REPUBLIC OF MOZAMBIQUE
MINISTRY OF LAND AND ENVIRONMENT
National Directorate of Forestry

"NFMS to support GHG reporting in Mozambique"

COP27 side event

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JOFCA KOKUSAI KOGYO CO.,LTD. ASIA AIR SURVEY CO.,LTD. JAXA RESTEC forest monitoring GAFAG an e-GEOS (ASI / Telespazio) Company esa The European Space Agency

Outline

- Overview
- Objective
- Methodology
- Outputs
- Same examples od mapping
- Challenges
- Request

Objectives

- Guide and ensure the generation of data that allow to demonstrate, based on results and in a robust and transparent way, the REDD+ commitments assumed by the country, particularly to contribute to the mitigation of global climate change.
- Aggregate deforested areas detected by the existing (early) warning systems operated by each organization, and monitor the general condition of the forest.
- Requirements and necessary preparation to implement REDD+ under UNFCCC, the development of a NFMS is one of the elements (according to paragraph 71 of decision 1/CP.16).
- In addition, having the NFMS in place is one of the requirements in order to be eligible for results-based payments in accordance with decision 9/CP.19.
- Strengthened technological control of deforestation, through satellite-based Deforestation Reference System (SDRS) to monitor Deforestation in semi-real-time (JAXA-JICA), 2022.
- Feed up GHG reporting of the forest sector in the country

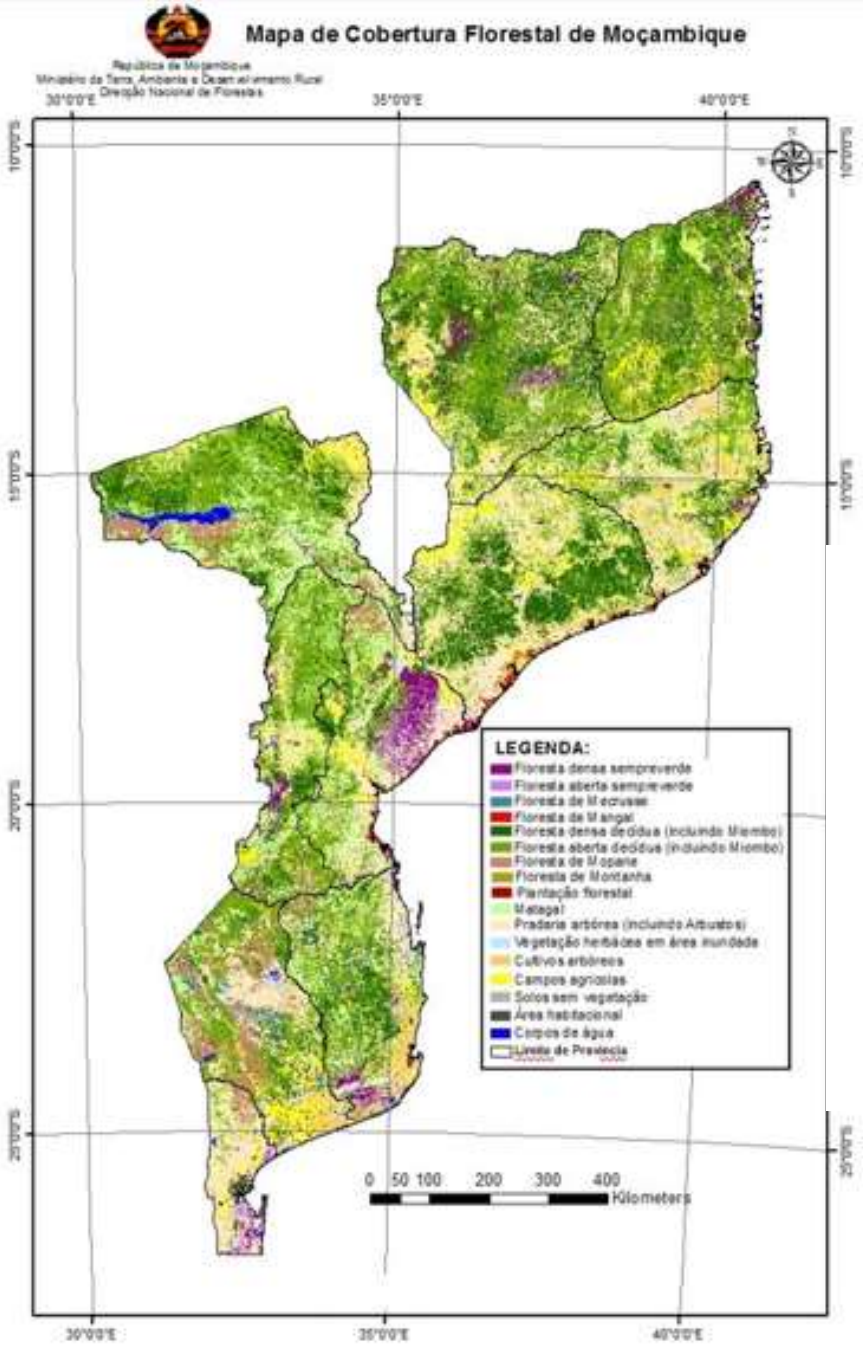
Methodology

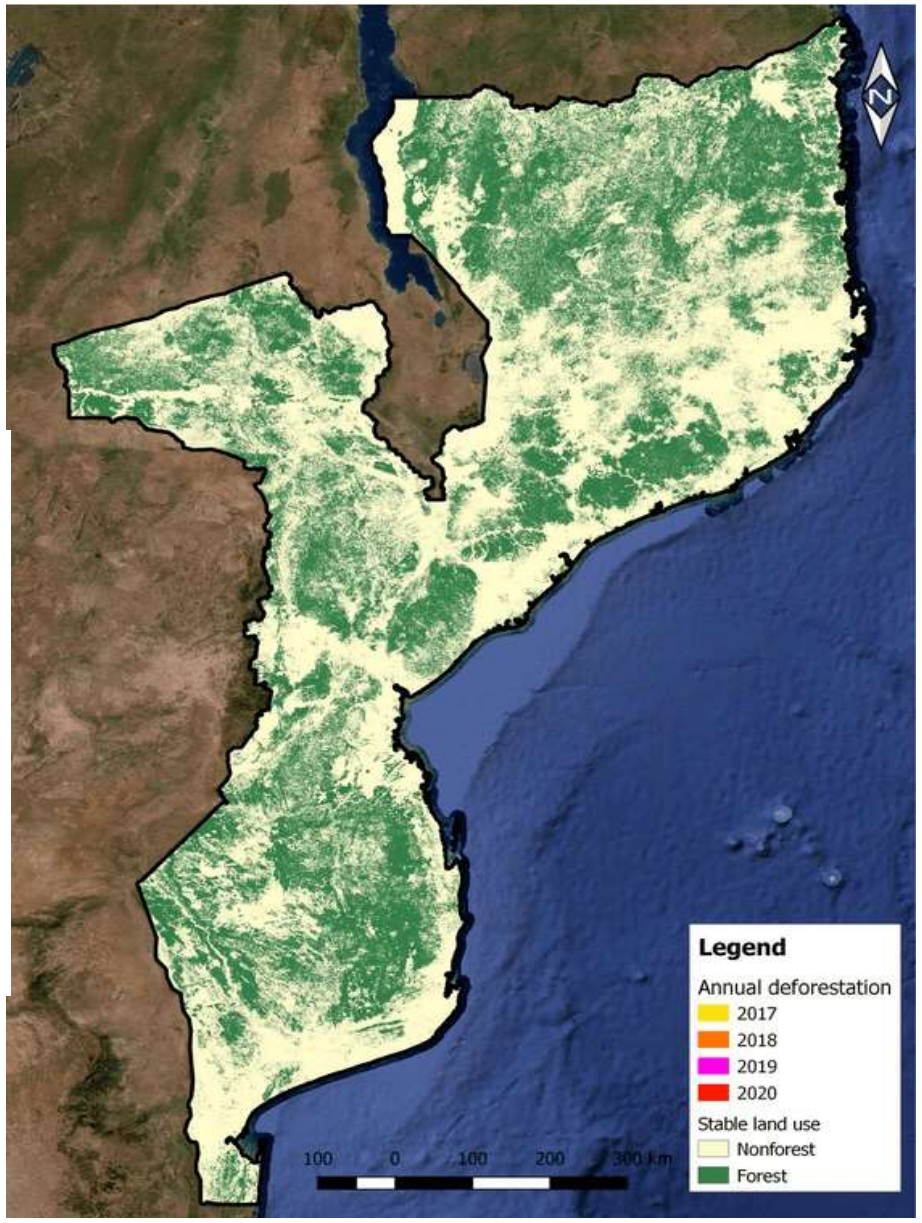
- **Wall-to-Wall metho c**arried out based Determination of NDVI tree cover of Forest and Non-Forest types. Number of verification points, verification method, and target accuracy to accomplished the reclassification forest types:
  - **i) The Number of Verification Points** in each of 8 types of Forests type and Non-Forest type. The accuracy assessment is done with a total of by each area. The verification is operated points across target areas.
  - **ii) Verification method** is chosen without arbitrariness and geographical biases as long as possible. Verification carried out using the field survey result, Google Earth, and other existing data.
  - iii) **Target accuracy** is secured more than 95% by overall accuracy in each area. To evaluate it, accuracy evaluation matrix is employed.
- Produce forest cover and change maps;
- Produce deforestation and forest degradation maps;
- We analyze annual changes in forest cover associated to charcoal production using multitemporal Landsat imagery.
  1. Create Mopane mask
  2. Identify best annual Landsat image
  3. Calculate NDVI images
  4. Calculate NDVI difference
  5. Map Forest degradation due to charcoal production

