Ground Based Forest Monitoring Radar analysis ~K&C phase 4 Progress report ~

Project For The Establishment Of Sustainable Forest Resource Information Platform For Monitoring REDD+ In The REPUBLIC OF MOZAMBIQUE

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Project outline and objectives

Preliminary radar image analysis for the detection of deforestation areas was conducted to design a better National Forest Monitoring System For REDD+ in Mozambique, improving forest mapping of tree loss and deforestation;

PALSAR-2 data have been utilized for Ground Based Forest Monitoring Radar Analysis to allow more accurate forest information mapping to support large scale mapping on tree loss and deforestation; Also, recap of the past analysis and remaining issues;

Methodology

1. Radar images of two different time points that seem to cover deforested areas are obtained.

2. Differences in backscatter coefficient (intensity) between the pair of radar images are calculated.

3. Areas with the calculated differences below a threshold determined using field survey results as reference are extracted as deforestation areas.

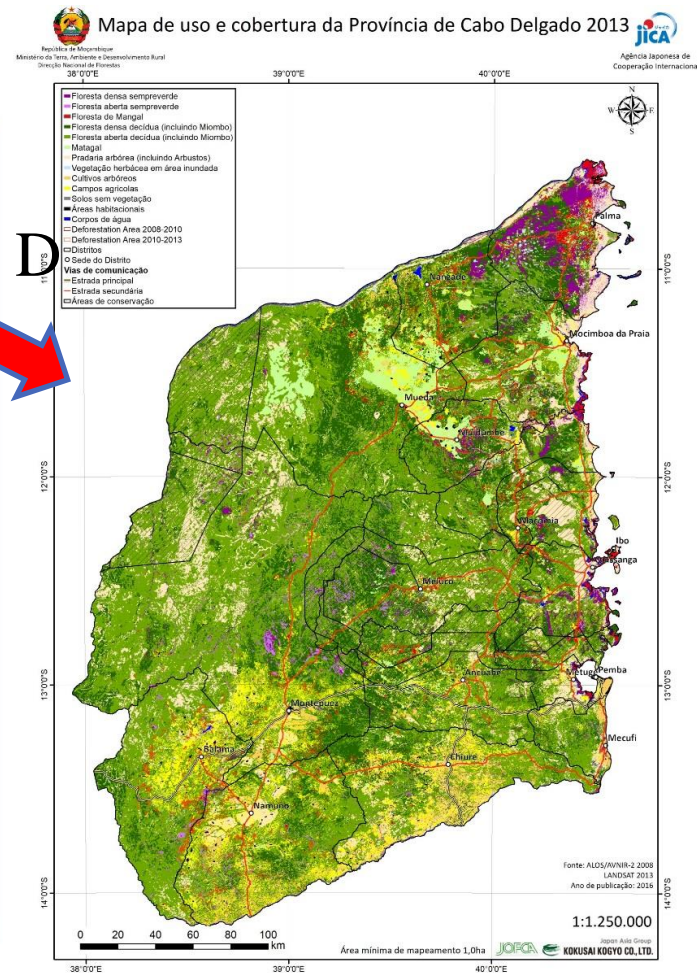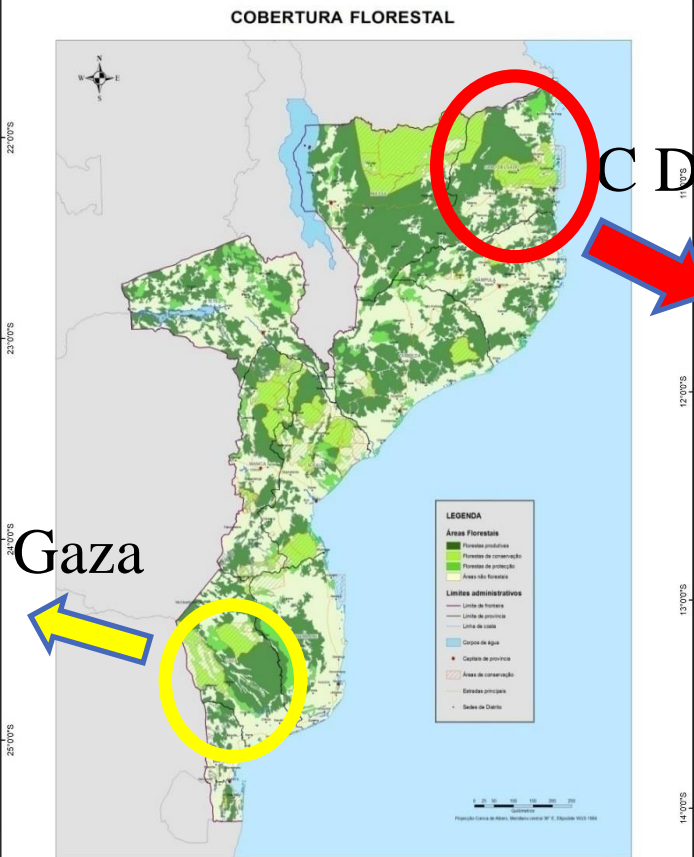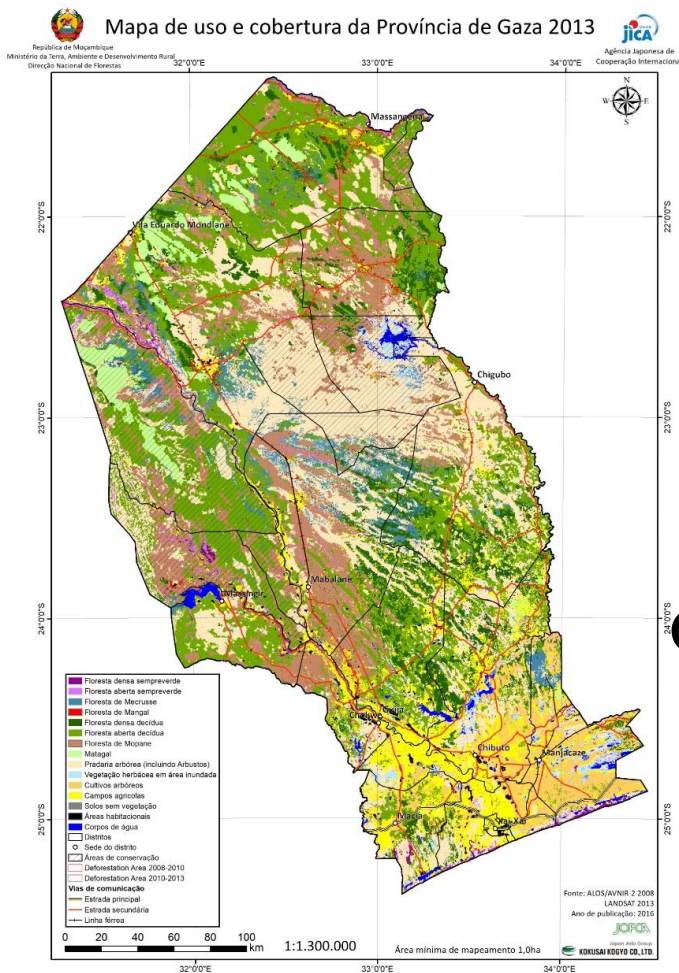# Recap of the past analysis and remaining issues

