



# Introducing the Forest Canopy Disturbance Monitoring (FCDM) Tool

FCDM-optical and FCDM-radar Monitoring Approaches

**GEO GFOI WORKSHOP**

**16.-17.06.2021**

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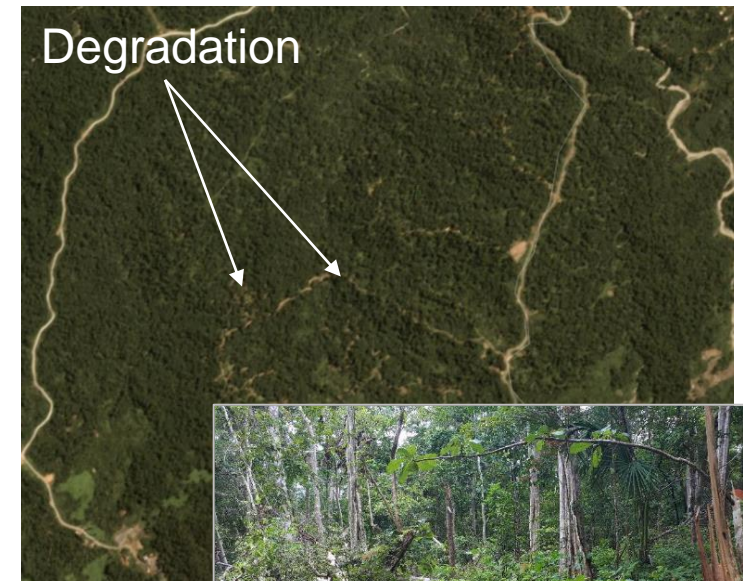
*JRC.D1*

# Challenges of Monitoring Disturbances

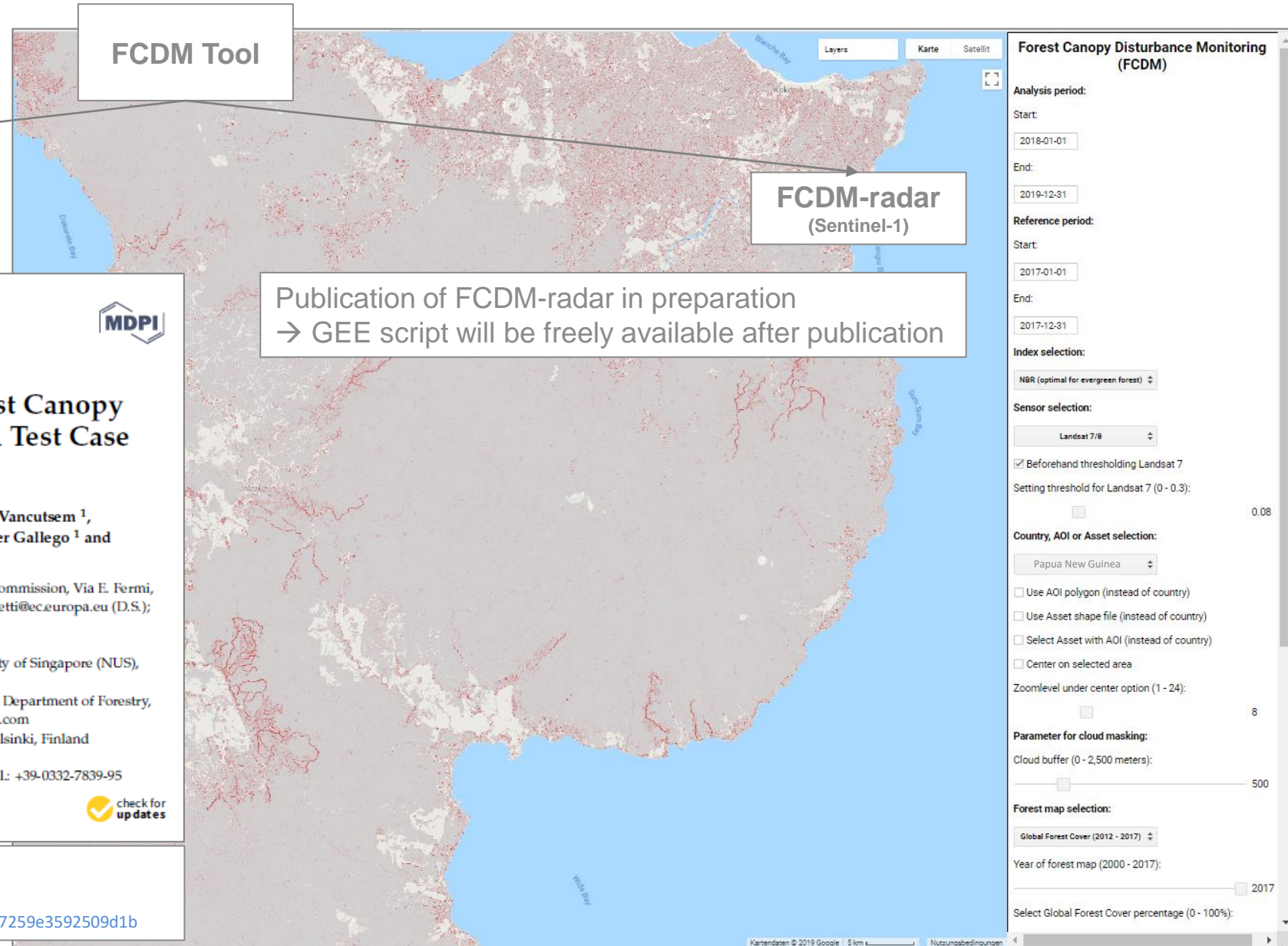
## Problems to detect forest disturbances/ degradation

- Small-scale signal (e.g. removal of single trees)
- Weak signal (low signal-to-noise ratio)
- Signal only detectable over a short period due to
  - Fast vegetation regrowth in tropics
  - Frequent cloud coverage in tropics
- Differentiation between natural phenological changes (e.g. seasonality) and actual disturbance events

→ **FCDM targets the detection of small-scale and short duration disturbances** that are not accurately detected by other approaches