Outputs

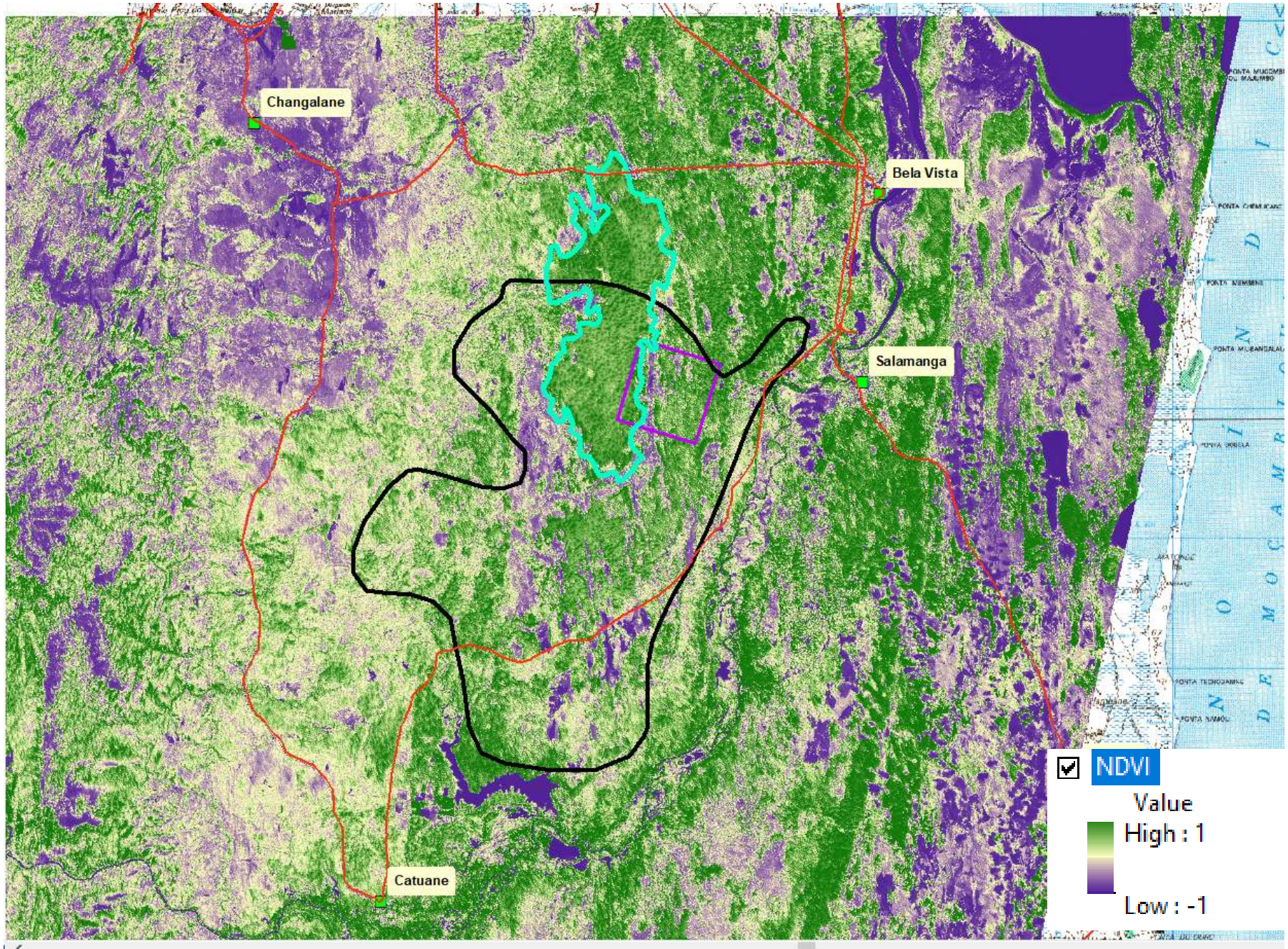
- **Forest area ~38 Million ha** which represente 48% of the land cover
- **Deforestation is 220 000 ha** per year;
- **National Forest Reference base map of 2013** (Landsat 8 data and **ALOS Radar data and Landsat 8 wall-to-wall methodology**), 2017, **JICA**
- Estimation of **activity data** based on **deforestation** from 2001-2016, Collect Earth;
- Prepared Forest Reference Level (FREL), based on 2001-2016 **data of deforestation** and submitted to the UNFCCC in 2018, **UEM, FNDS**
- National forest Inventory, 2018, **DINAF**
- On **update data of annual deforestation and estimation of forest degradation** from 2016 up to date using Sentinel 2 data, 2022;, **FNDS**
- **Historical Map of changes** (2002,2004, 2006, 2008, 2010, 2013 Landsat 8) of two provinces (Gaza and Cabo Delgado) using wall-to-wall method, **DINAF-JICA**;
- **Provincial Forest Zoning** (Niassa, Sentinel 2) for REDD+ and **integrated Forest Management Model for national wide, DINAF-JICA;**
- **Wildfire data map.**
- Produce **annual land use and land cover (LULC) maps with resolution of 30 meters** for Mozambique based on the classification of satellite image time series from 1990 to 2019. A pilot using technologies developed by the **Brazil Data Cube** project team