➢ Water mask works well.

➢ Blue + is a best fit threshold for detecting tree loss area in whole Mozambique through field survey (76 plots).

➢ Image inconsistency is confirmed in east side of GAZA

➢ Value at the "before"- 18dB, -19dB or -20dB?

➢ Accuracy assessment (Before & After)

➢ Wide area analysis (Province)
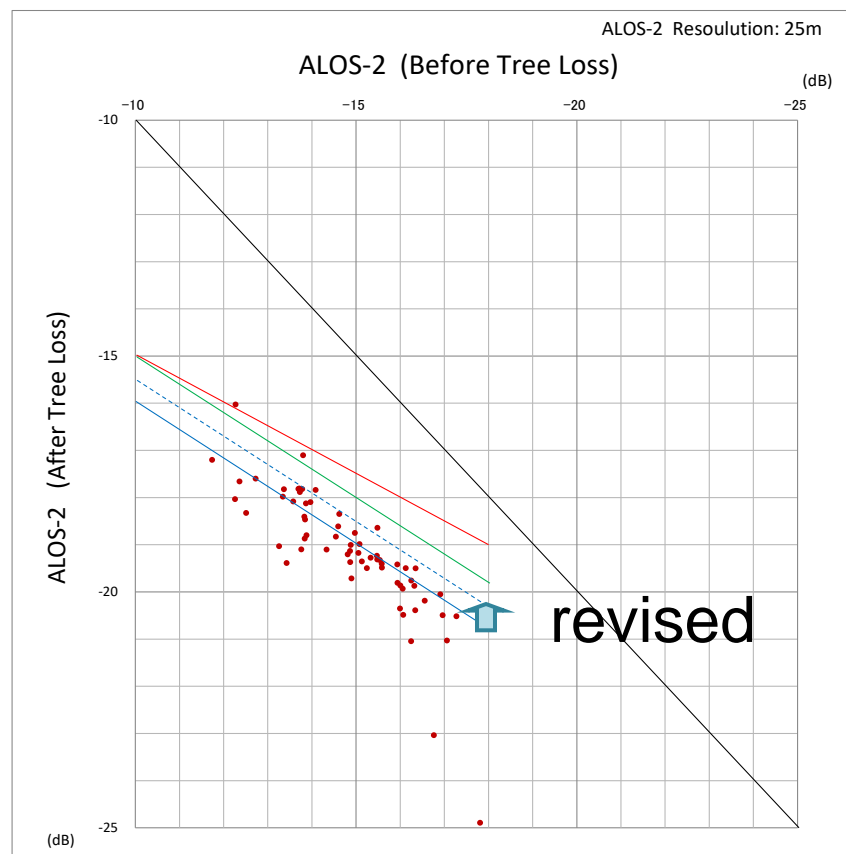
     -> 2008-2010, 2010-2015, 2015-16
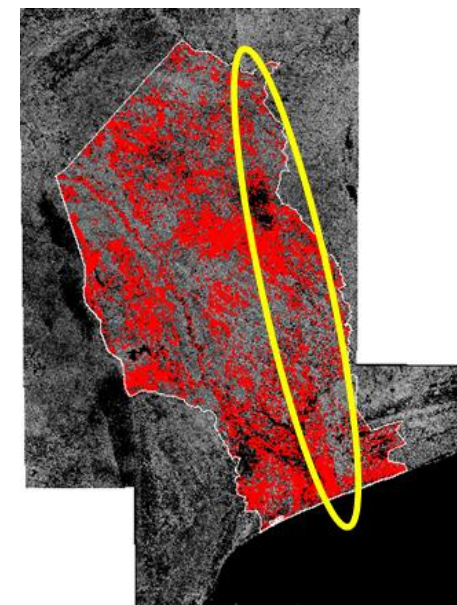
# Land Cover Map of Cabo Delgado and Gaza Provinces

