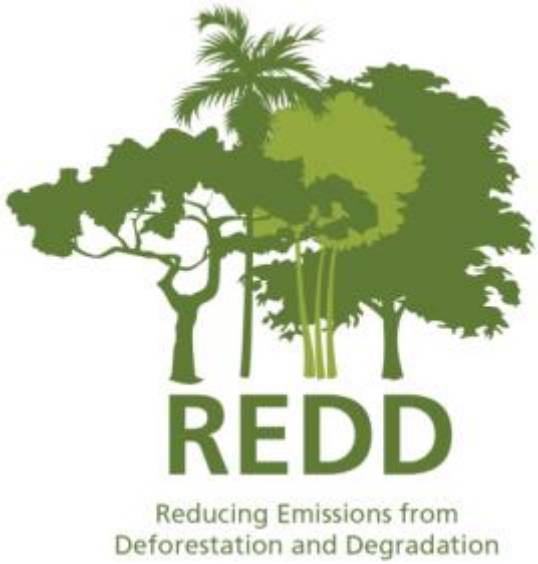
United Nations/Germany International Conference on Earth Observation

26-28 May 2015; Bonn, Germany



Contribution of EO to the Monitoring of Deforestation and Degradation in the Context of REDD

Dr. Thomas Haeusler

GAFAG

Presentation Outline

- Background REDD
- Experiences with REDD Pilot Projects in:
  - Tropical Humid Forests
  - Tropical Dry Forests
- Technical Issues in Forest Monitoring for REDD
- Conclusions and Outlook

Background REDD

Deforestation and degradation of forest land is estimated to account for roughly 17% of global greenhouse gas emissions (IPCC WGII, 2014).

- **At the UNFCCC Conference of Parties (COP) 11 in Montreal in 2005, a group of developing countries initiated a post-Kyoto Protocol mechanism to address the critical issue of reducing emissions from deforestation and degradation (REDD).**

- **The policy process went on to include other eligibel activities: sustainable forest management (SFM), enhancement of forest stocks, conservation – referred to as REDD+**

Background REDD

- The basic premise of the REDD+ policy is that countries can financially benefit by taking measures to avoid deforestation and degradation.
- In order to implement REDD+ policy requirements a key component is the assessment of **forest area change** over time.

The UNFCCC COP in 2010 noted that **remote sensing technologies** are a useful tool to provide forest information for REDD+ and countries are including this in the National Forest Monitoring Systems

Experiences with REDD Pilot Projects

REDD

1. REDD Pilot Cameroon

2008 -2009

kfw ENTWICKLUNGSBANK esa

2. GSE REDD Extension in Rep. of Congo and Gabon

2009 - 2014

esa

3. R&D REDD for Africa Cameroon and CAR

2010-2013

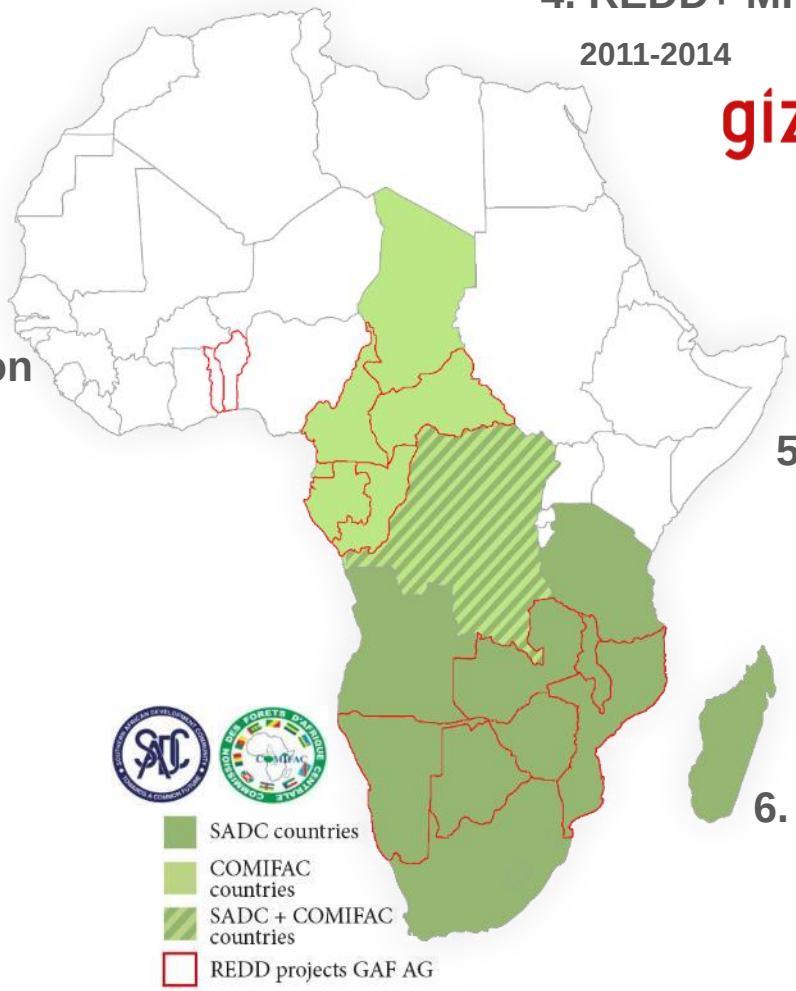
REDDAF

REA

4. REDD+ MRV for SADC

2011-2014

giz On behalf of Federal Ministry for the Environment, Nature Conservation and Nuclear Safety of the Federal Republic of Germany



5. GSE REDD – Dry Forest Mapping – Malawi, Zimbabwe

2014-2015 esa

6. GeoforAfri Rep. of Congo; Gabon, Benin, Togo

2012-2015 IRD Institut de recherche pour le développement; FFEM Fonds Français pour l'Environnement Mondial