Forest Reference Base Map Vs Deforestation Map





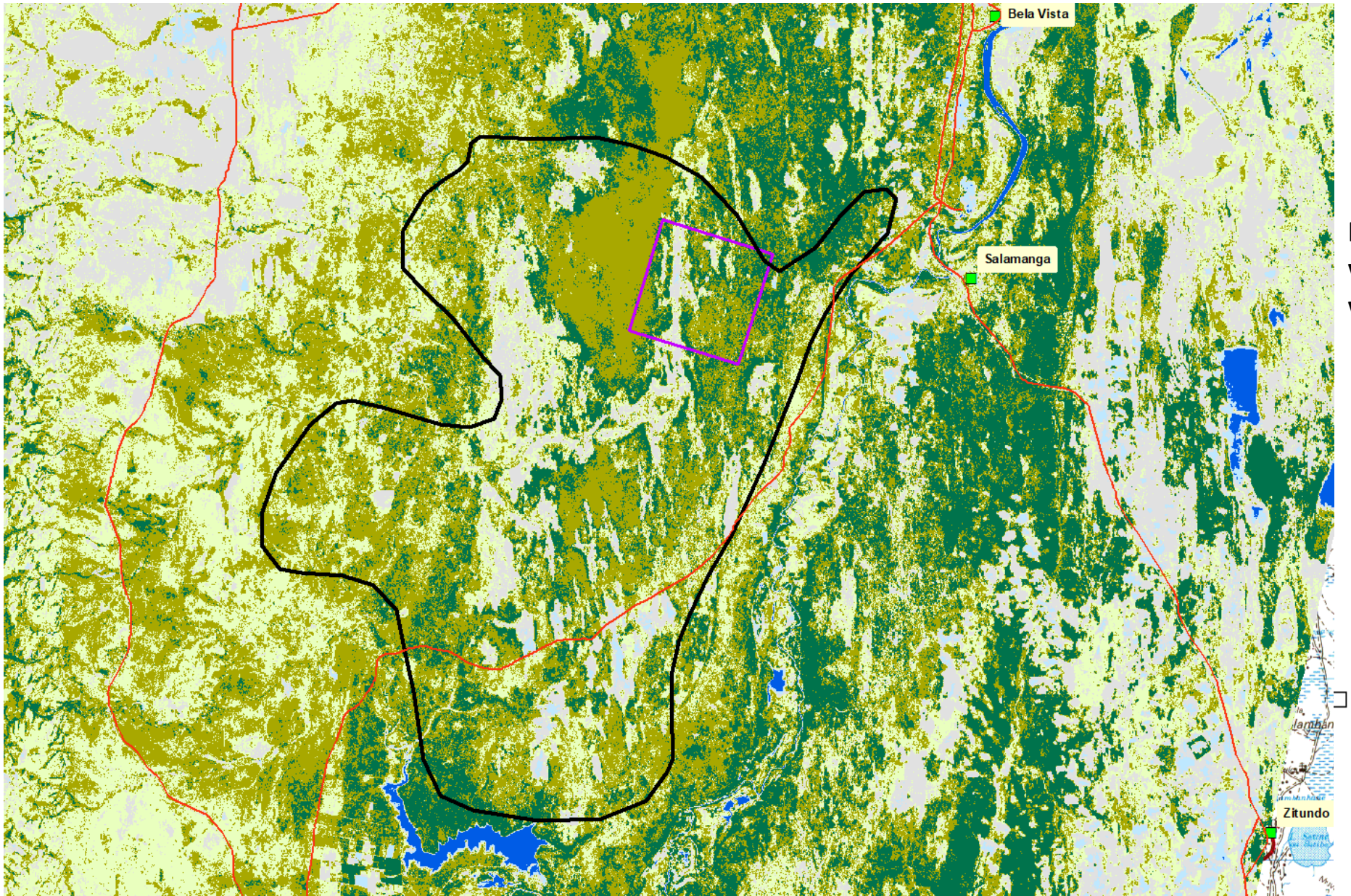
NDVI for different class of vegetation intensity



1=major intensity
-1= Low intensity

Sentinel **2**
2nd June, 2022
Spatial Resolution 10m

Reclassification

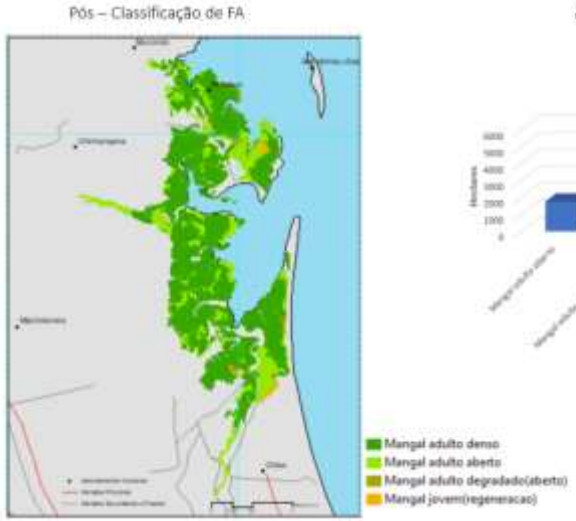


Reclassification for ground verification and data validation

Mangrove mapping

Landsat 4-5 ETM+ instrument has a spatial resolution of 30 m for the six reflective bands and 60 m for the thermal band and includes a panchromatic band with a 15 m resolution

Orthorectified aerial photography with 5 m resolution – Original Sensor data WorldView-2 multispectral 0.50 m spatial resolution, georeferenced by the orbital parameters of the satellite, delivered in GeoTIFF, WGS-84



Estimated área by class

Mangrove Classification from Landsat 4-5 ETM+, at 30 m resolution

How to access the FRIP and SDRS

Link from DINAF portal (http://www.dinaf.gov.mz)

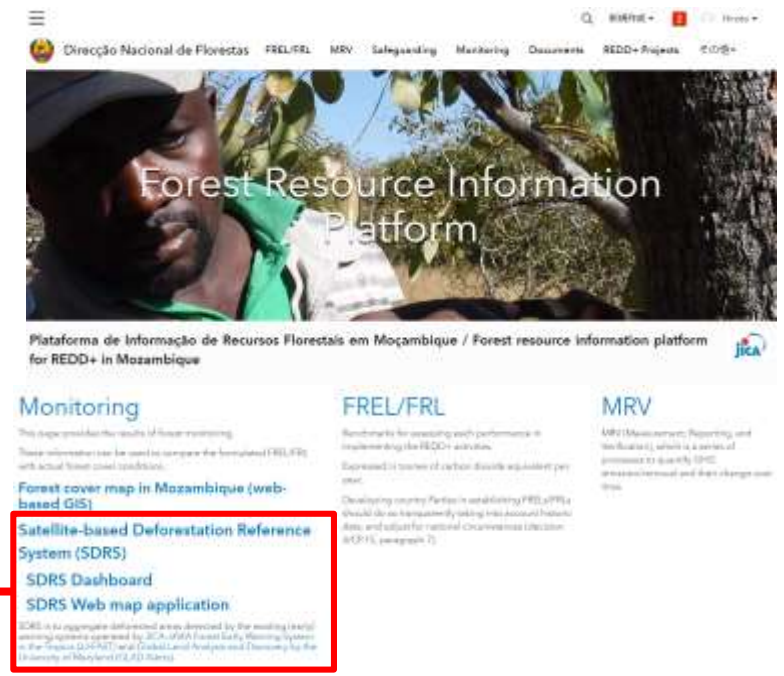
Satellite-based Deforestation Reference System

SDRS _Dash board application

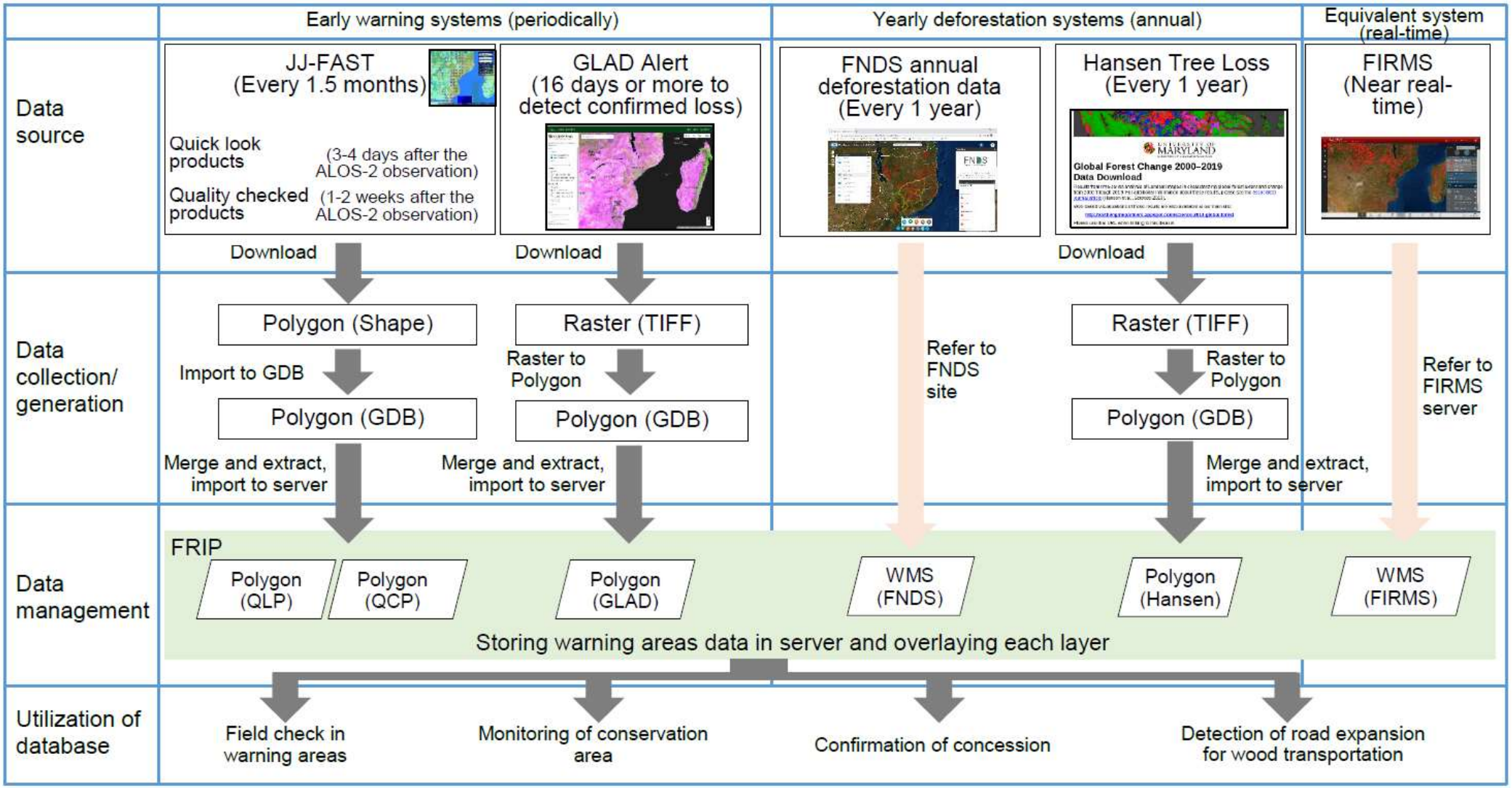
https://www.dinaf.gov.mz/portal/apps/opsdashboard/index.html#/ec8916bbd4384bc7bd18af95c03a9c8b