Review 1: Threshold for detecting tree loss

Blue + (dotted line) is a best fit threshold for detecting tree loss area in whole Mozambique through field survey.
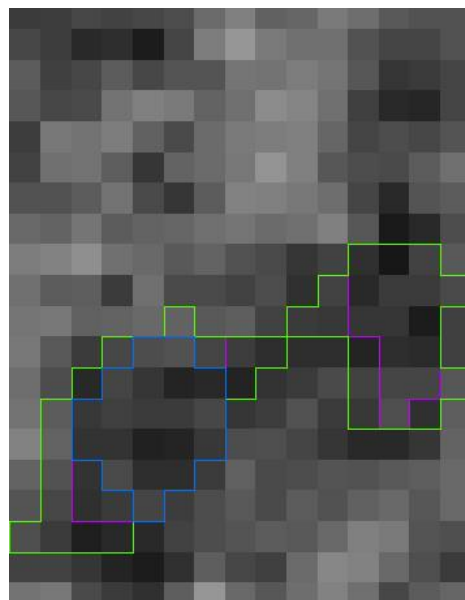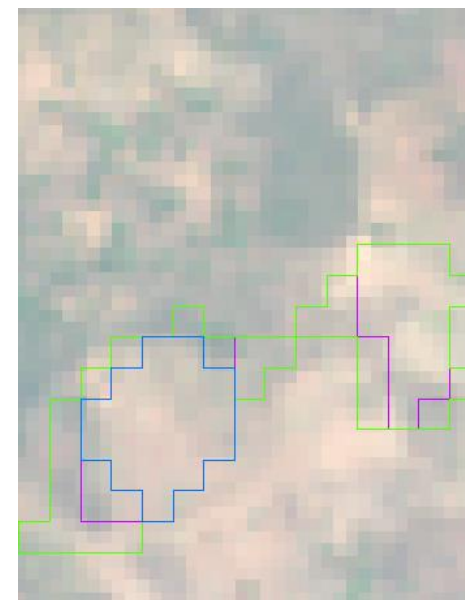
Review 1: Threshold for detecting tree loss

➤ **Blue line indicates BLUE, green line indicates GREEN, purple line indicates BLUE+ detection area. This example shows that BLUE+ could detect properly.**
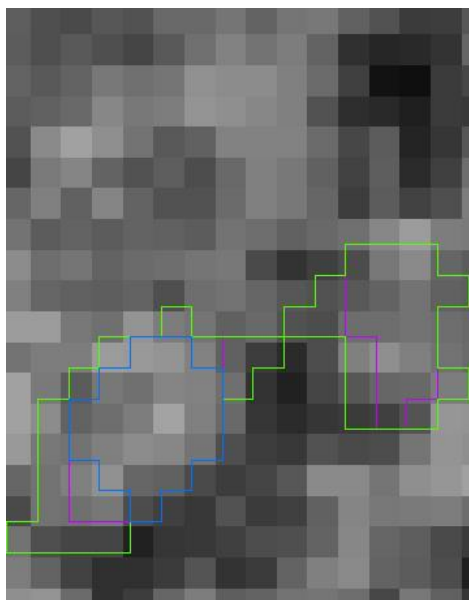

| ALOS-2 (beginning) | ALOS-2 (end) | Sentinel-2 (end) |

Review 2: Water Mask

☐ **From the radar image at each time point, those that satisfy the following conditions for each pixel were used as a watershed mask.**

☐ **- Three times: over 2 time periods are water bodies (-18 dB or less) from 2008, 2009, 2010**

☐ **- Fourth times: over 3 time periods are water bodies (-18 dB or less) from 2007, 2008, 2009, 2010**
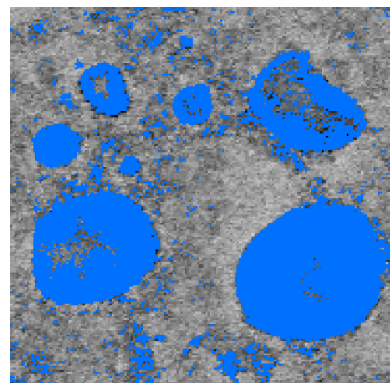
Improved place by using four times image

