	833,881	-6.74%
Africa	653,447	638,187	2.39%	771,206	624,009	23.59%	730,795	624,009	17.11%

The relative error of PALSAR-2 (2015/2016) is bigger than that of PALSAR (2010). The forest area of Indonesia and Africa are increased but that of Amazon is decreased. The thresholds are calculated for each region but this result suggested that backscatter is changed between different observation years and also determination of thresholds are required more tuning for each region.

## Comparison between forest area of PALSAR/PALSAR-2 FNF map and that of FRA by FAO

Tab. Comparison of Forest Area between PALSAR/PALSAR-2 and FRA by FAO  
(3) Countries with large forest area

	2010			2015			2016		
	PALSAR(2010) [1000ha]	FRA(2010) [1000ha]	Relative Error (±) [%]	PALSAR-2(2015) [1000ha]	FRA(2015) [1000ha]	Relative Error (±) [%]	PALSAR-2(2016) [1000ha]	FRA(2015) [1000ha]	Relative Error (±) [%]
Brazil	436,358	498,458	-12.46%	412,842	493,538	-16.35%	428,298	493,538	-13.22%
Colombia	77,667	58,635	32.46%	68,323	58,502	16.79%	70,568	58,502	20.63%
Peru	76,266	74,811	1.95%	72,059	73,973	-2.59%	73,375	73,973	-0.81%
Indonesia	103,811	94,432	9.93%	111,155	91,010	22.13%	116,439	91,010	27.94%
PapuaNewGuinea	31,124	33,573	-7.29%	32,537	33,559	-3.05%	33,761	33,559	0.60%
Malaysia	17,964	22,124	-18.80%	21,111	22,195	-4.88%	20,812	22,195	-6.23%
Philippines	16,479	6,840	140.93%	8,345	8,040	3.80%	9,891	8,040	23.02%
Congo(Kinshasa)	167,631	154,135	8.76%	174,273	152,578	14.22%	174,180	152,578	14.16%
Kenya	11,040	4,230	161.00%	13,737	4,413	211.28%	12,936	4,413	193.12%
Mozambique	26,961	38,972	-30.82%	36,402	37,940	-4.05%	34,394	37,940	-9.35%
Cameroon	36,565	19,916	83.59%	37,367	18,816	98.59%	38,114	18,816	102.56%
Nigeria	28,317	9,041	213.21%	28,199	6,993	303.24%	27,992	6,993	300.28%

This result shows various trends. For example, the relative error of Nigeria and Kenya are 200-300%, this is quite big error. It depends on the difference of definition of forest in each countries. Especially in Africa, these countries have different forest definition.

## **4. Discussion and Future View**

## Conclusion

The result of Validation using Google Earth images is over 85% and the error of total forest area of whole earth is under 10%. These result are good accuracy.

But the trend between PALSAR FNF and PALSAR-2 FNF is different.

- To establish consistency between PALSAR FNF and PALSAR-2 FNF.
- To update classification method of Forest/Non-Forest

The result of each countries have various trends (overestimation and underestimation).

- To determine the definition of forest.
- To consider and collect validation data



## Future tasks

### **Definition of forest:**

tree height, biomass per hectare, tree coverage of the area etc.

### **Classification method:**

segmentation, threshold, supervised classification...

### **Validation data:**

Google Earth, Optical images (Landsat, Sentinel-2), Field survey...

The banner features a satellite image of a coastal region with green land and blue water. The word "ALOS" is written in large, white, serif capital letters on the left side.

# ALOS

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**Thank you!**