SDRS_Web map application

https://www.dinaf.gov.mz/portal/apps/webappviewer/index.html?id=a79142a2a13946d1a5595cd55f4d45a1



Work flow of the SDRS



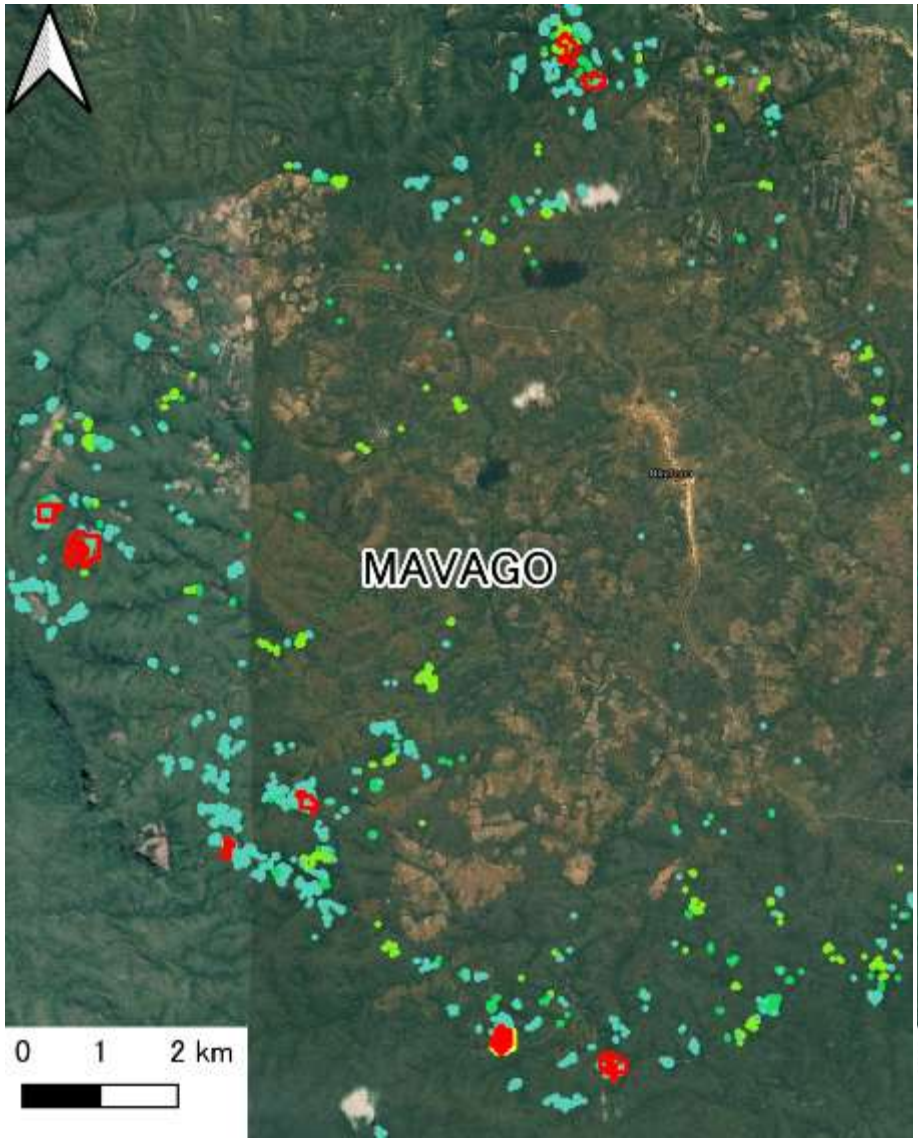
Comparison of the existing forest warning systems

- The SDRS handles the following five existing system of forest warning systems and relevant systems. FNDS has prepared annual deforestation data themselves using by satellite images and published them on the FNDS web site using by ArcGIS online

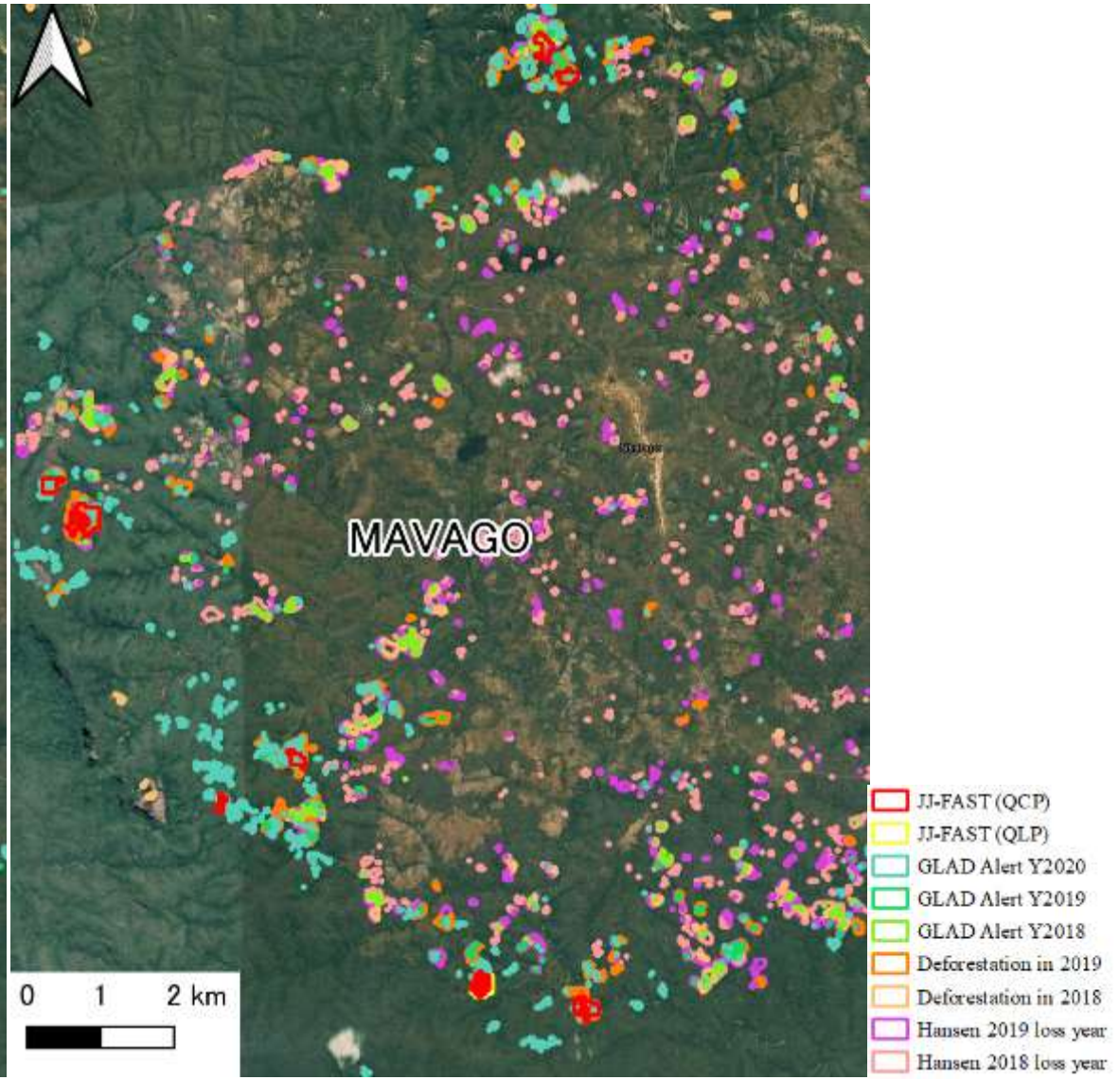
Item	JJ-FAST	GLAD Alerts	FNDS	Hansen Tree Loss	FIRMS
General descriptions (objectives)	To constantly monitor the conditions of decreasing tropical forests and detect the change areas.	To estimate and show areas with possible tree cover loss.	To estimate area of deforestation and emissions.	To estimate tree loss and gain by time-series analysis and visualize the global forest extent and their changes.	To distribute near real-time active fire data within 3 hours of satellite observation from NASA.
Satellite imageries	ALOS-2/PALSAR-2/ ScanSAR	LANDSAT 7 and 8	Sentinel-2/Collect Earth	LANDSAT	MODIS/VIIRS
Target area	Natural tropical forest areas (Artificial forest areas are excluded.)	All countries between the latitudes 30 degrees north and 30 degrees south	Mozambique	Whole world	Whole world
Observation frequency	Every 1.5 months (Quick look products: 3-4 days after the observation) (Quality checked products: 1-2 weeks after the observation)	Every week(5 days) or more to detect confirmed loss (Depending on cloud conditions, observation intervals can be extended by several weeks or even several months.)	Every year	Every year	MODIS: 2 times per a day
Spatial resolution	50m -> 25m(under development)	30m	20m	30m	MODIS: 1km VIIRS: 375m
Observation period	2016 to the present	2017 to 2021 (under system upgrading)	2017 to the present	2001 to the present	MODIS: 2000 to the present VIIRS: 2012 to the present
Data format	Shape file and KML	Raster (Tiff)	Shape file and WMS	Raster (Tiff)	Shape file, Text, KML and WMS