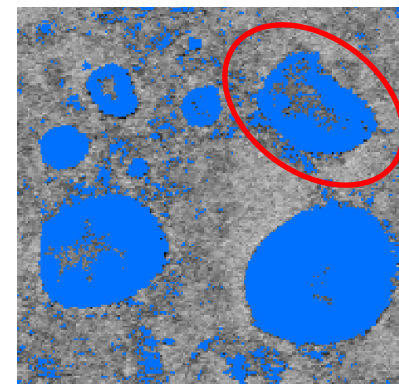Vegetation change in non-forest area
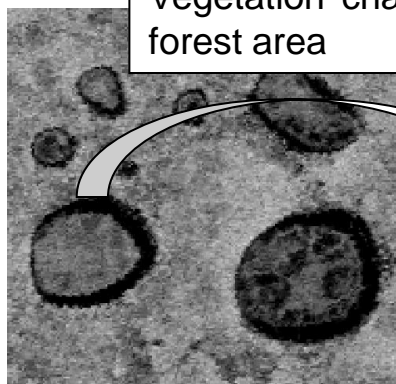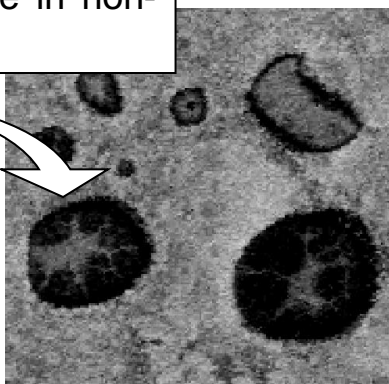
ALOS 2007   ALOS 2010

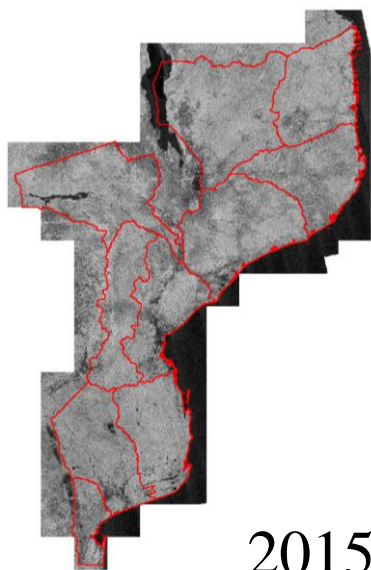3 times (water area more than 2 times

4 times (water area more than 3 times

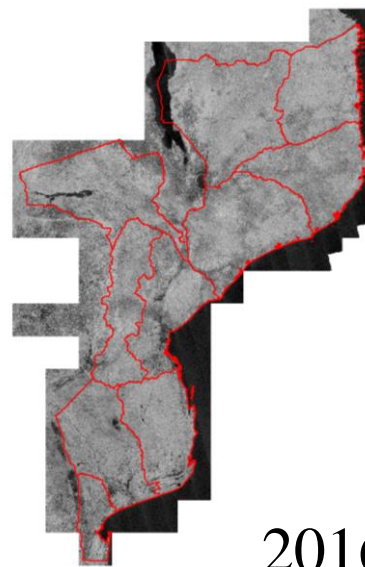Example of watershed mask

Progress of FY2017

1. Wide area analysis

2. Calculate Tree Loss area and Deforestation area

3. Implementation of training on radar image analysis

2015   2016

Result 1: 2015-16

☐ **Confirmed area, which has not been detected.**

  -> These areas cover 7 provinces except CD,GZ and Maputo

☐ **The detected area has a large difference in each region.**

☐ **Original image, the water mask looks fine.**
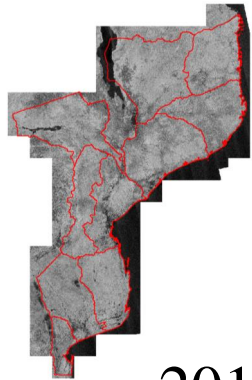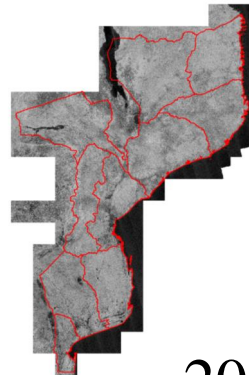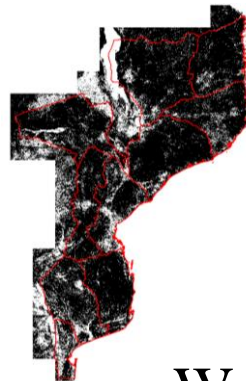
2015   2016   Watermask

Detected area

☐ **Observation day**

434(day)↵

397(day)↵   420(day)↵

798(day)↵

761(day)↵   420(day)↵
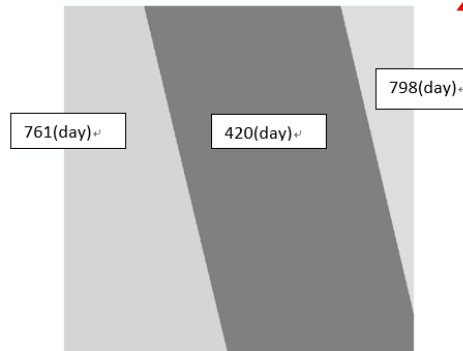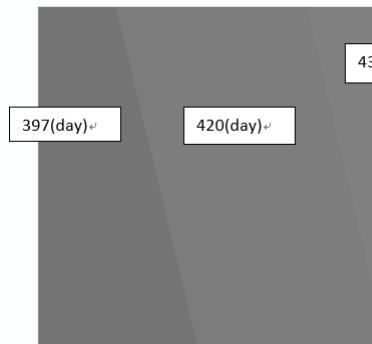
->2015 path data is used for 2016

->Not appropriate to compare

Result 1: 2015-16 in Cabo Delgado

☐ **The detected area in CD has been analyzed more.**

☐ **The ideal range of observation period is 1 year (365days).**

☐ **Mosaic data has been developed the image, which observed between July and September.**