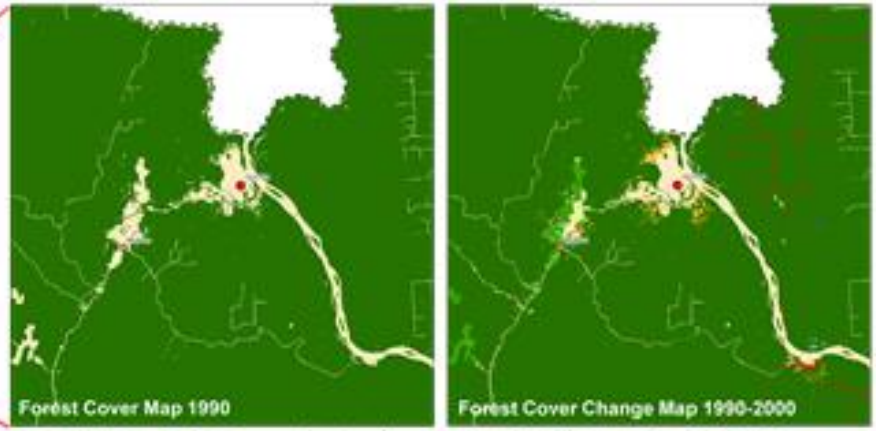
EO Mapping Components

Activity Data Assessment based on EO methods

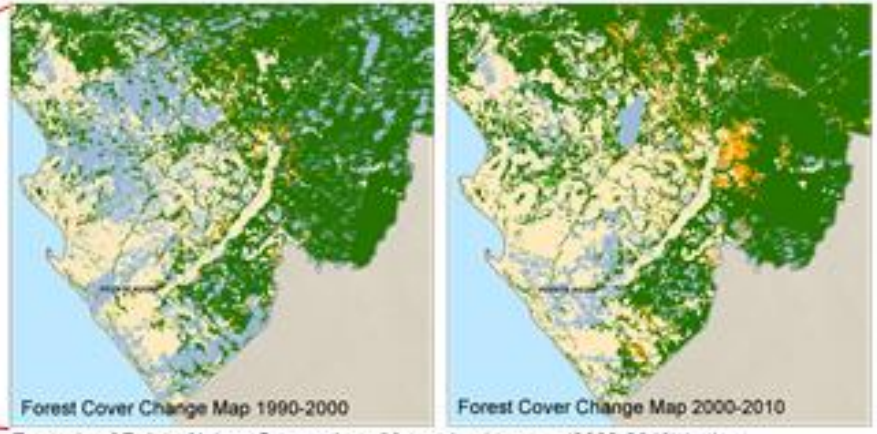
- **Historical and current forest cover mapping (1990-2000; 2000-2010/ 14), MMU 0.5 -1 ha, Accuracy. >90%**
- **Classification of deforested areas into IPCC compliant Land cover/use categories:**
  - Cropland,
  - Wetland,
  - Settlement,
  - Grassland,
  - Other land
- **Degradation mapping: disturbance mapping**

Service in Tropical Humid Forest: Republic of Congo

Forest Cover Map 2000

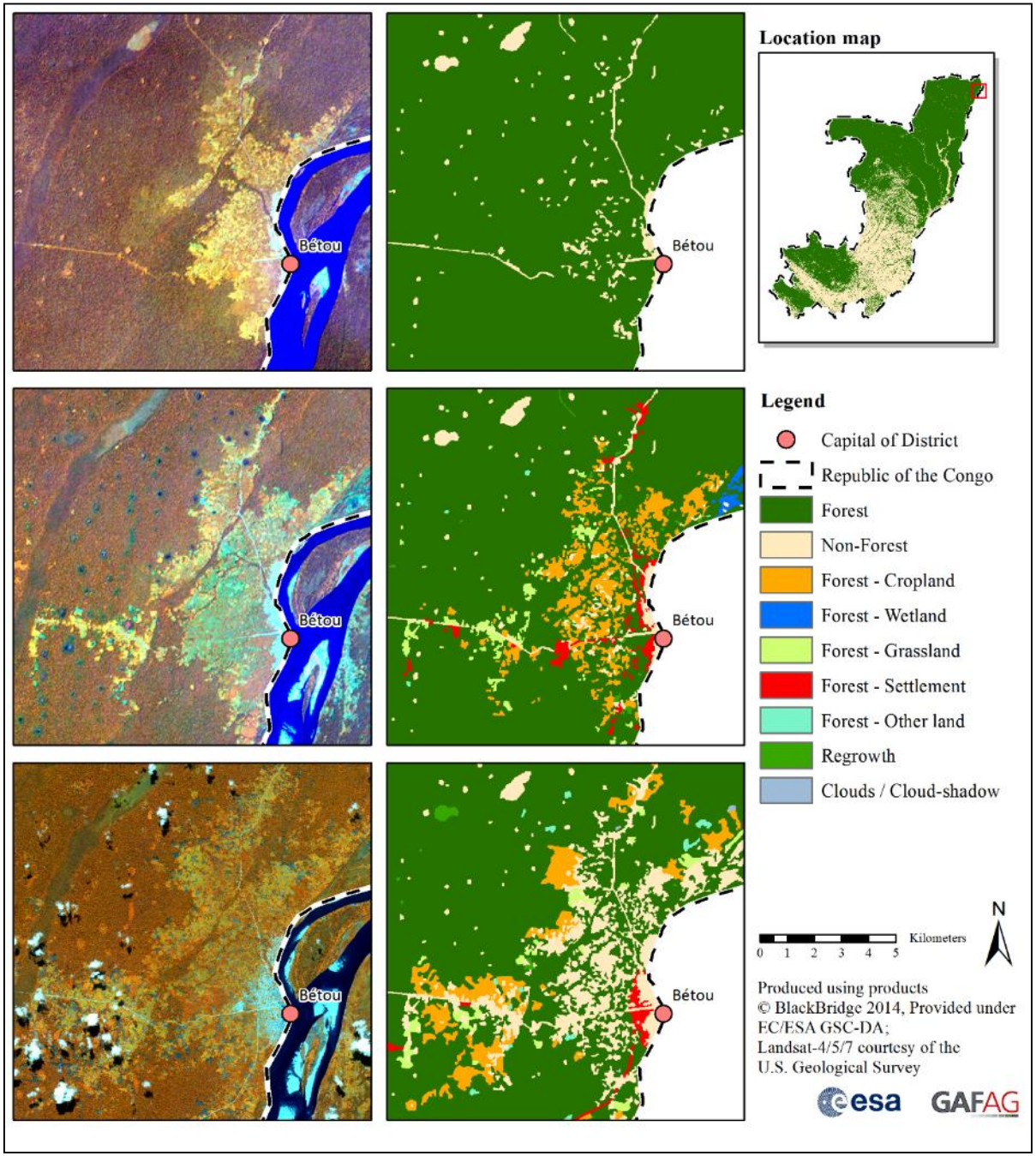


Example Ouesso - Logging road network expansion and settlement expansion (red), conversion of forest land to cropland (orange), reforestation (light green)