# GUI of FCDM Tool in Google Earth Engine





FCDM Tool

FCDM-optical  
(Landsat, Sentinel-2)

FCDM-radar  
(Sentinel-1)

Publication of FCDM-radar in preparation  
→ GEE script will be freely available after publication


 **remote sensing** 

Article

## Towards Operational Monitoring of Forest Canopy Disturbance in Evergreen Rain Forests: A Test Case in Continental Southeast Asia

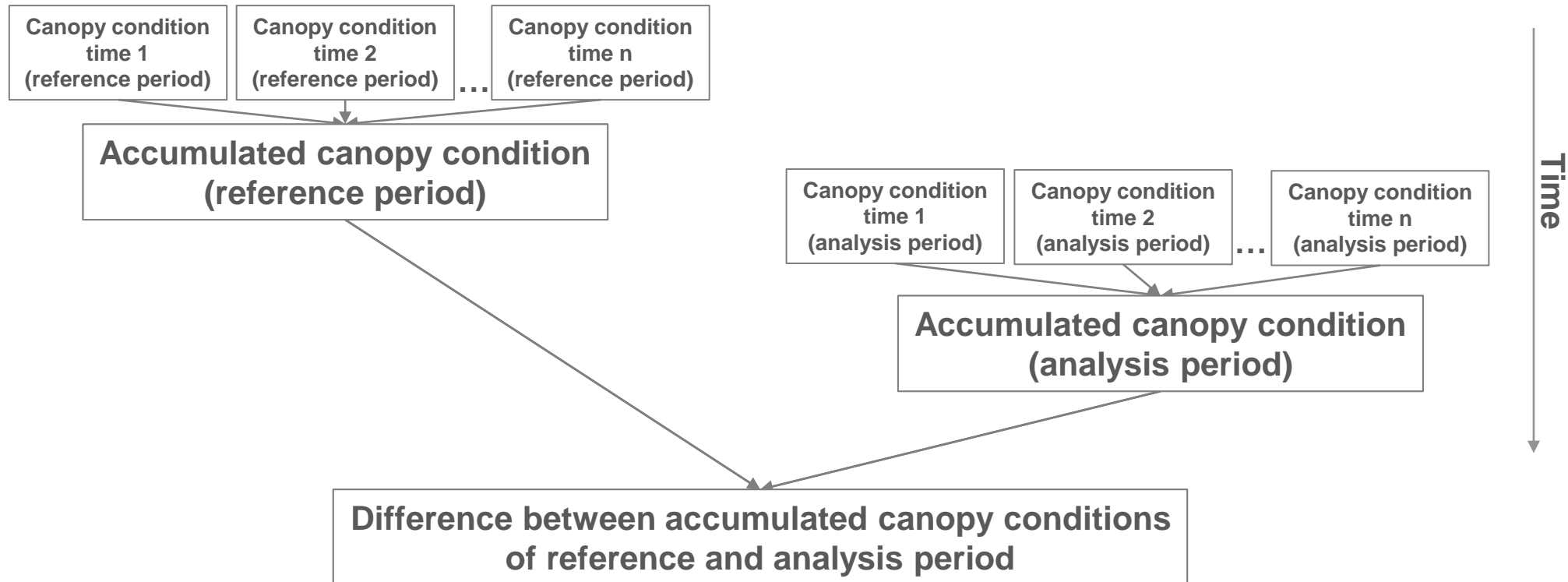
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→ GEE script is freely available  
Paper: <http://www.mdpi.com/2072-4292/10/4/544>  
Script v2.4.1: <https://code.earthengine.google.com/c08ef143fa94c22bc7259e3592509d1b>

# Basic Concept of the two FCDM Methodologies



|                       | Reference period | Analysis period | FCDM result |
|-----------------------|------------------|-----------------|-------------|
| <b>Canopy Opening</b> | No               | Yes             | Disturbance |
|                       | Yes              | No              | Regrowth*   |
|                       | Yes              | Yes             | No change   |
|                       | No               | No              | No change   |