☐ **The minimum difference between 2015-16 was assumed 10 months (Sep 2015-July 2016)**

☐ **Confirmed a lot of short observation period (e. g. 210 days) in the CD**

517

414

2015

792

624

2016
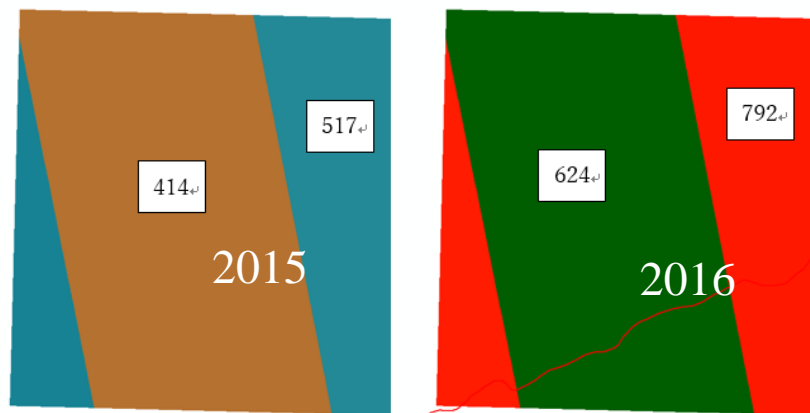
- > Not appropriate for wide and one year analysis

- > Can be used for specific small area

- > No problem for using accuracy assessment!?

Result 1: 2015-16 in Gaza

☐ **The amount of the detecting area in GZ is quite large.**

☐ **Image inconsistency is still confirmed in east side of GAZA**

2015

2016
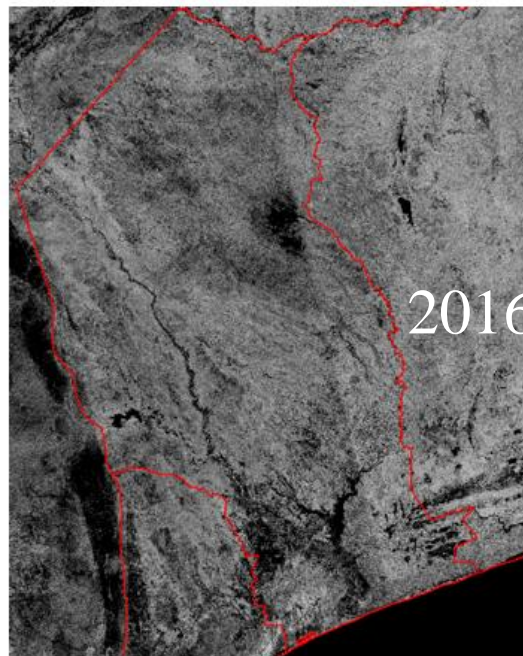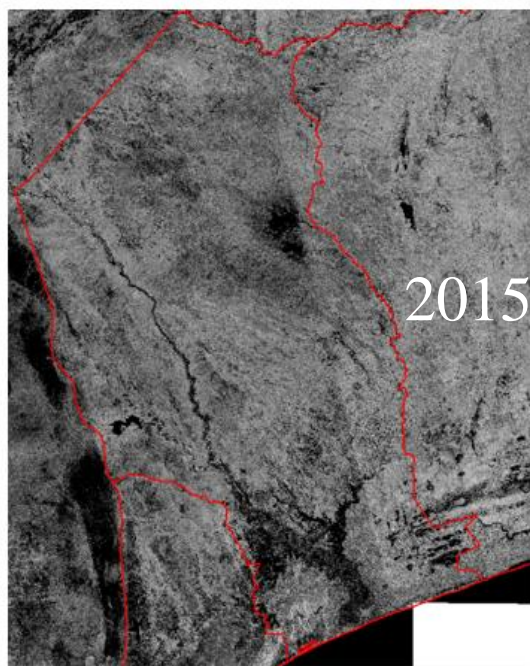
- > Not suitable for analysis of 2015-16/ 2010-15 in GZ

Result 2: 2008-10

☐ Tree loss area (ha/year) (Min area>1.0ha)

	Hansen Tree Loss	Radar Image Analysis		
		−18dB	−19dB	−20dB
CD 2008−2010	20,883	19,521	22,568	24,370
GZ 2008−2010	2,572	2,856	3,606	4,031
CD 2010−2015	9,356	32,327	40,652	47,643

-18 is most proper "dB".

☐ Deforestation area (ha/year) (Min area>1.0ha)

	JICA Forest Cover map	Radar analysis −18dB
CD 2008−2010	7,913	11,070
GZ 2008−2010	6,472	1,844
CD 2010−2015	9,328	16,295

Area was calculated with the selected polygon only overlapped with forest area of 2008/2010 map