Example of Pointe-Noire - Conversion of forest land to crop (2000-2010) in the department of Kouilou close to the city of Pointe Noire

Forest cover and forest cover change maps for Republic of Congo



Expansion of settlements into forest land between 1990 and 2010 (Refugee camp near the border to the Democratic Republic of Congo)

Technical Issues for Tropical Humid Forests

- Overall high thematic mapping accuracies achievable (90-95%)
- Availability of cloud free EO data for large areas is problematic

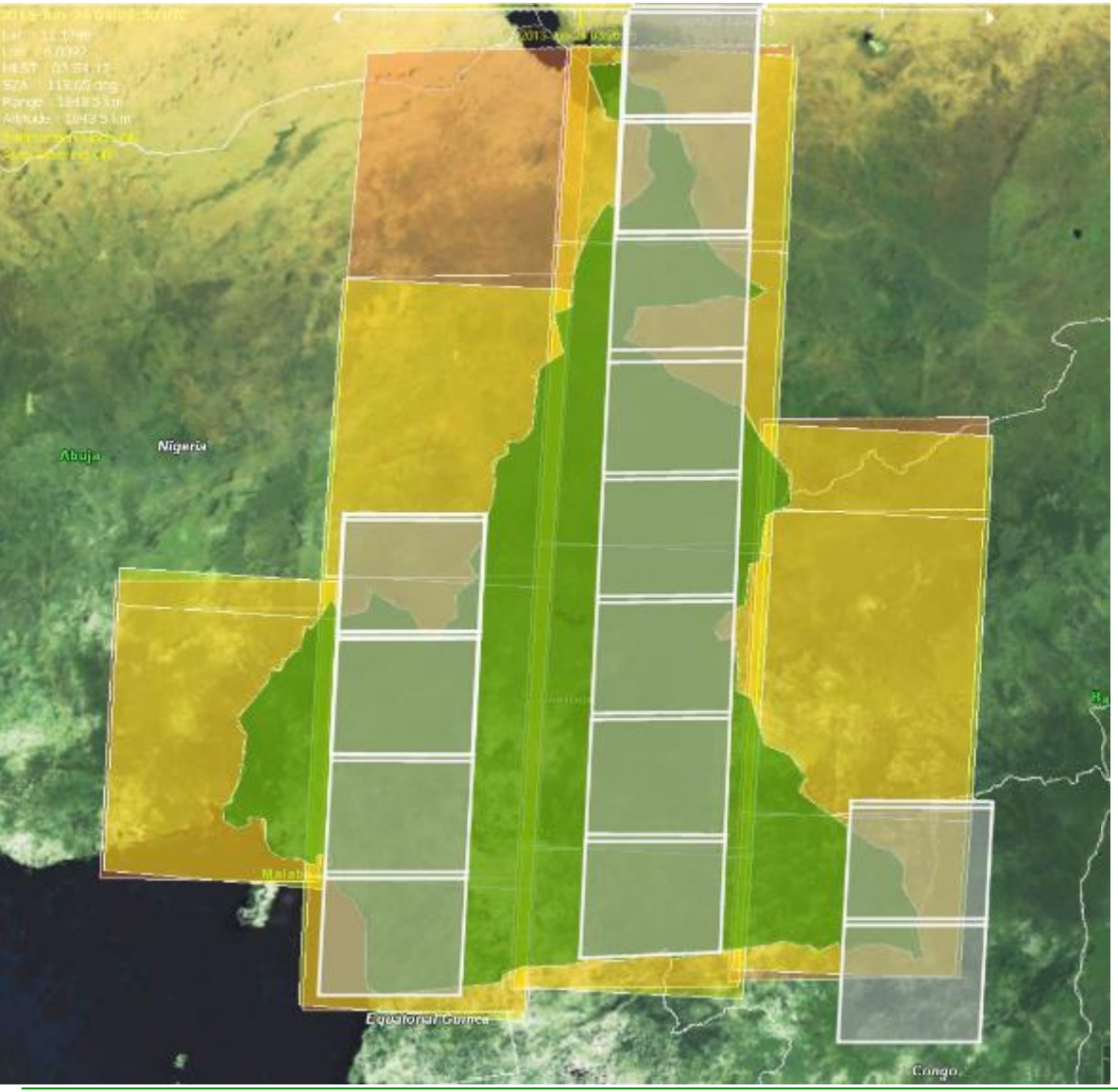
➡ Multi-sensor EO data mosaics are needed to overcome this problem

➡ Leads to higher processing effort and higher costs

- Multi-sensor adjustments
- Radiometric calibrations
- Number of residual spectral strata to be treated separately

New European satellite system SENTINEL-2 with repetition rates of 5 days and large area coverage can overcome these problems