Sample image of overlaid each data source

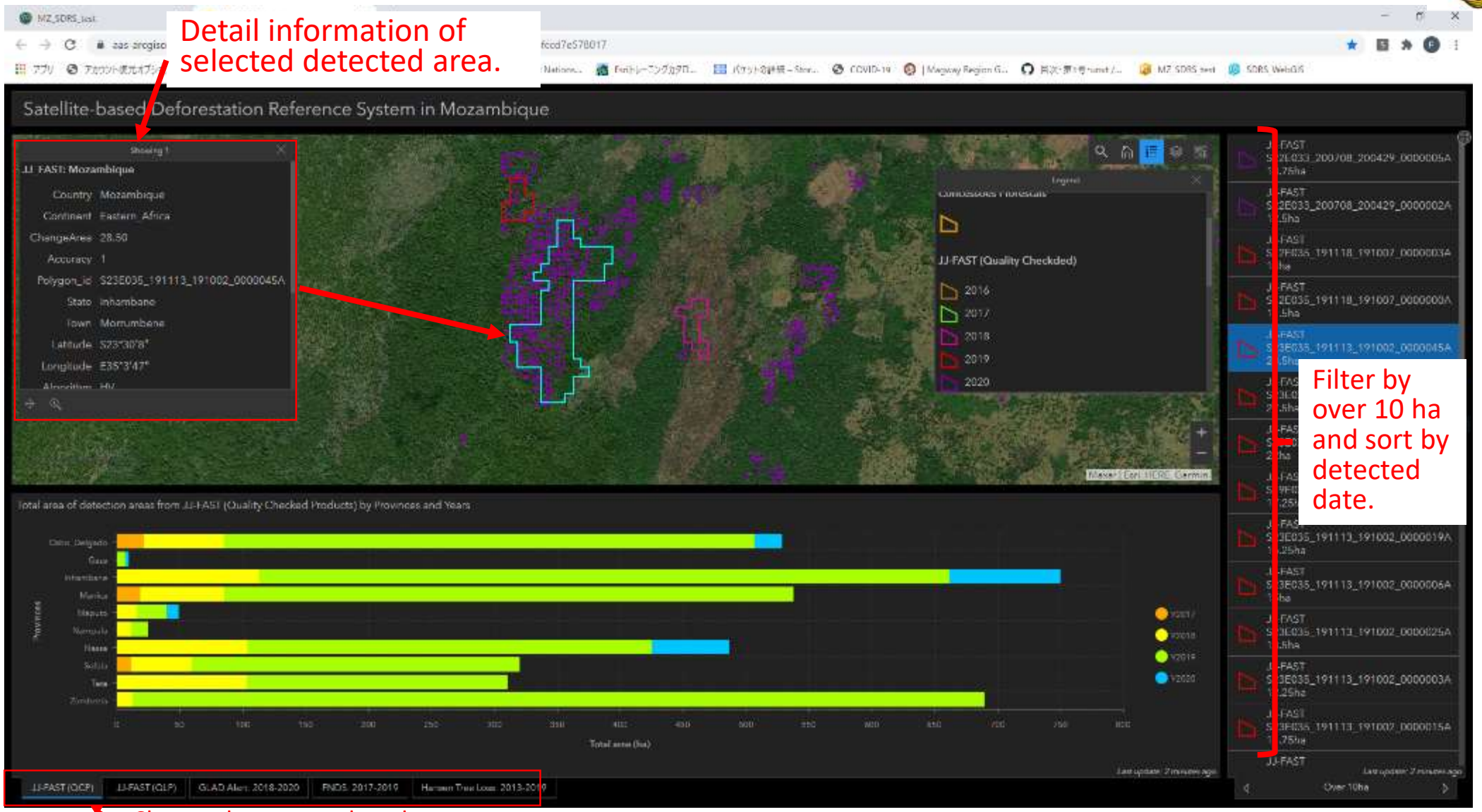
JJ-FAST and GLAD Alert



JJ-FAST, GLAD Alert, FNDS and Hansen

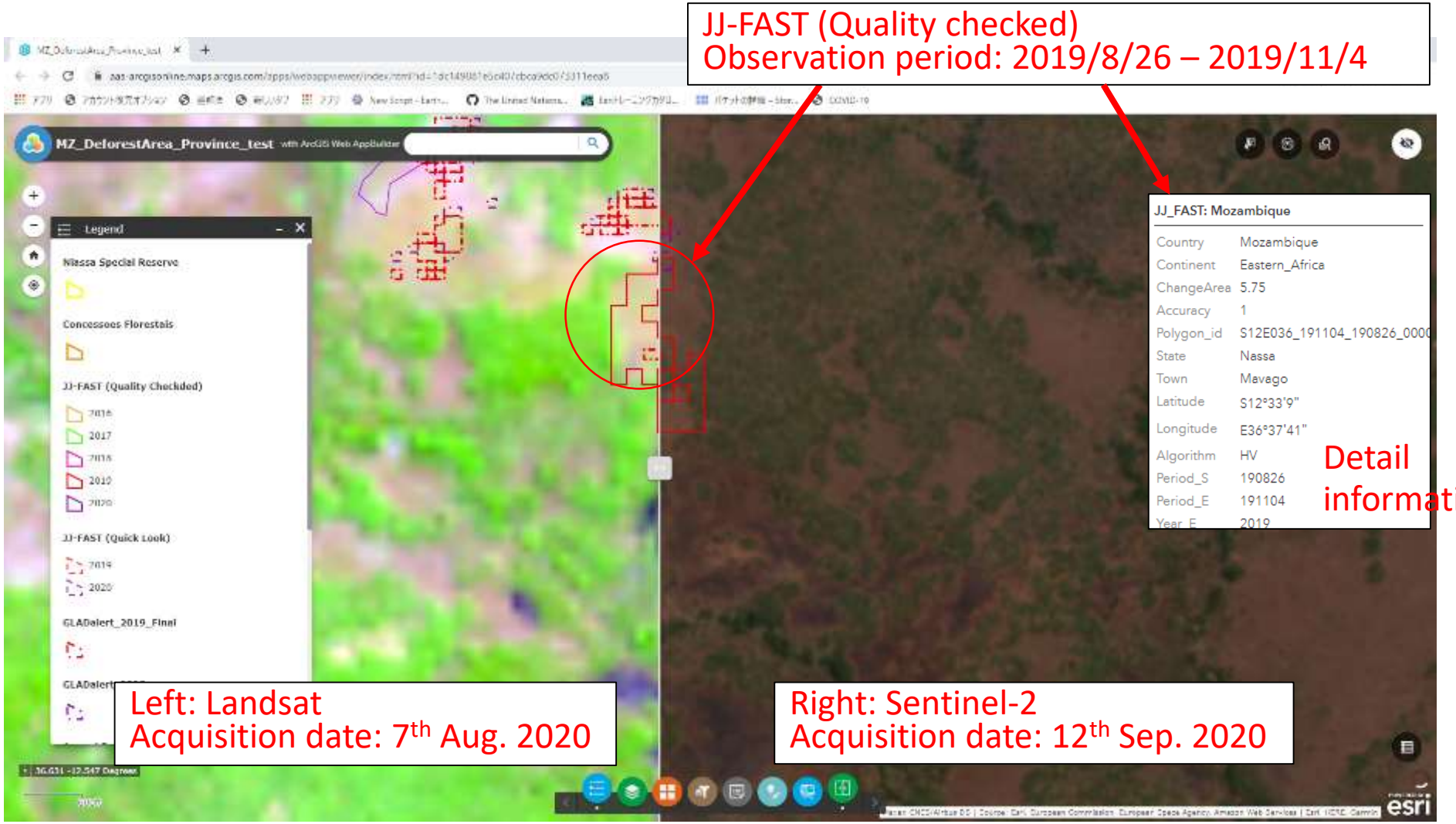


Sample image of Dashboard



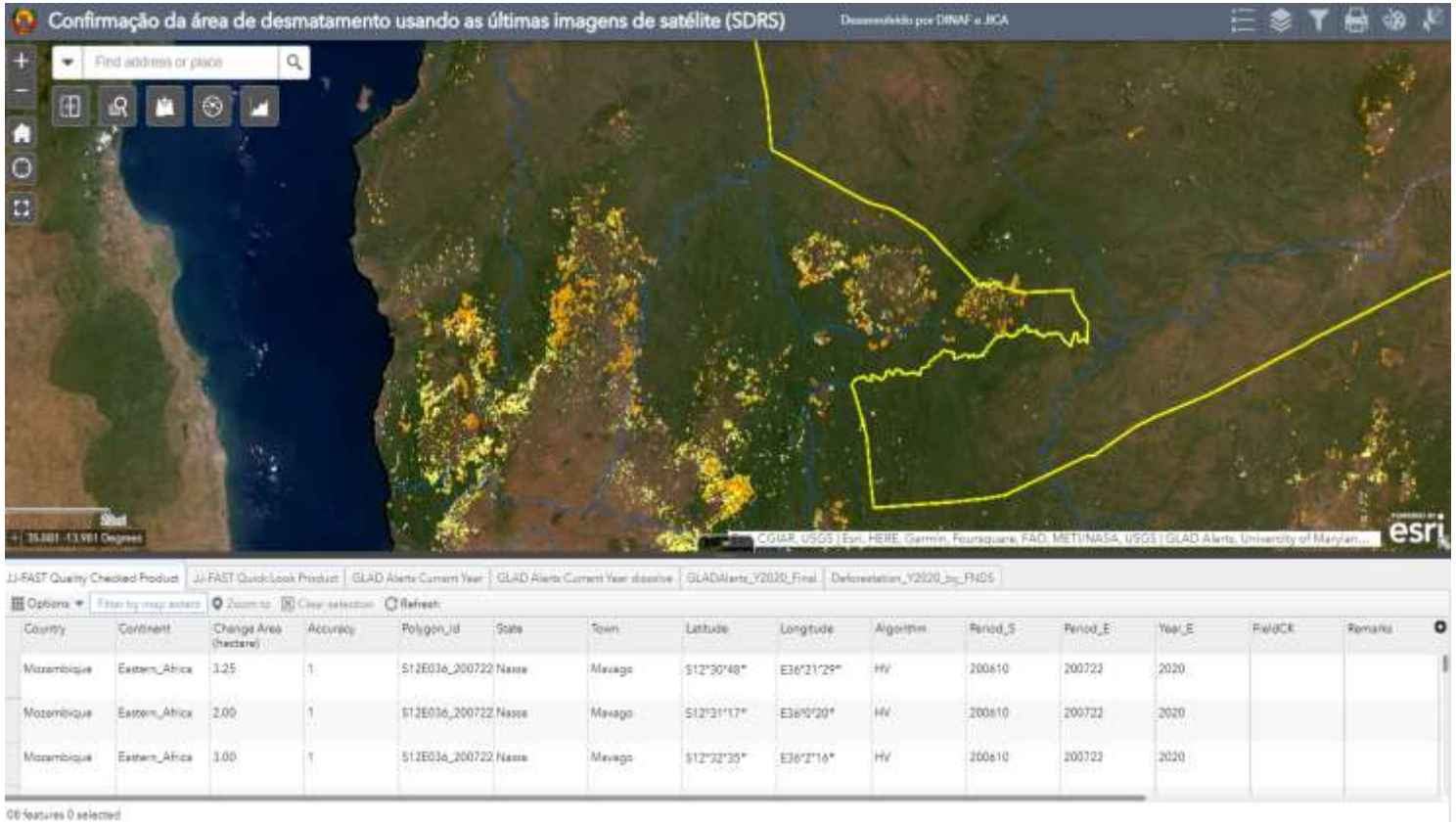
Example of utilization of the SDRS (1)