Reference: Hansen Tree Loss

*Include are less than 1 ha

TREE COVER LOSS (2001 - 2015) GZ — 684 Ha

TREE COVER LOSS (2001 - 2015) CD — 23,476 Ha

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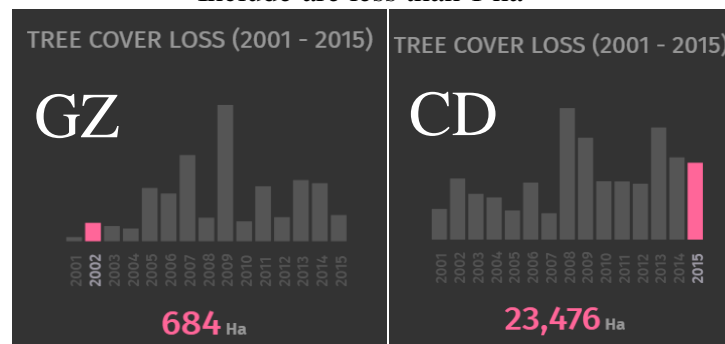
Result 2: 2008-10, 2010-15 (CD)

<TreeLossArea>

2008-2010

☐ The detected area of Hansen and Radar analysis (-18dB) are similar

☐ -18dB is proper value for using at the beginning(before)

2010-2015

☐ There is a large difference between Hansen and Radar

☐ Although no concrete reason, the image of CD also may has error?

☐ Hansen detects tree loss year based on the forest in 2000. Also, it cannot detect the same area more than two times.

-> The area is small in later years.

Result 2: 2008-10, 2010-15 (CD)

<Deforestation Area>

2008-2010

☐The amount of deforestation area of radar image analysis is larger than JICA Forest Cover Map deforestation area;

☐Radar image detects some water area, even though using a mask;
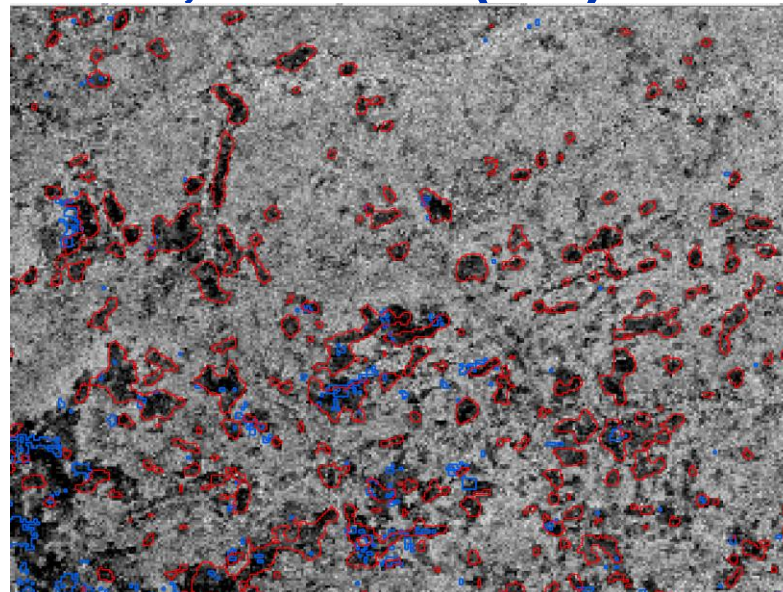
2010-2015

☐According to Hansen, tree loss was detected much more between 2013-15 -> Radar (2010-15) tend to detect larger than JICA Forest Cover Map, which calculated one year average between 2010-13;

☐Threshold can detect almost all deforestation areas;

☐The following image shows that radar analysis detect tree loss are correctly;

Result 2: 2008-10, 2010-15 (CD)

2010   2015
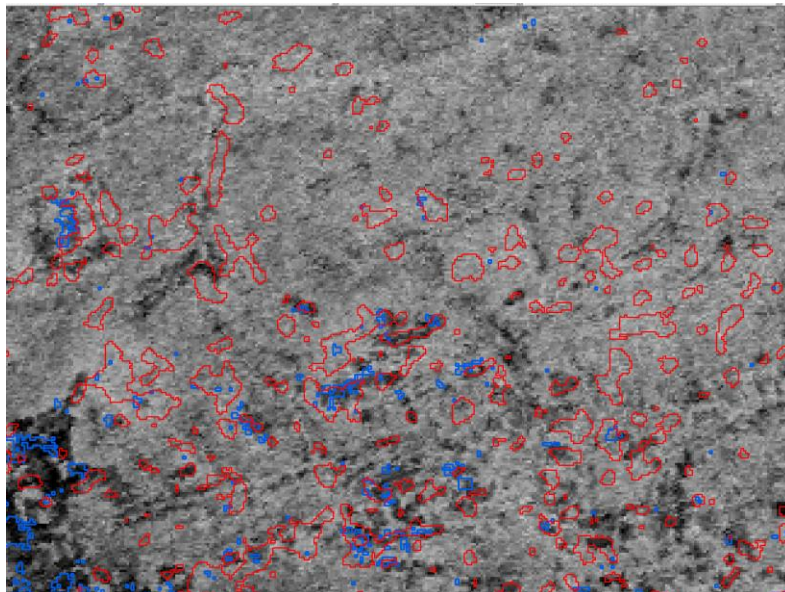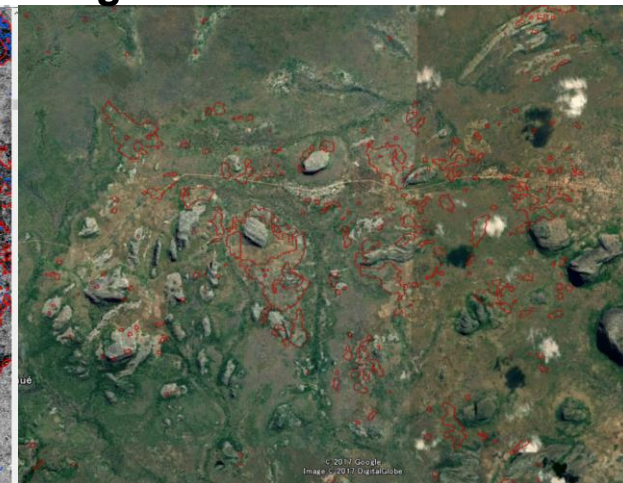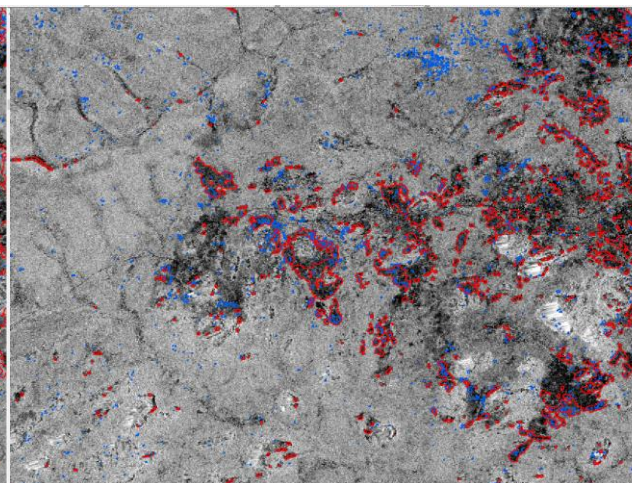
Red: Radar,