Sentinel 2 enables lage area coverages in short time intervals



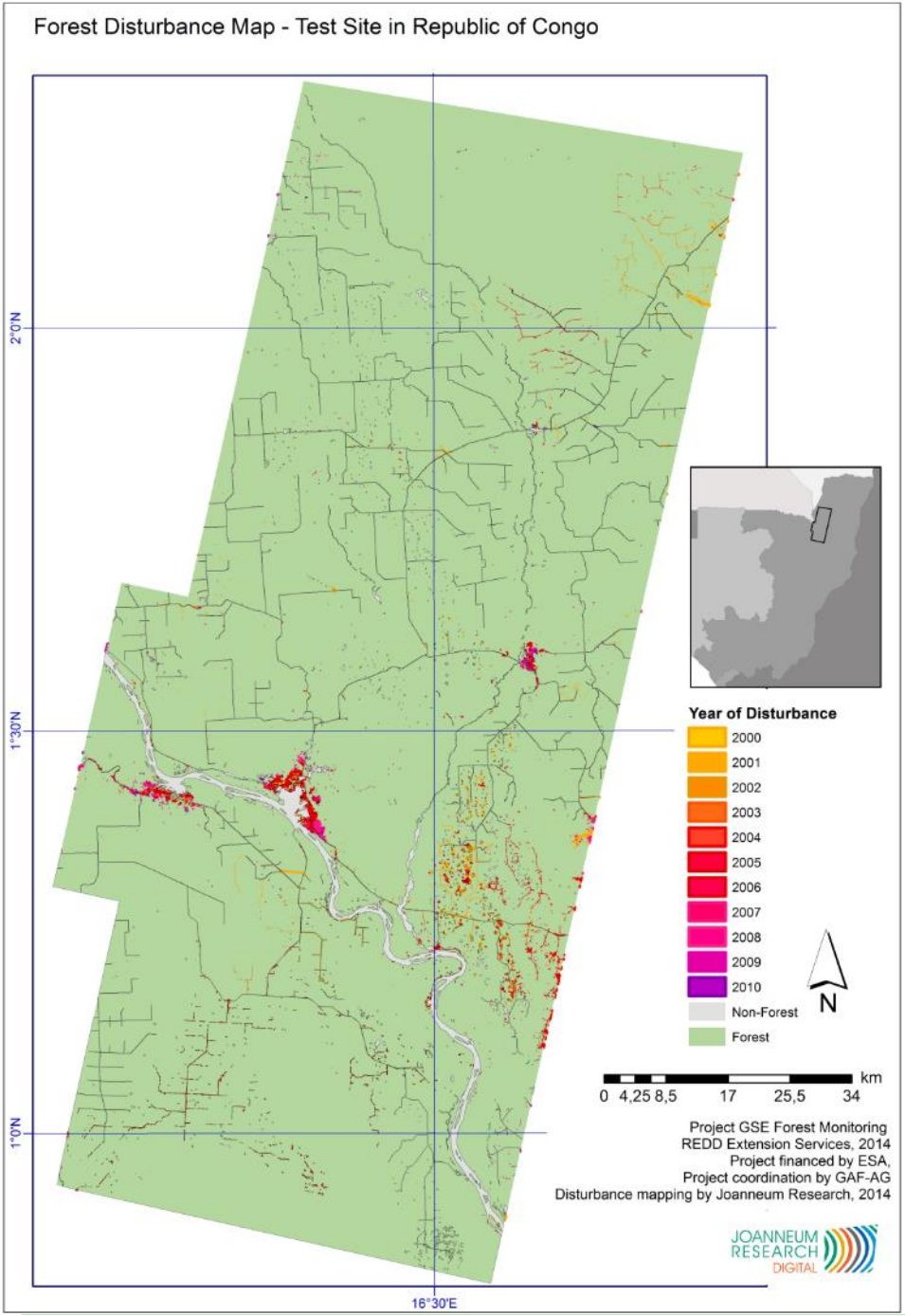
Landsat/Sentinel 2 Coverages in Cameroon (10 days Simulation)