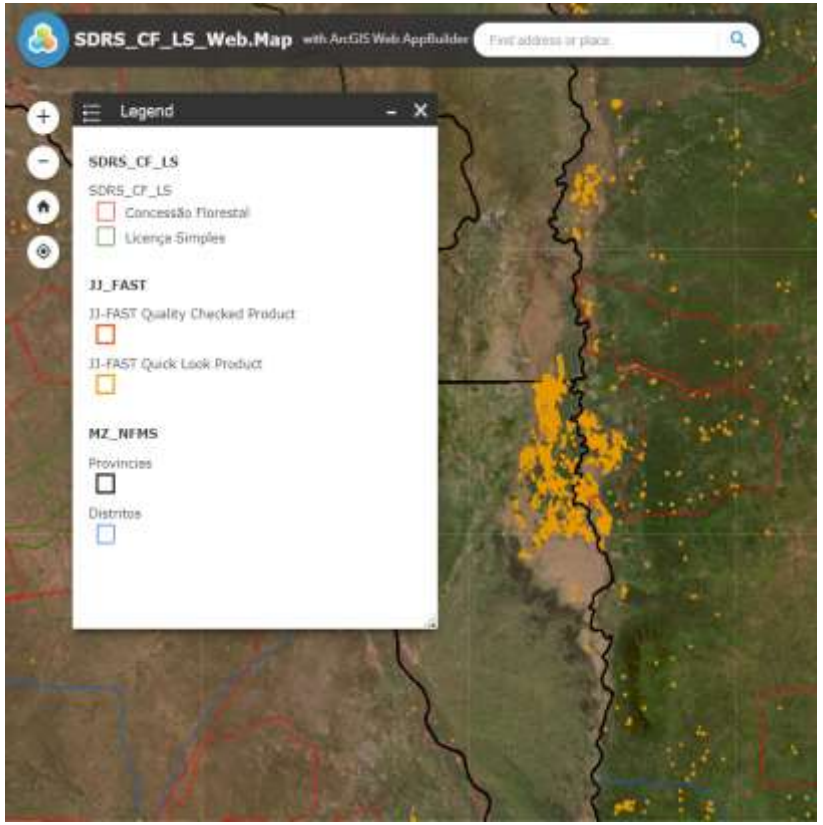
Confirmation of the deforestation area on the latest Landsat and Sentinel-2 images



Information sharing with related institution of SDRS

- Share the information, especially early warning (GLAD & JJ-fast), to the related institution (Agriculture, Aqua and ANAC).