Blue: Hansen

2010   2015   Google Earth
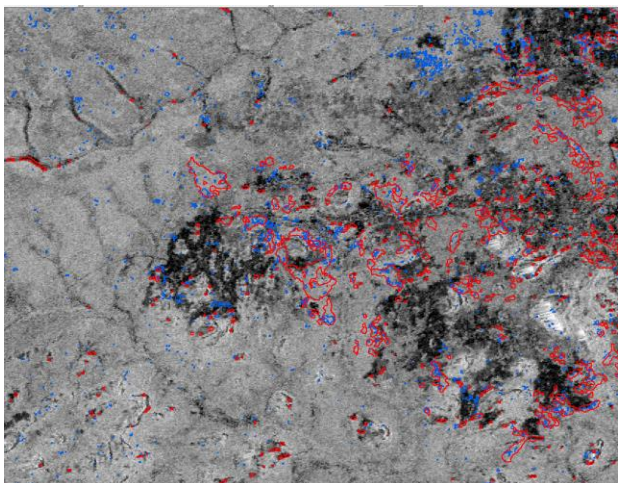
Deforestation in 2010-2013:
5,342 ha

Deforestation in 2010-2013:
35,453 ha

Deforestation Area Map from 2010 to 2013 inGaza

Deforestation Area Map from 2010 to 2013 in Cabo Delgado
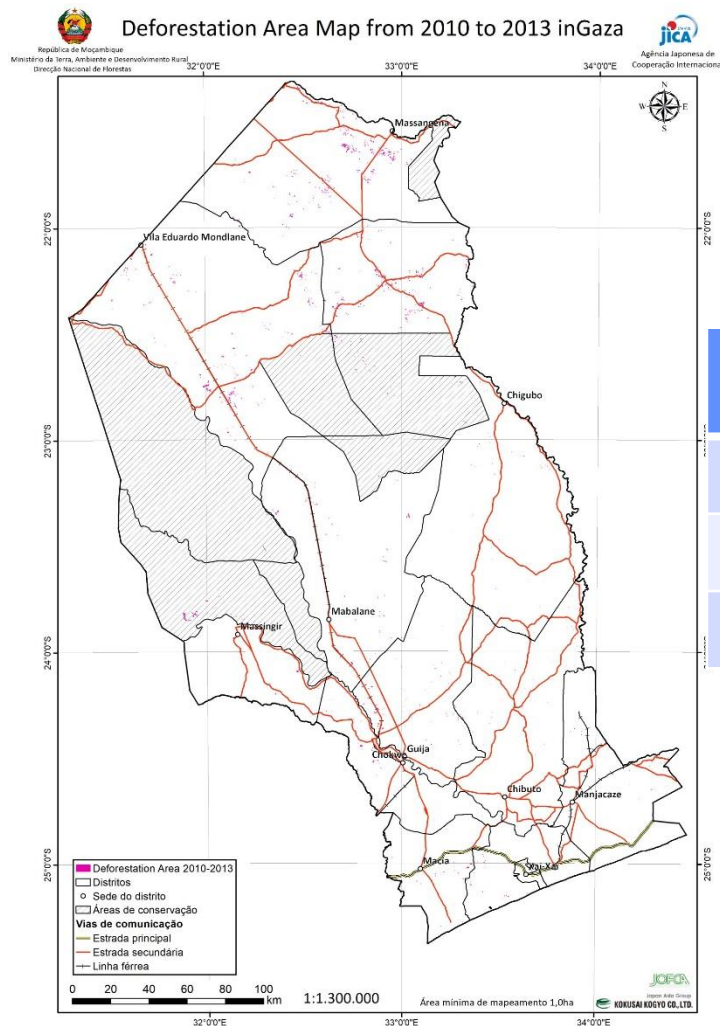
GHG Emission from Deforestation (DIRF-JICA)	
2010-2013	**CO_2 ton/yr**
Cabo Delgado	1,485,013
Gaza	594,232
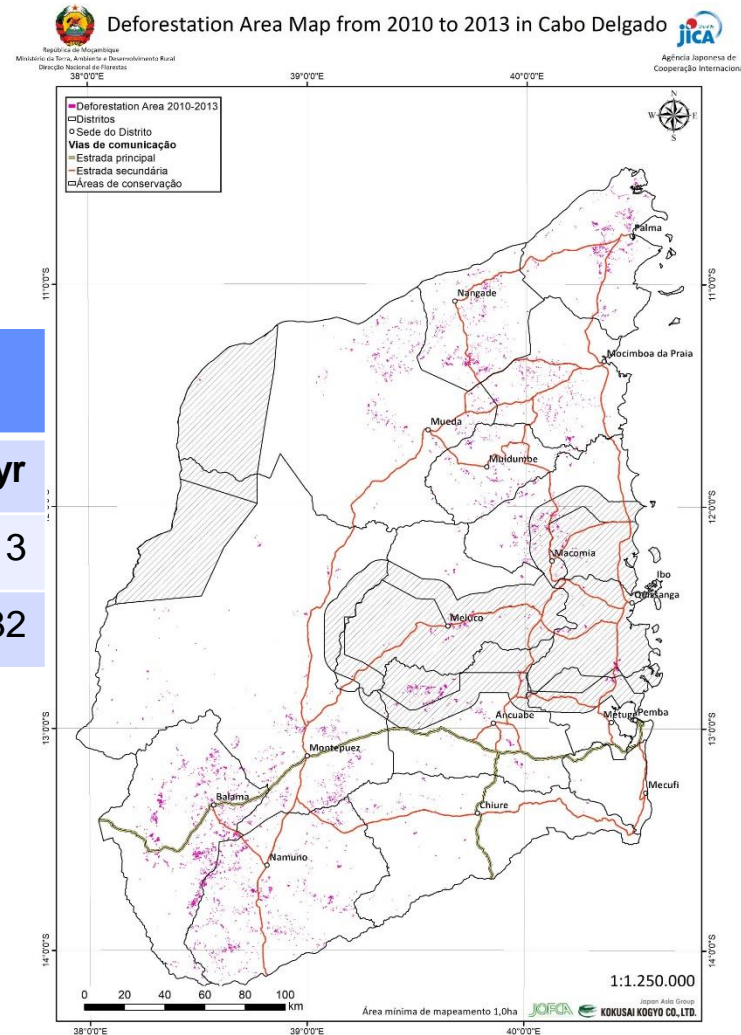
Result 3:

☐ **Practical training on radar image analysis in relation with GBFM-GT was provided in which C/P learned the analytical procedures and actually extracted deforested areas from areas where backscatter coefficients dropped.**

Contents

- Examination of thresholds to be used in extraction of deforested areas based on results of GBFM
- Extraction of deforested areas using new thresholds
- Extraction of deforested areas targeting at wide areas (entire provinces)
- Watershed masking using radar images obtained in different periods
- Extraction of deforested areas also referring to masked watershed
- Conclusion and evaluation of training

Remaining Works

➤ **Accuracy assessment (CD 2015-16)**

- We implemented accuracy assessment for 100 detected area,   which were selected randomly;

- Check the polygon if F or NF both before and after

| Accuracy Assessment(%)		
Before	After	Both
98	98	96

➤ **Analysis used by the mosaic dataset of 2017**

- A new mosaic dataset of 2017 can be used by the end of fiscal   2017;

- It is expected that the problem caused by using data of the same observation date will be solved;