# Comparison of Different Monitoring Approaches (GFW)



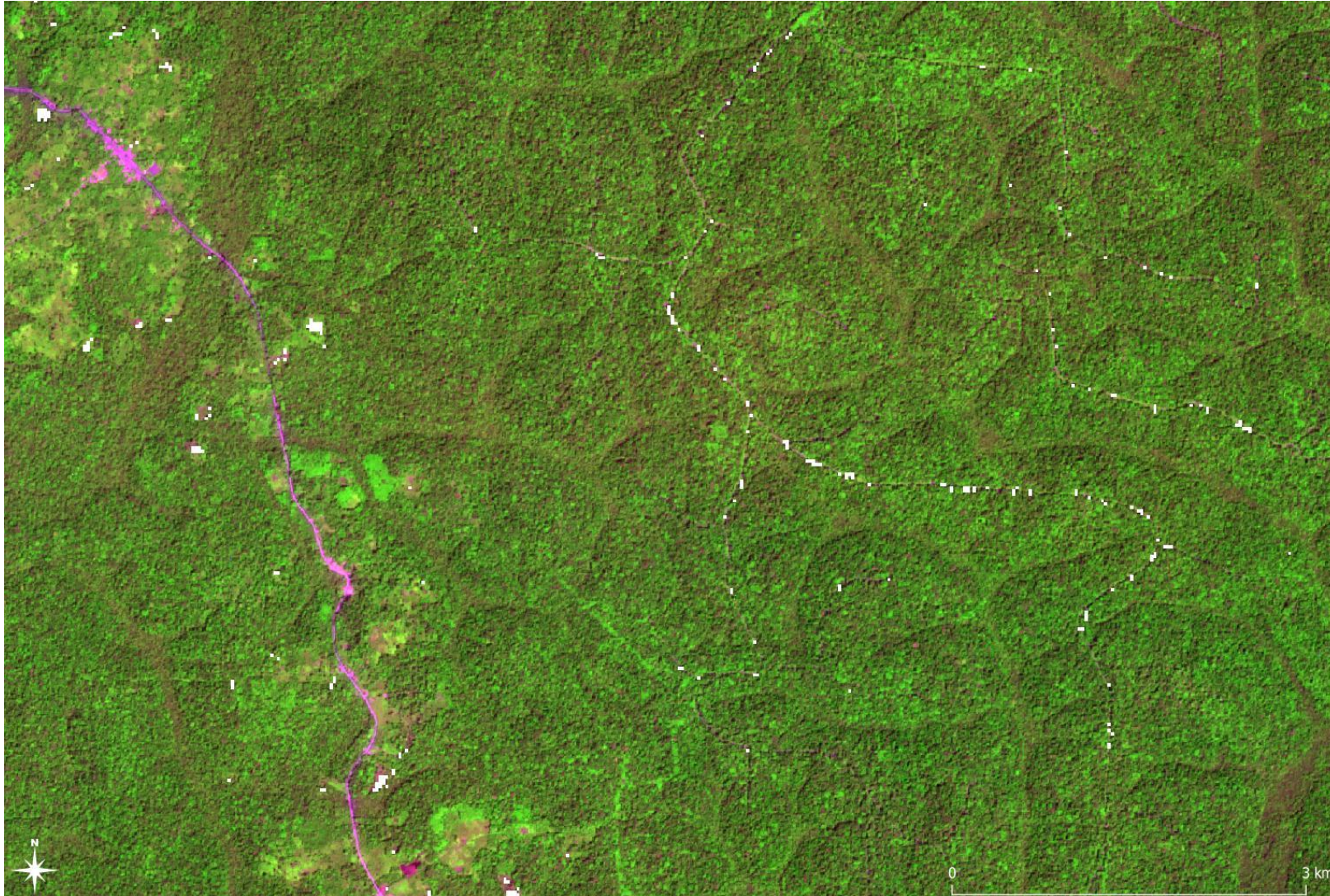
**Cameroon:**

Analysis period:

01.01.2020 – 31.12.2020

- Planet data (01.12.2020)
- GFW loss 2020

# Comparison of Different Monitoring Approaches (GLAD)



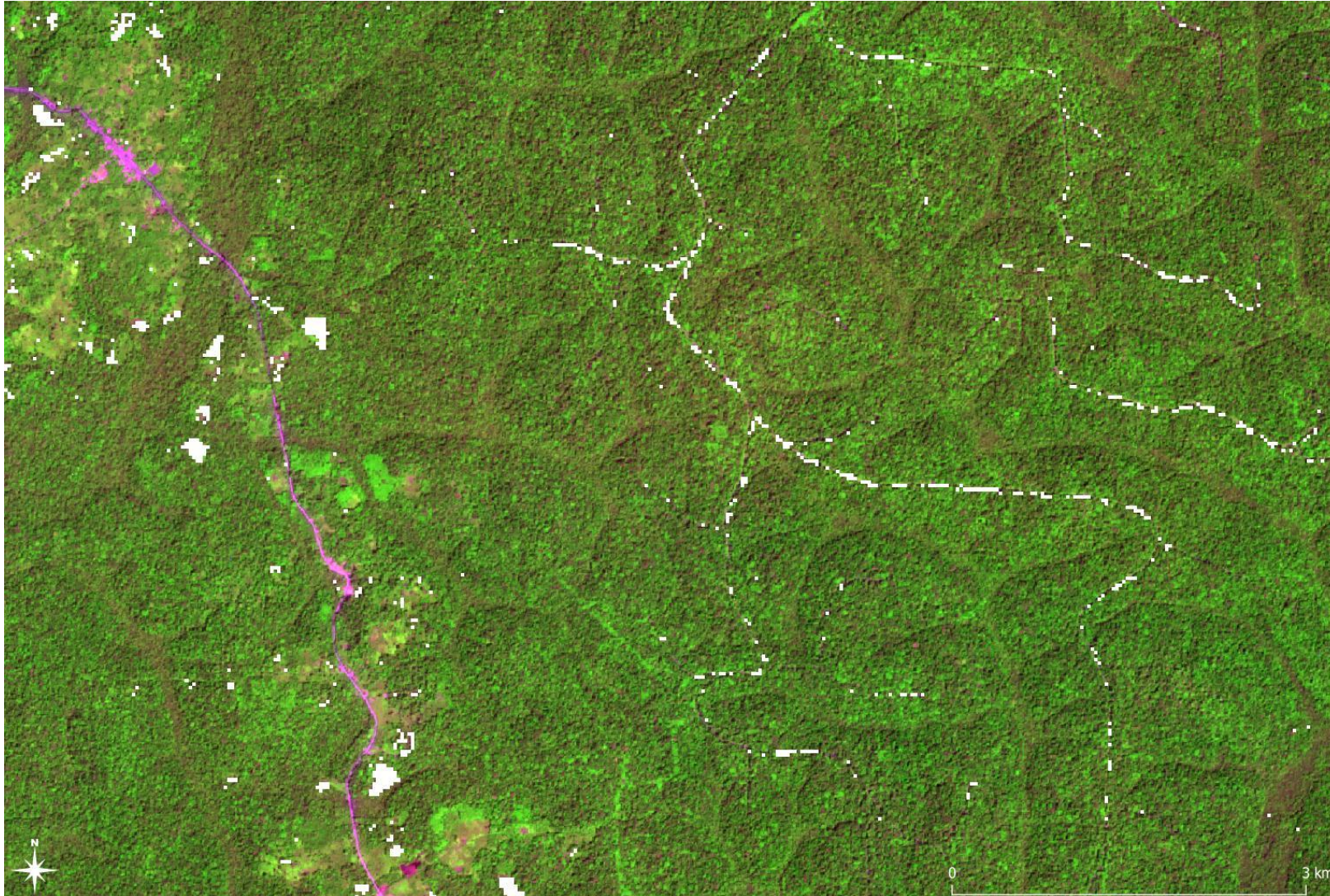
## Cameroon:

Analysis period:

01.01.2020 – 31.12.2020

- Planet data (01.12.2020)
- GFW loss 2020
- GLAD alerts 2020

# Comparison of Different Monitoring Approaches (TMF)



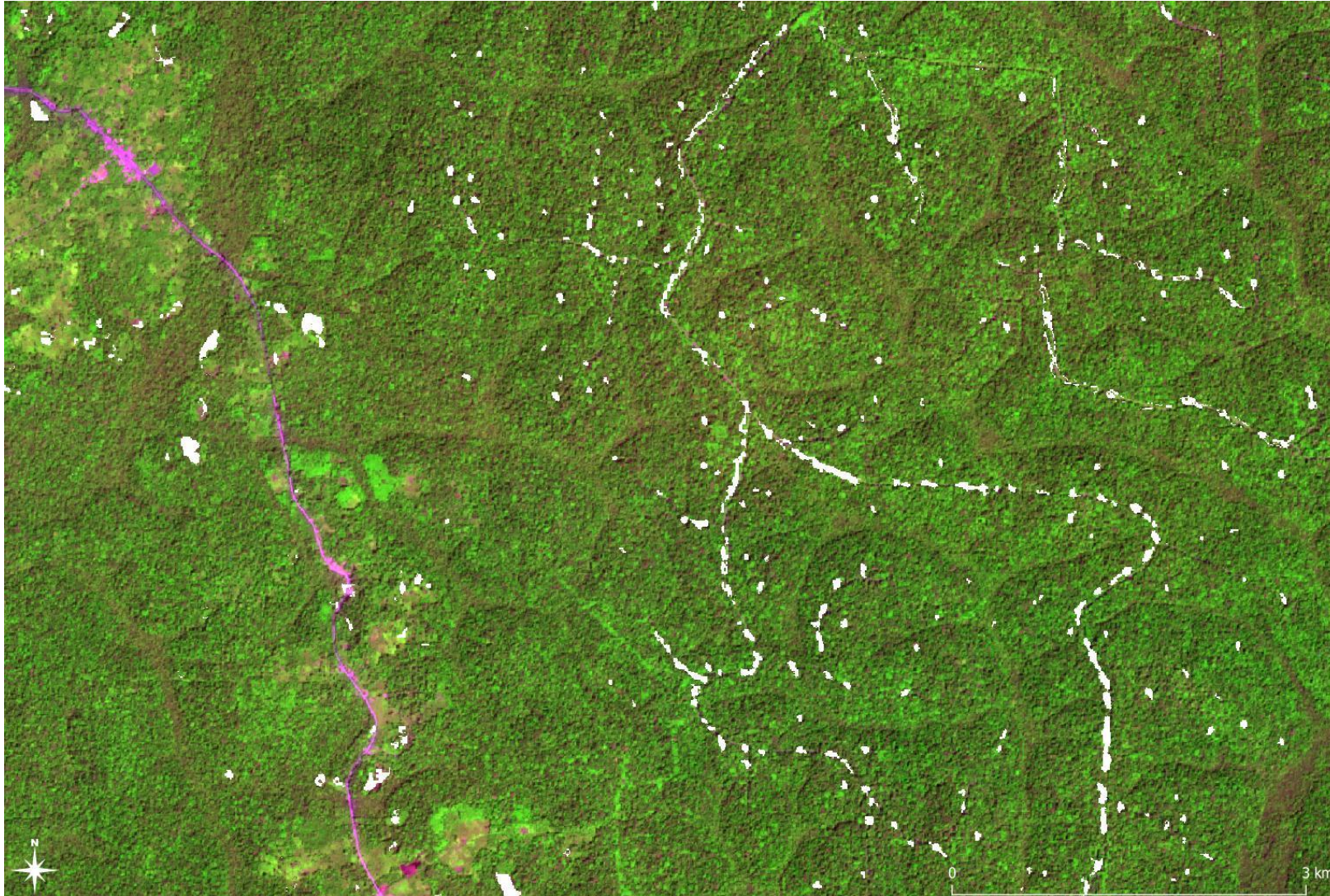
## Cameroon:

Analysis period:

01.01.2020 – 31.12.2020

- Planet data (01.12.2020)
- GFW loss 2020
- GLAD alerts 2020
- TMF 2020

# Comparison of Different Monitoring Approaches (RADD)



## Cameroon:

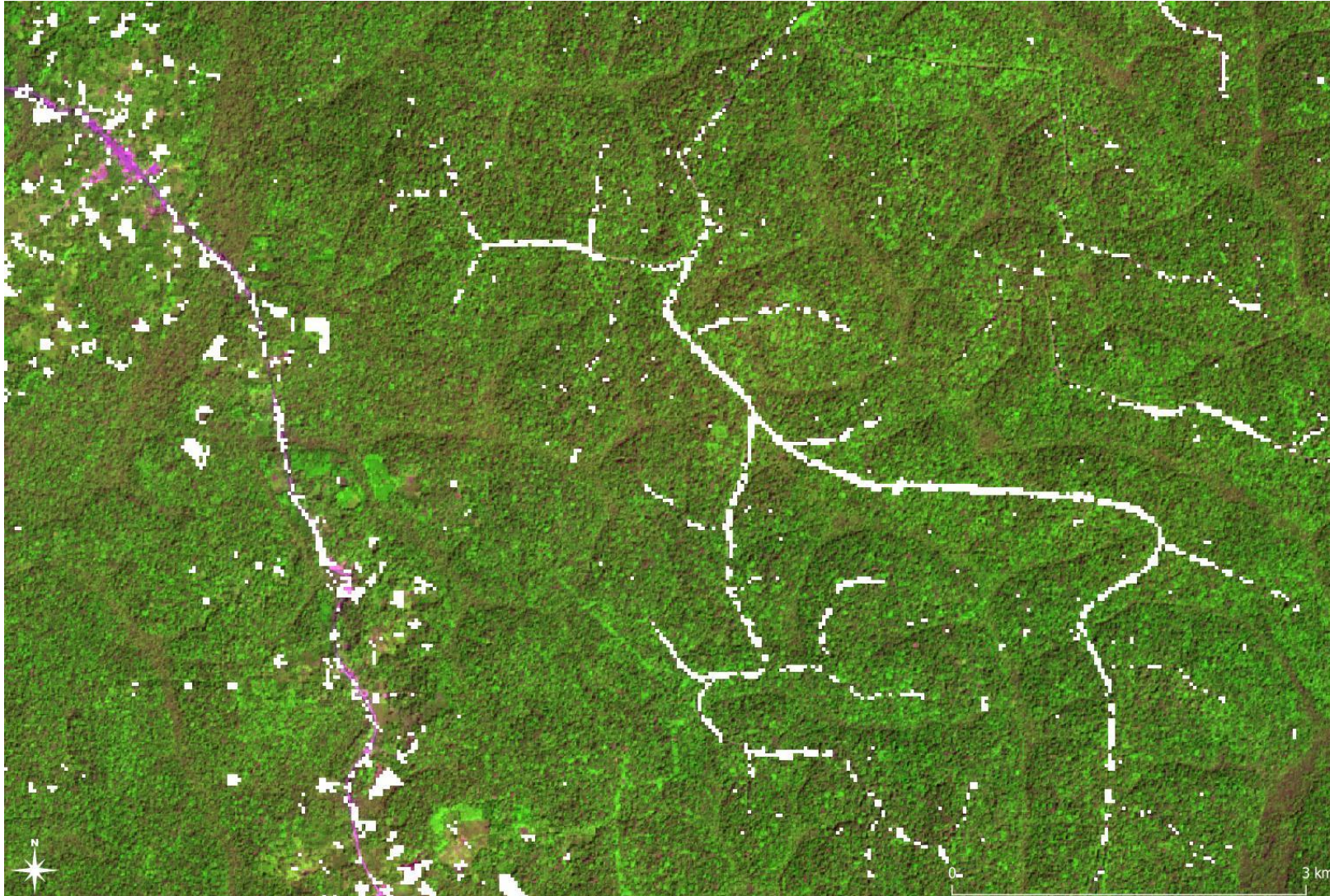
Analysis period:

01.01.2020 – 31.12.2020

- Planet data (01.12.2020)
- GFW loss 2020
- GLAD alerts 2020
- TMF 2020
- RADD alerts 2020



# Comparison of Different Monitoring Approaches (FCDM)



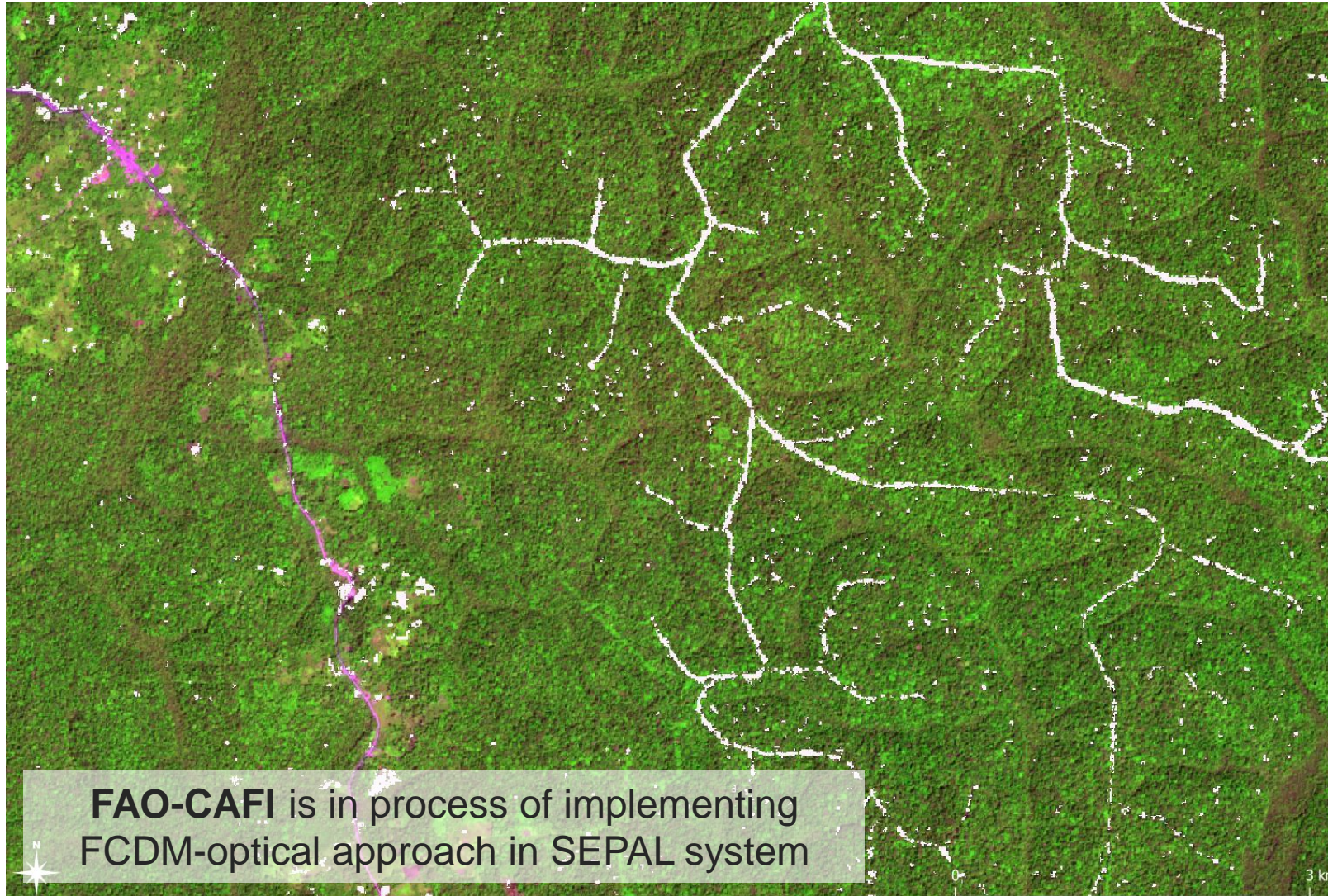
## Cameroon:

Analysis period:

01.01.2020 – 31.12.2020

- Planet data (01.12.2020)
- GFW loss 2020
- GLAD alerts 2020
- TMF 2020
- RADD alerts 2020
  
- FCDM-optical (L7/ L8) 2020

# Comparison of Different Monitoring Approaches (FCDM)



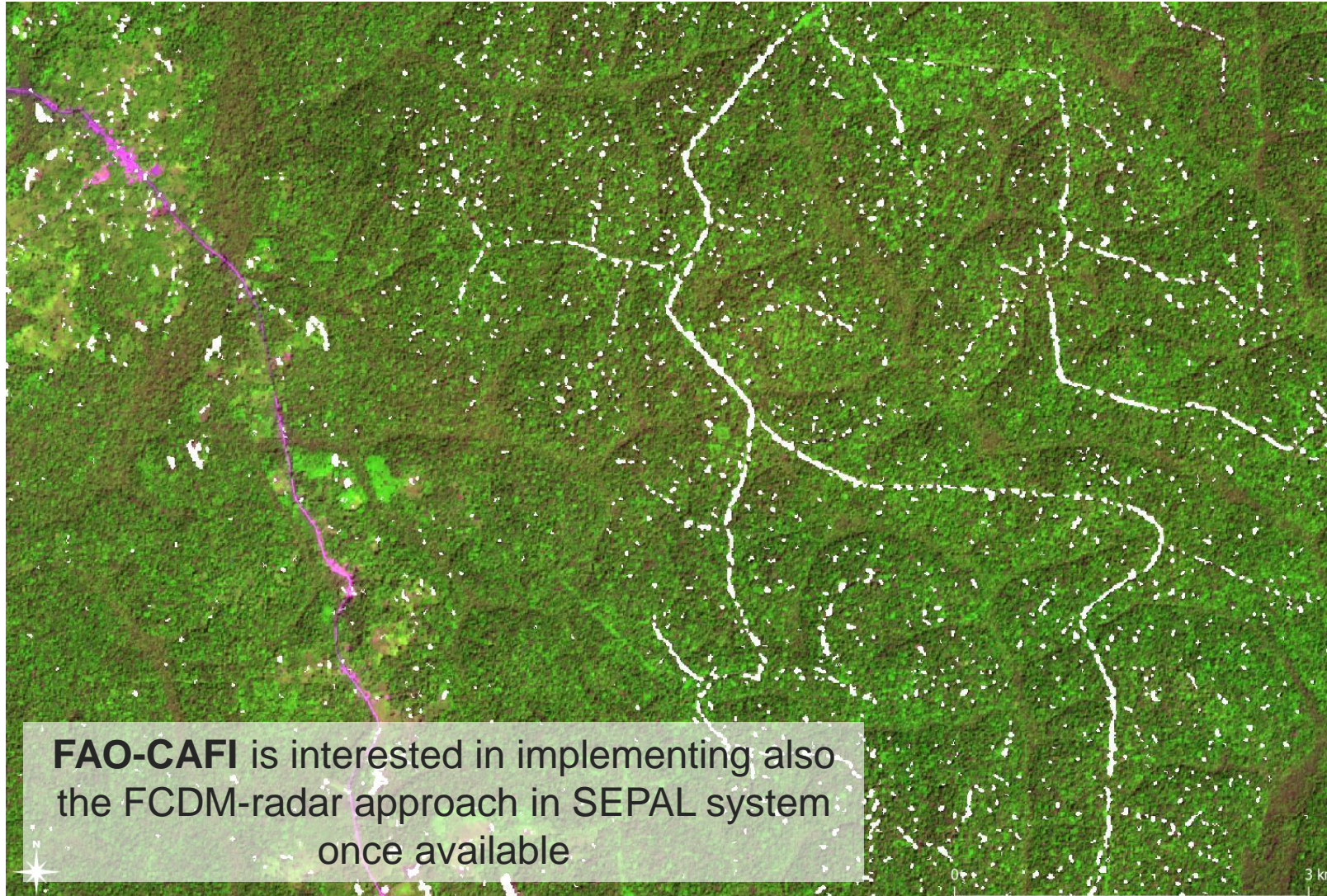
## Cameroon:

Analysis period:

01.01.2020 – 31.12.2020

- Planet data (01.12.2020)
- GFW loss 2020
- GLAD alerts 2020
- TMF 2020
- RADD alerts 2020
  
- FCDM-optical (L7/ L8) 2020
- FCDM-optical (S2) 2020

# Comparison of Different Monitoring Approaches (FCDM)



## Cameroon:

Analysis period:

01.01.2020 – 31.12.2020

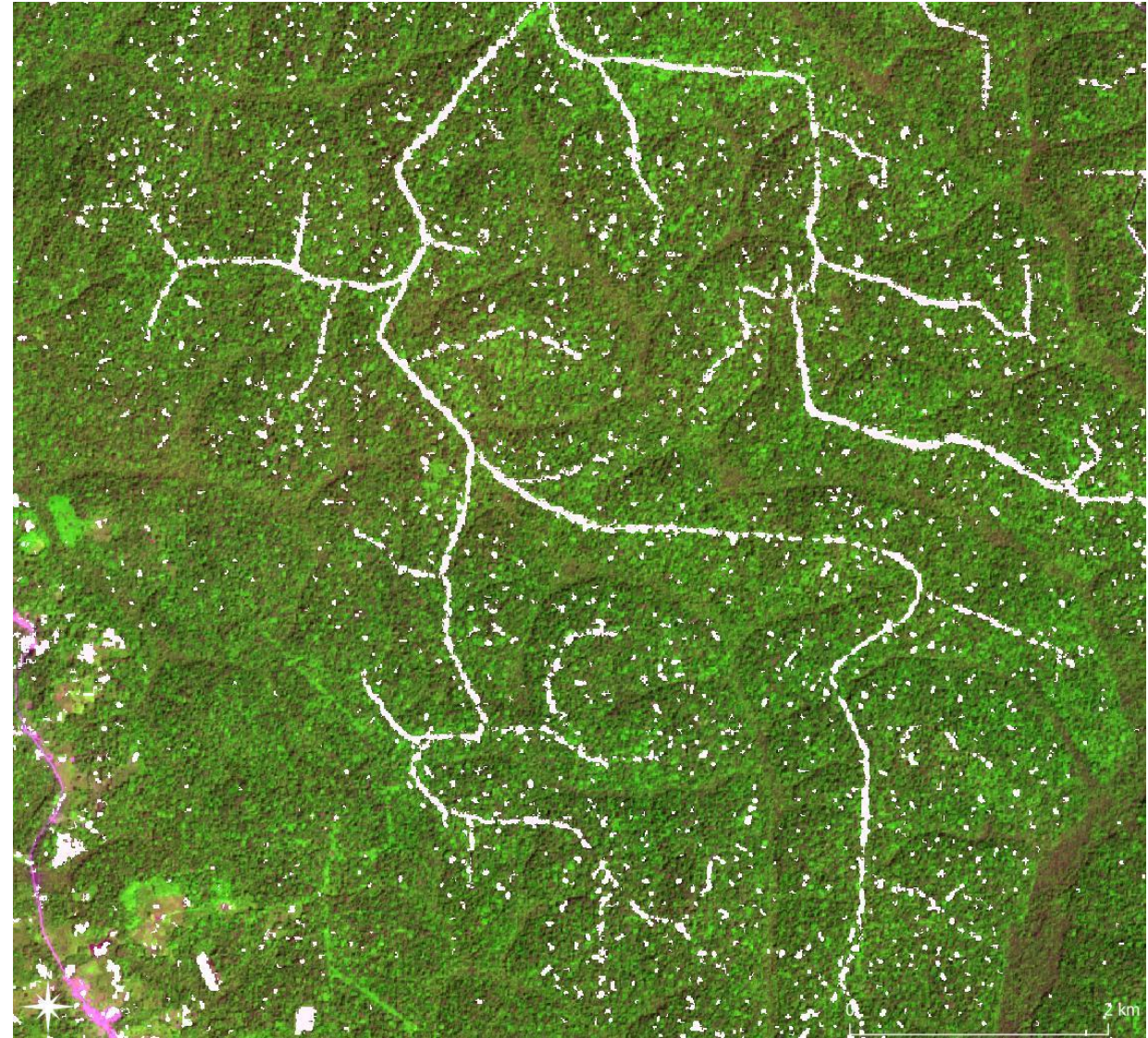
- Planet data (01.12.2020)
- GFW loss 2020
- GLAD alerts 2020
- TMF 2020
- RADD alerts 2020
  
- FCDM-optical (L7/ L8) 2020
- FCDM-optical (S2) 2020
- FCDM-radar (S1) 2020

# Comparison of Different Monitoring Approaches

GFW, GLAD, TMF, RADD for the year 2020



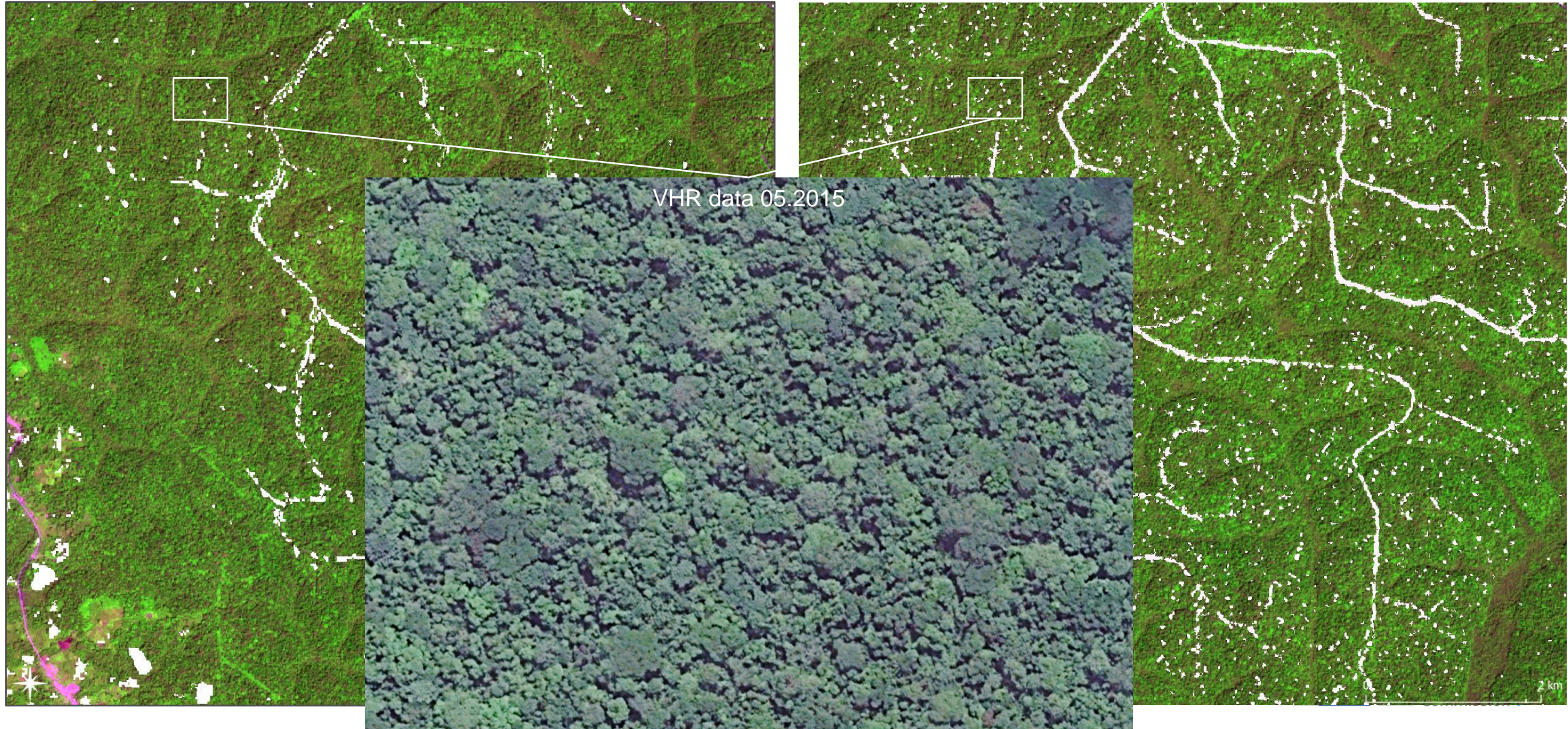
FCDM-optical (S2), FCDM-radar (S1) for the year 2020