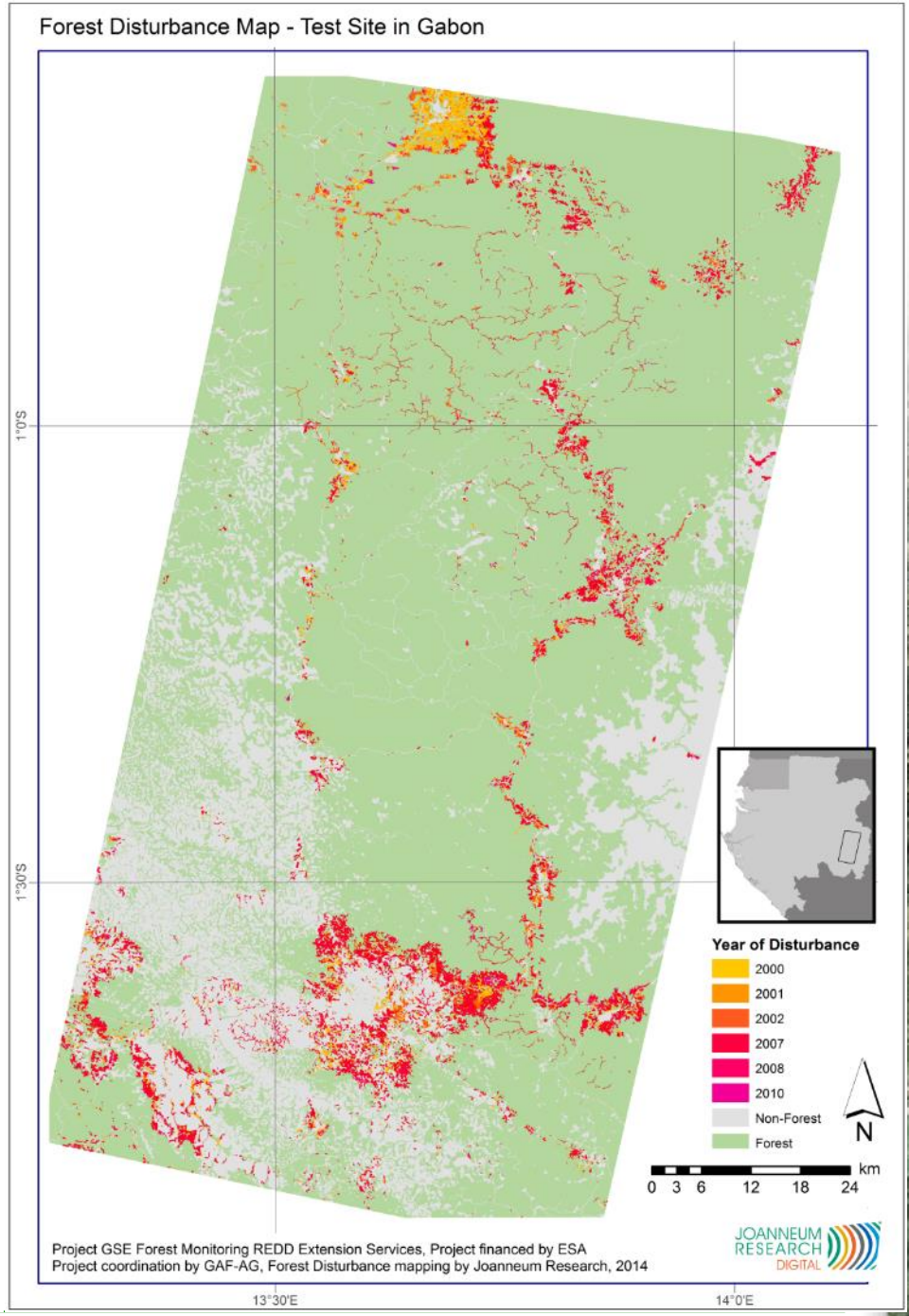
Landsat

Landsat & Sentinel 2A

Landsat & Sentinel 2A & Sentinel 2B

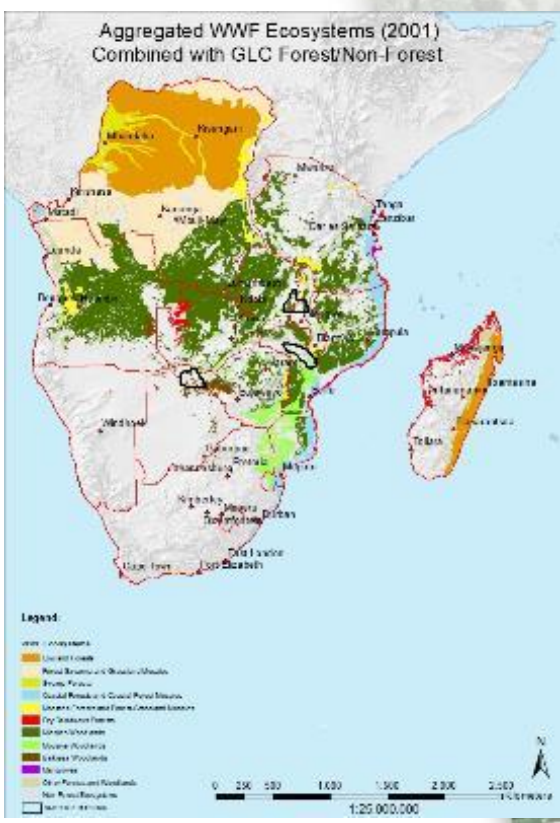
Courtesy ESA


Forest Disturbance Map - Test Site in Republic of Congo
2°0'N
1°30'N
1°0'N
16°30'E
Year of Disturbance
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Non-Forest
Forest
N
0 4,25 8,5 17 25,5 34 km
Project GSE Forest Monitoring
REDD Extension Services, 2014
Project financed by ESA,
Project coordination by GAF-AG
Disturbance mapping by Joanneum Research, 2014
JOANNEUM RESEARCH DIGITAL


Forest Disturbance Map - Test Site in Gabon
1°0'S
1°30'S
13°30'E
14°0'E
Year of Disturbance
2000
2001
2002
2007
2008
2010
Non-Forest
Forest
N
0 3 6 12 18 24 km
Project GSE Forest Monitoring REDD Extension Services, Project financed by ESA
Project coordination by GAF-AG, Forest Disturbance mapping by Joanneum Research, 2014
JOANNEUM RESEARCH DIGITAL

Service for Tropical Dry Forest: SADC

- **SADC - Southern African Development Community, 15 Member States, 5,5 mio km²**
- **Dry Forest Ecosystems cover 2.7 million sq.km in Africa and these countries have some of the highest deforestation rates**
- **SADC was interested in a regional, ecosystem based REDD+ MRV system**
- **Project implemented with 5 Pilot countries and 3 Dry Forest Ecosystems (2012-2015):**
  - Namibia, Botswana, Zambia, Malawi, Mozambique
  - Baikieae, Miombo, Mopane