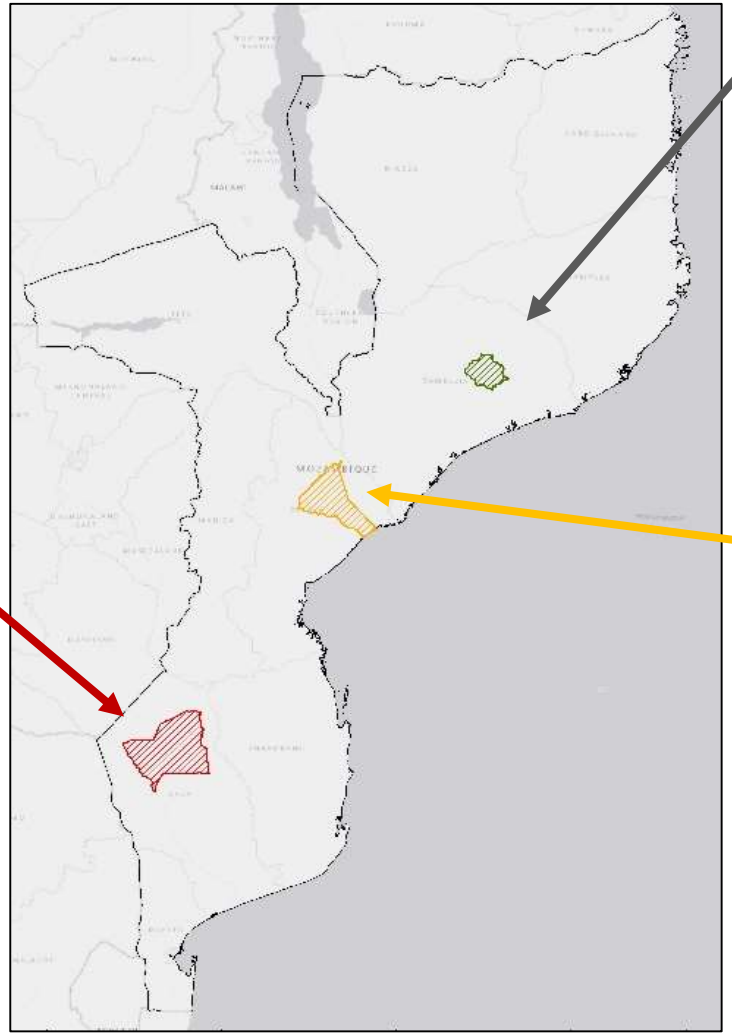




Overview of Demonstration Sites – Phase 1

Gaza Province (Mapai)

- 11,593 km^2 assessed
- Dry tropical mopane Forests
- Climatic sensitivity highest in area
- Heavy charcoal production as a main driver of deforestation
- Other influences from small scale agriculture, harvesting of timber and harvesting non-timber products



Zambézia (Mulevala)

- 2,700 km^2 assessed
- 13% of MOZ forest over the region
- Region accounts for 8% of MOZ deforestation
- Densely populated
- Highest deprivation rate

Cheringoma

- 7,108 km^2 assessed
- Miombo and Evergreen Forests
- Limestone Gorge forests particularly rare and sensitive to change
- Largely unprotected forests
- Logging common in area
- Highest poverty rates

Identified Challenges

- Improving accuracy of Miombo and Mopane forest detections in a stable and reliable way.
- Utility of the TCD to help to support the categorization of open versus closed canopy; threshold of 65% to define this.

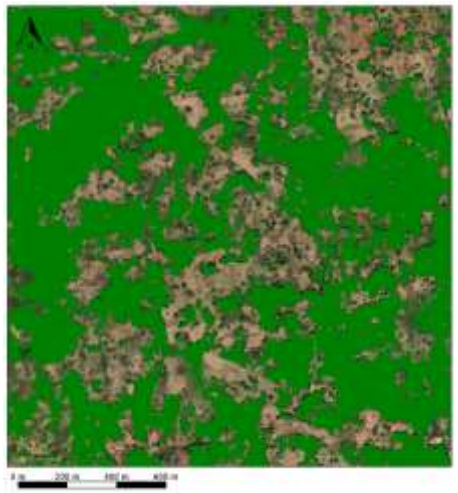
Mixture between cropland and open canopy woodland

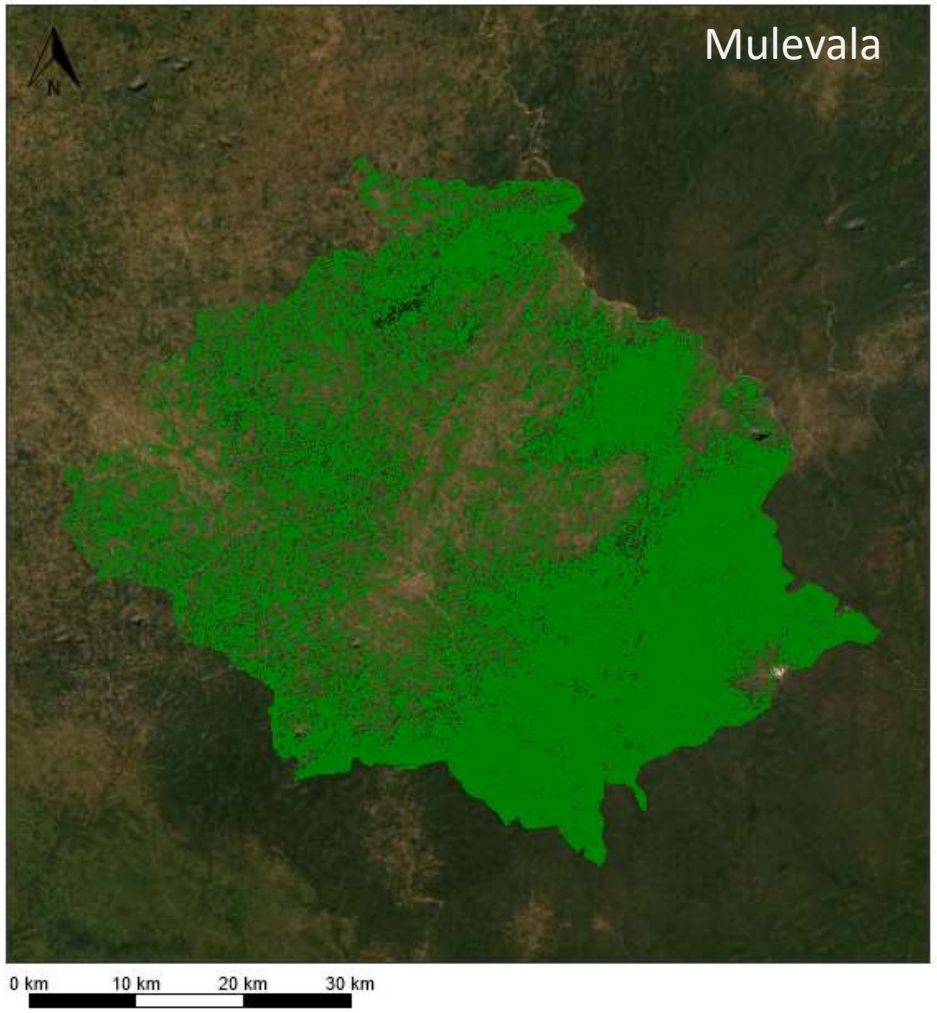
Dense miombo type woodland under leaf-on / leaf-off condition

Service Provision – Tree Cover

- Stable and high accuracy coverage of complex ecosystems
- Identify trees at a high detail (10m) with accuracies of approximately 87.6 % in challenging Mopane and Miombo ecosystems.
- Other influences from small scale agriculture, harvesting of timber and harvesting non-timber products can be accounted for, at this scale (10m)
- Allows flexibility for adaptation to a wider range of use cases

Tree Covered area in 2020		
Category	Area (km²)	Area (%)
Tree Cover	1,679	62
Non-tree Cover	1,022	38
Overall Accuracy		89