# Comparison of Different Monitoring Approaches

GFW, GLAD, TMF, RADD for the year 2020

FCDM-optical (S2), FCDM-radar (S1) for the year 2020



# Comparison of Different Monitoring Approaches

GFW, GLAD, TMF, RADD for the year 2020

FCDM-optical (S2), FCDM-radar (S1) for the year 2020



# Documentation of FCDM

The screenshot shows the Zenodo record for 'Andi1974/Forest-degradation-monitoring: FCDM tool v2.4'. It includes the date 'June 6, 2019', the author 'Andreas Langner', and a description 'Another bug fix for Sentinel 2 processing'. The record is categorized as 'Software' and 'Open Access'. It has 5,598 views and 1,577 downloads. A file list is visible, including 'Delta-rNBR.txt' (117.0 KB), 'DeltaNBR.pdf' (8.7 MB), 'LICENSE' (35.1 KB), 'Manual\_GEE\_script\_Delta-rNBR.pdf' (3.3 MB), and 'README.md' (1.1 KB). A GitHub repository link is also present.

<https://zenodo.org/record/3240021#.YMsoCagzaJY>

The screenshot shows the GitHub repository for 'Andi1974 / Forest-degradation-monitoring'. It includes the repository name, a description 'Repository for technical data dealing with (semi)-evergreen forest degradation monitoring', and a list of files: 'Delta-rNBR.txt', 'DeltaNBR.pdf', 'LICENSE', 'Manual\_GEE\_script\_Delta-rNBR.pdf', and 'README.md'. The repository has 31 commits and 14 releases. The README.md file is expanded, showing the following content:

**Forest-degradation-monitoring**

Repository for technical data dealing with (semi)-evergreen forest degradation monitoring

A Google Earth Engine (GEE) script allows deriving changes in canopy cover closure, which can be interpreted as forest degradation information.

New script as Google shifted to new (Landsat) data collections and removed the old collections

- Surface Reflectance (SR) - Top of Atmosphere (ToA) Combination (SR data with 'simpleCloudScore' band coming from ToA data)

Purposes:

- Mapping all kind of canopy disturbances (natural or human induced) within (semi)-evergreen forests
- Disturbances can be interpreted as forest degradation events (after threshold -e.g. 0.05- is decided to separate signal from noise)
- In order to separate natural from human disturbances we recommend manual screening of the data by an experienced human interpreter

<https://github.com/Andi1974/Forest-degradation-monitoring>

The screenshot shows the IFORCE website. The header includes the European Commission logo and the text 'EU SCIENCE HUB'. The main heading is 'Forest Resources and Carbon Emissions (IFORCE)'. Below this, there is a navigation bar with 'Home > IFORCE > Forest Canopy Disturbance Monitoring (FCDM) - A freely available tool to assess potential forest degradation'. The main content area features the title 'Forest Canopy Disturbance Monitoring (FCDM) - A freely available tool to assess potential forest degradation'. The text describes the tool's purpose and how it works, mentioning the 'Normalized Burn Ratio' index (Delta-rNBR) and its application in Google Earth Engine (GEE). A screenshot of the Google Earth Engine interface is shown, displaying a map with red and green areas representing forest degradation. The interface includes a search bar, a map view, and a panel on the right with 'Analysis period' and 'Reference period' settings.

<https://forobs.jrc.ec.europa.eu/iforce/dNBR.php>

# Application of FCDM

- **Vietnam:**
  - **Forest Inventory and Planning Institute (FIPI)** uses the FCDM-optical approach for revising all cycles of NFIs
- **Laos:**
  - **Department of Forest Inspection (DOFI)** requested training on FCDM-optical approach at province level
  - **Forest Inventory and Planning Division (FIPD)** of the Department of Forestry and **F-REDD (JICA Japan)** with **SilvaCarbon (USAID)** test whether FCDM approaches can replace field work for degradation monitoring
  - **Pro-FLEGT (GIZ Germany)** together with **Aruna Technology** uses the FCDM-optical and FCDM-radar approach for Operational Logging & Degradation Monitoring (OLDM)
- **Cambodia:**
  - **General Directorate for Nature Conservation and Protection (GDANCP)** of the **Ministry of Environment (MoE)** underlines interest in further training on the FCDM approaches for monitoring of illegal logging
  - **CEEJA project (Copenhagen University, DANMISSION)** uses FCDM-radar for monitoring forest disturbances within PAs
- **Thailand + Myanmar:**
  - **Royal Forest Department (RFD), Department of National Park, Wildlife and Plant Conservation (DNP)** and **Forest Department (MoNREF)** interested in training and technical support on FCDM approaches
- **Indonesia:**
  - **DG Forest Planning (MEF)** and **DG Climate Change (MEF)** sees in the FCDM approaches a suitable replacement for visual/ manual monitoring of degradation. A tailored workshop is desired.
- **EU Commission Horizon 2020 REDDCopernicus Project:**
  - **Evaluation of FCDM approaches to develop products of a future Copernicus Forest Monitoring (FM) and REDD+ Service Component**
- **CAFI (Africa):**
  - **FAO-CAFI** is in process of implementing FCDM-optical approach in SEPAL system
  - **FAO-CAFI** is interested in implementing also the FCDM-radar approach in SEPAL system once available