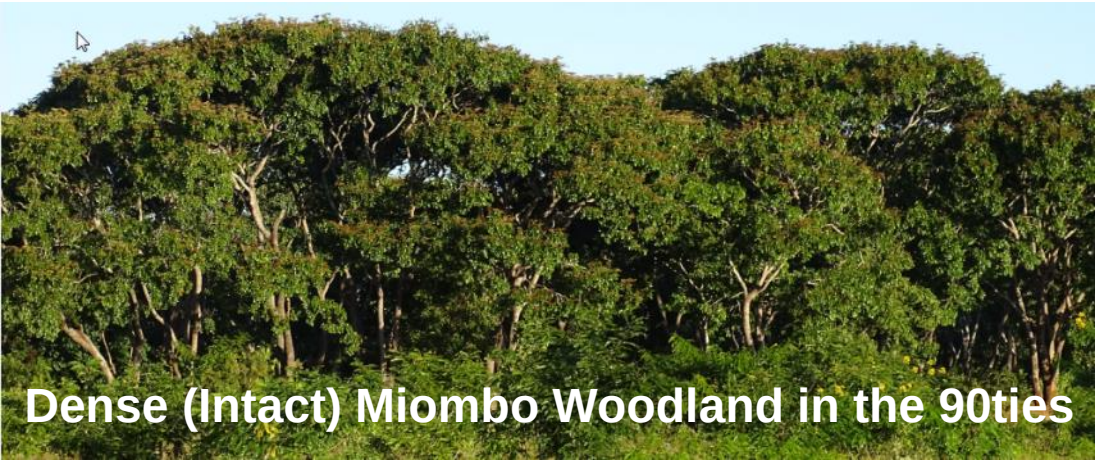


Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Deforestation in Malawi

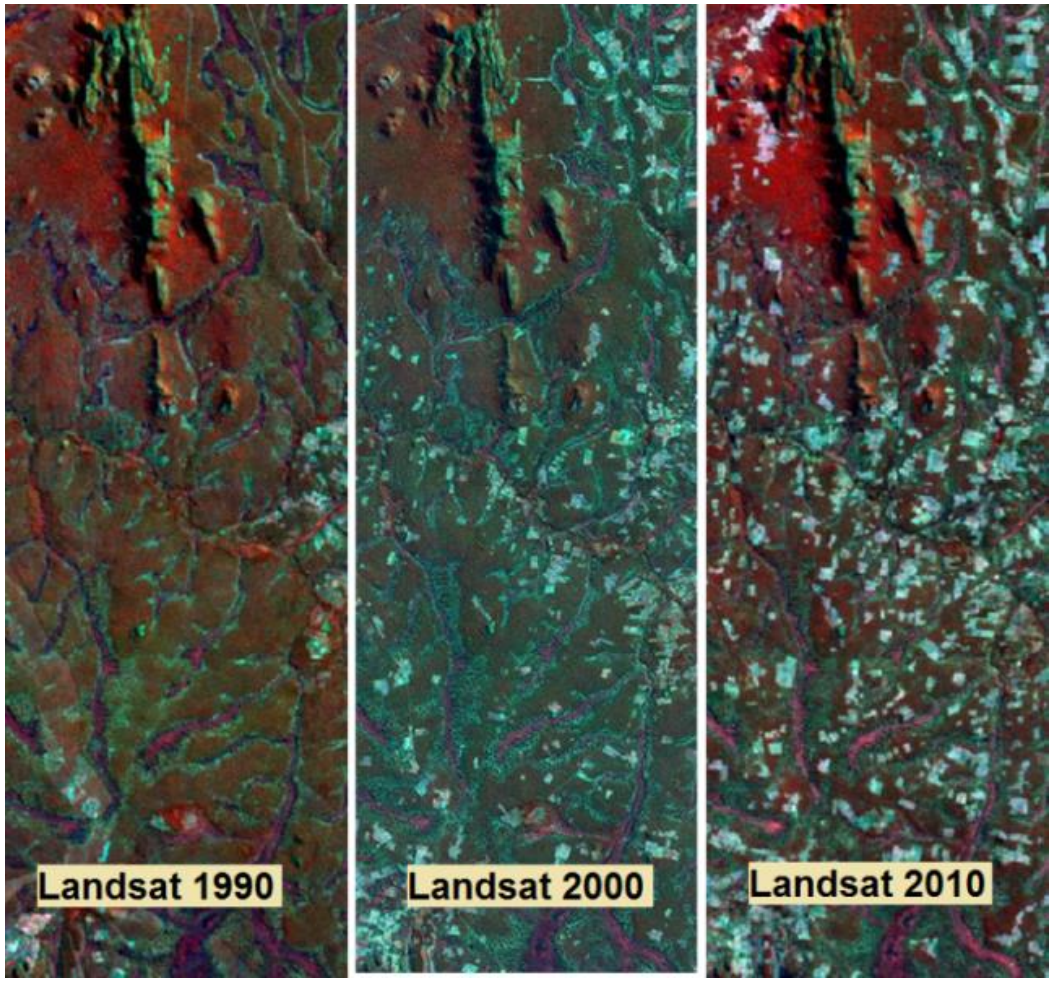
Degradation in Malawi



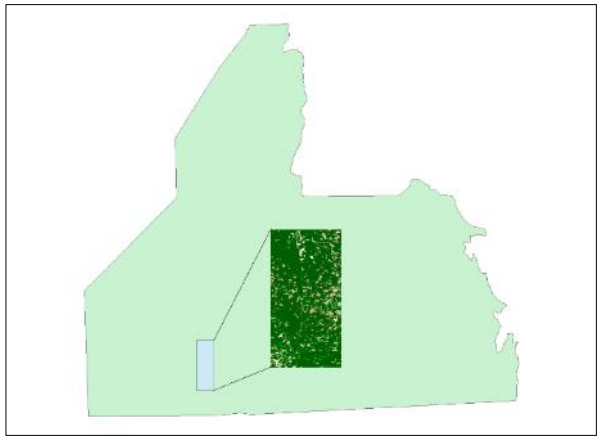
Extraction of trees for fuel wood consumtion and on-site production of charcoal….

Leads to degradation of Miombo woodlands in very short time, decline of biodiversity, finally to deforestation

Forest Change in Malawi



- Landsat images on Zambia Malawi border
- Changes in Forest Cover due to agricultural expansion



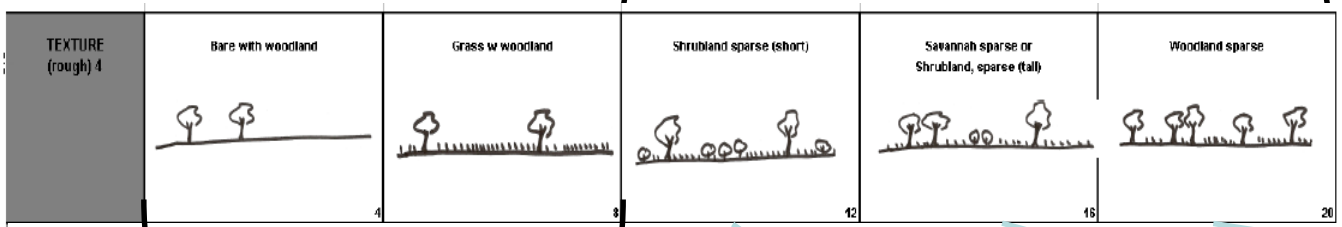
Area enlarged in Miombo study area

Technical Issues for Dry Forest Mapping

Phenology of the tree species and stand sites:

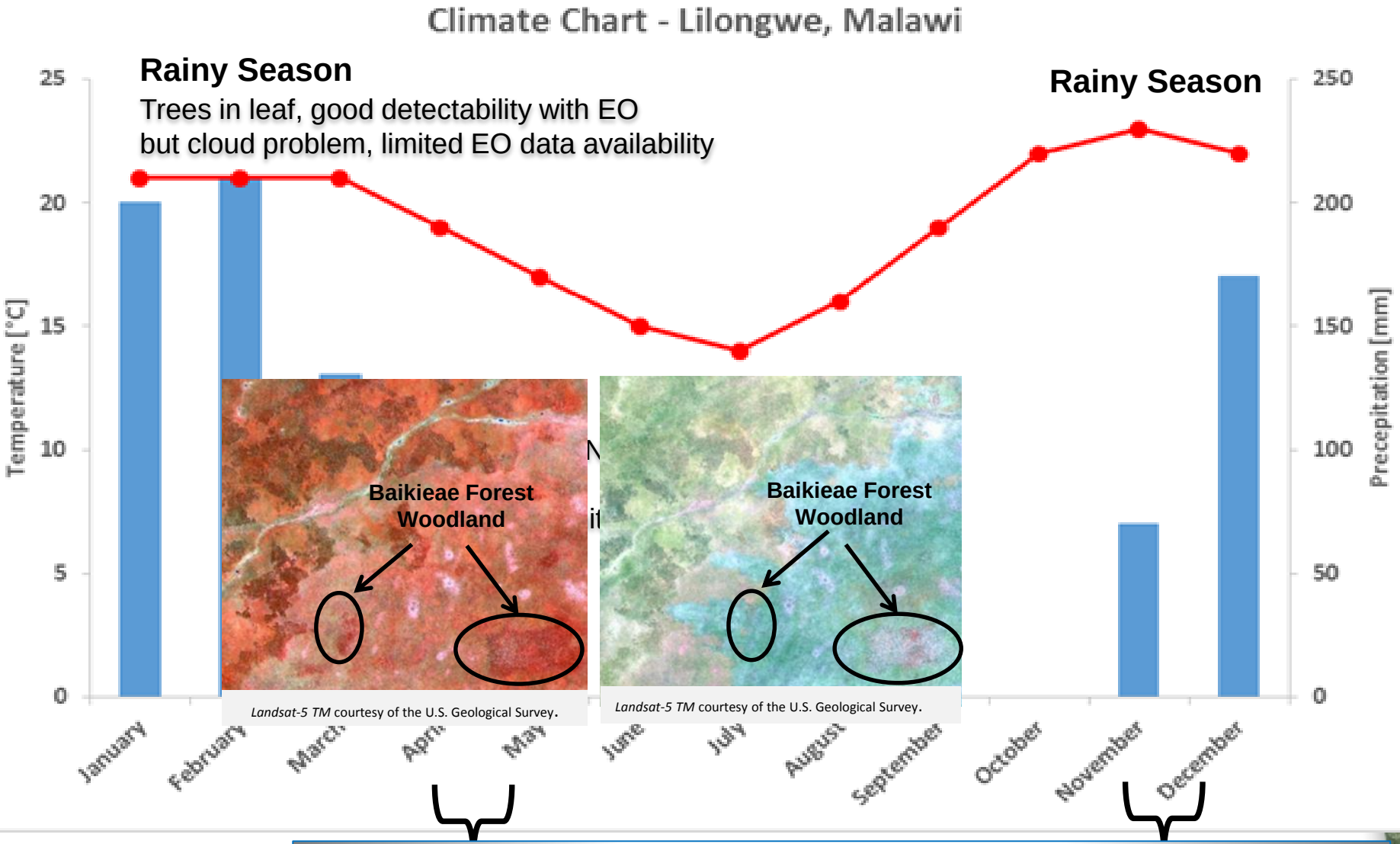
- low tree height of mature trees (7-15m),
- low canopy closure on large areas
- bare soils, shrubs and thickets interspersed in varying intensity

Forest, i.e. areas ranging from 10% to 100% tree cover



Non-Forest

➔causing spectral confusion leading to higher uncertainty of the area assessments.

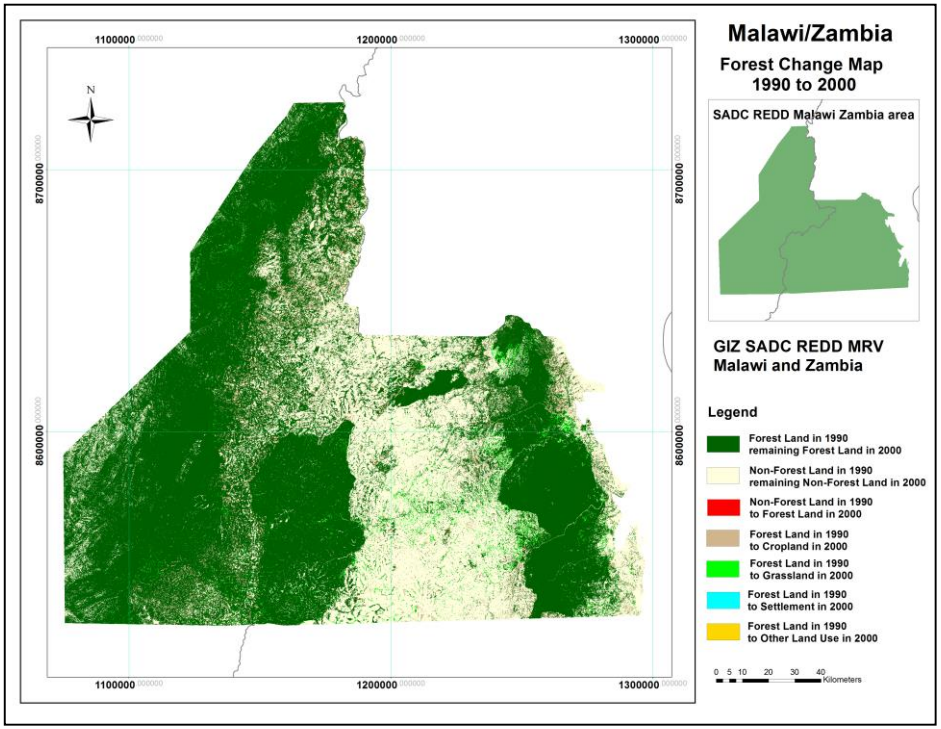


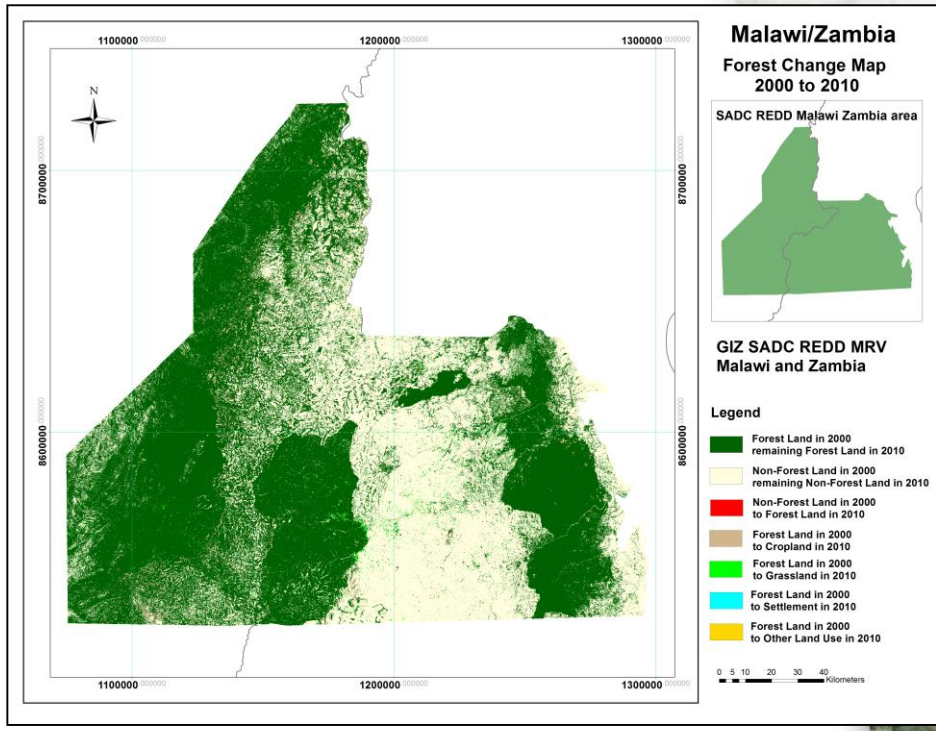
Optimal EO data aqcuisition windows: Less cloud cover, trees in leaf

➔ Seasonality effects lead to higher area uncertainties.