- Validation of the base map using high resolution imagery and available ground data and analysis of forest assessment in 2018;

Thematic Support

- **C**arbon cycle science,

- **C**limate Change,

- International **C**onventions,

- Environmental **C**onservation,
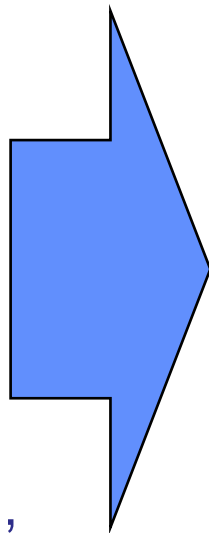
ê **Mapping systematically vegetation cover change;**

ê **Carbon Emission monitoring;**

ê **Applications to conservation;**

ê **FREL/FRE;**

ê **Provision of accurate information for National communication under UNFCCC;**

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Project milestones

☐ **Fine scale maps of land cover change;**

☐ **Maps of deforestation areas;**

☐ **GHG Emission from Deforestation;**

☐ **Validation of the base map using high resolution imagery and available ground truth data;**

☐ **Integration of the information produced in our national platform**

Deliverables and extension

☐ Ground truth data at national level;

☐ Provincial land cover map/land cover change map;

☐ GHG Emissions from deforestation at provincial level;

☐ Intention of Extension: It can allow us to estimate GHG emissions from deforestation at national level more accurately, scale up the national capacity of using PALSA/PALSAR-2 data and feed up our recent Platform for REDD+ which it's being finalized the development;

☐ The results of radar monitoring will continuously be used as a potential solution which allow to detect the increasing deforestation in the country;

Thank you