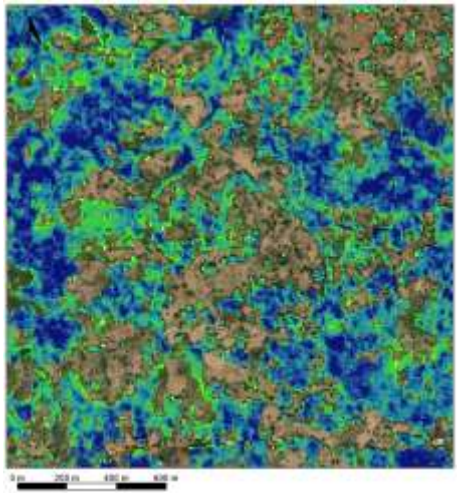


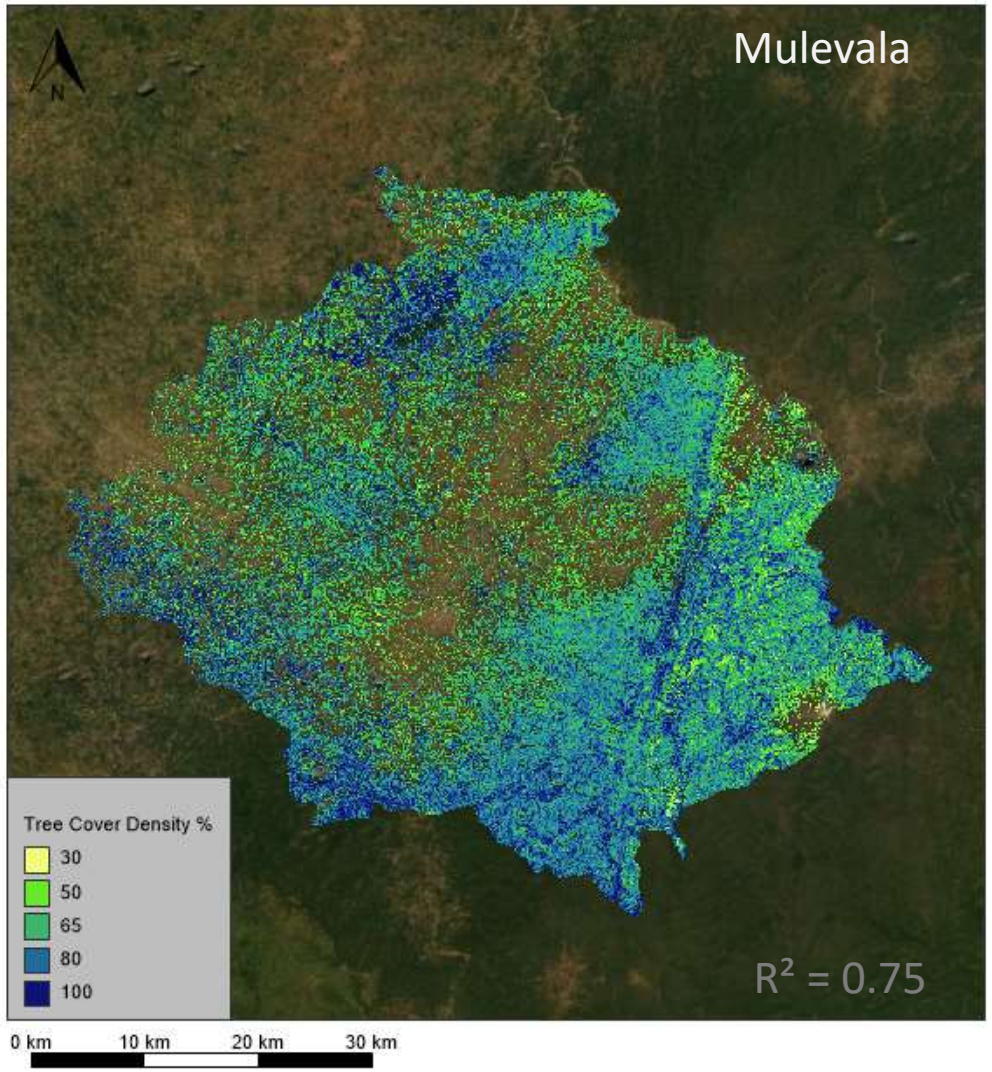


Source: Forest monitoring EO4SD FM Overview of Mozambique Activities, 2022 Oct., 27: GAF AG; ESA

Tree Cover Density

- TCD provided distinction between open and closed canopies based on 65% threshold





Tree cover density in 2020			
Density percentage (%)	Category	Area (ha)	Area (%)
0	No Tree Cover	418.04	12
>1-30	Open (sparse) canopy	467.12	13
>30-65	Open Canopy	856.3	24
>65-80	Closed Canopy	749.33	21
>80-100	Closed (dense) canopy	1,065.33	30

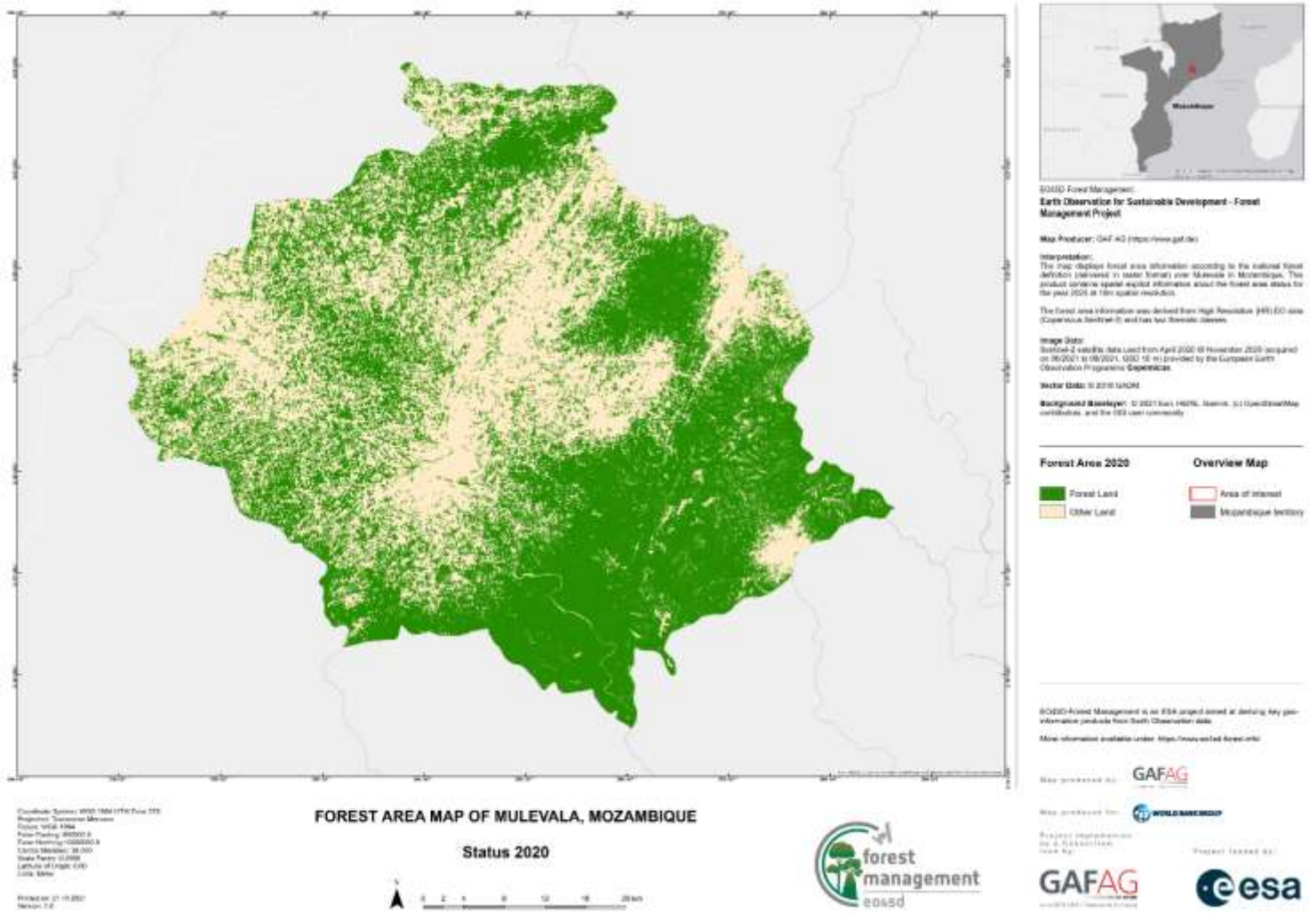
Source: Forest monitoring EO4SD FM Overview of Mozambique Activities, 2022 Oct., 27: GAF AG; ESA

Service Provision – Forested Areas

All forest types are consolidated into a single ‘forest’ category; other land cover types are aggregated into a ‘non-forest’ category.

The applied criteria to build the forest mask were:

- Tree covered area >1 ha
- Tree cover density >30 %



Area of this which is considered Forested		
Category	Area (km^2)	Area (%)
Forested Area	1,494	55
Non-forested area	1,206	45

Source: Forest monitoring EO4SD FM Overview of Mozambique Activities, 2022 Oct., 27: GAF AG; ESA

Challenges

- High resolution Satellite data acquisition;
- Difficulty to compare historical data from satellites with different resolution imagery;
- Hard work to full fill the work shedule due to the low internet speed;
- Hardware and software acquisition and it´s updates;
- Lack of human resource in RS/GIS and financial support;
- Provision of systematic data to support yearly GHG inventory report and BUR/BRT annex;

Request

- Needs of support on the challenges items presented for Systematic GHG reporting

Measure the Earth, Here and Beyond™

Thank you

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