➔ However, thematic accuracies of 82-88 % achievable.

Deforestation and Landuse Change



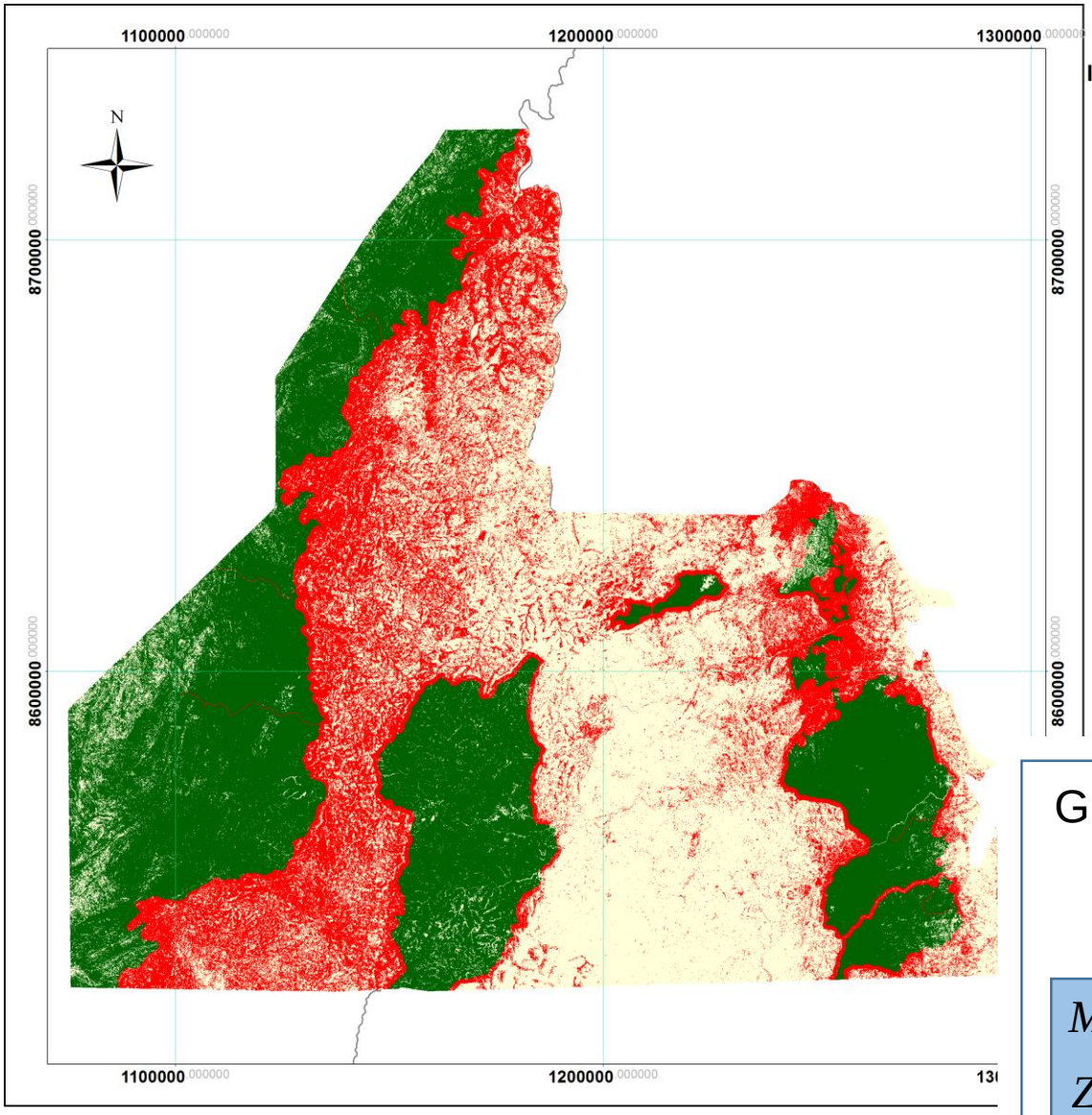


Gross Annual Deforestation Rate

	1990 - 2000	2000 - 2010
Malawi:	*1.11%*	*0.37%*
Zambia:	*0.86%*	*0.53%*

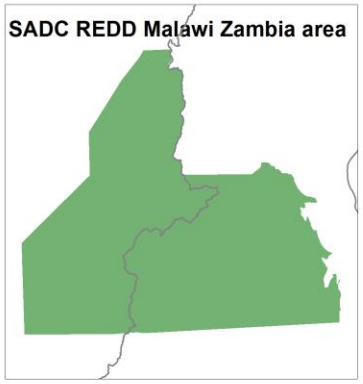
- Very high deforestationn rates in both countries.
- Peak of landuse change in the 90ties.

Expansion of Degradation Area



Malawi/Zambia

Intact Non Intact Forest Cover Map 2010



GIZ SADC REDD MRV
Malawi and Zambia

Gross Annual Degradation Rate

	1990 - 2000	2000 - 2010
Malawi:	*0.98%*	*0.64%*
Zambia:	*1.45%*	*1.64%*

Conclusions and Outlook

- **National Forest Monitoring Systems (NFMS) are obligatory requirements in the REDD policy process.**
- **EO applications for Tropical Frest Monitoring have reached a high level of oprationality, which countries can use for the their reporting.**
- **However, denes time series with new Sentinel data can address the technical issues identified for both the humid and dry forests:**
  - Improved temporal, spatial and spectral resolution
  - Increased automatisation of data processing, reduce effort and costs
  - Cost free data for FM important


Thank you very much!
Contact: forestry@gaf.de