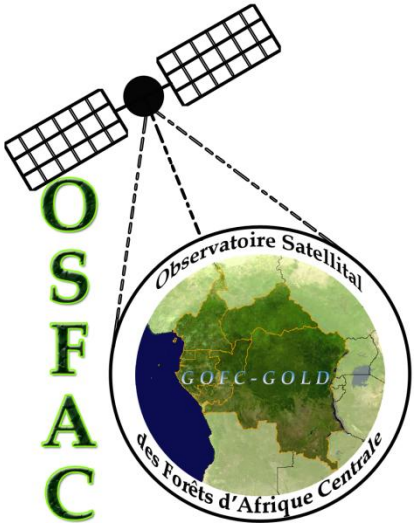
Plenary Meeting of the Congo Basin Forest Partnership (CBFP)
Palais des Congrès, Yaoundé. Cameroon
11 - 12 November, 2009

Role and importance of Satellite data in the implementation of the COMIFAC Convergence Plan



Landing MANE, OSFAC

Alice ALTSTATT, UMD

Diane DAVIES, UMD

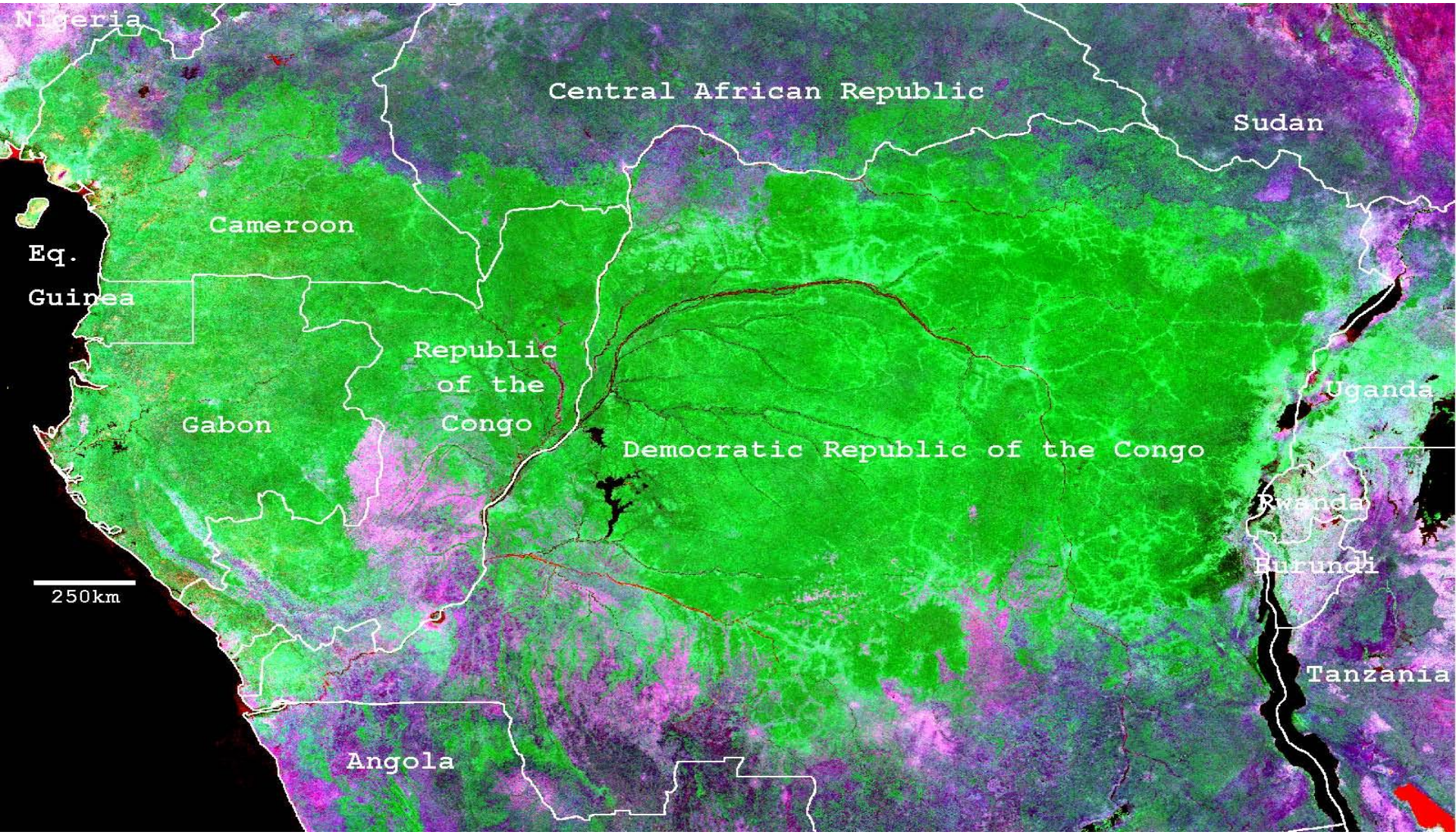
Summary plan

- Congo Basin overview
- Plan of convergence : Context and Challenge
- Role and importance of the Satellite imagery in the implementation of the Plans of Convergence
- Satellite data access

Congo basin overview

Forested area : 2,000,000 sq km

Second largest tropical forest in the world



Forests of Congo Basin play an important role for the conservation of biodiversity and other ecosystem services (biomass, carbon sequestration)

COMIFAC Plan of convergence : Strategic' axes

- **Axis 1**: Harmonization of forest policies and fiscal
- **Axis 2** : Knowledge Resource
- **Axis 3**: Management of reforestation and forest ecosystems
- **Axis 4**: Conservation of biological diversity
- **Axis 5**: Valuing sustainable forest resources
- **Axis 6**: Development of alternative activities and poverty reduction
- **Axis 7**: Capacity building, stakeholder participation, information, training
- **Axis**: Research - Development
- **Axis 9**: Development of financing mechanisms
- **Axis 10**: Cooperation and Partnership

Axis 2 : Knowledge of the resource

Component of Axis 2 (Knowledge of the resource)

1) Inventory of forest resources ...

2) Strengthening and / or establishment of national and regional centers

3) Geospatial monitoring of forest resources

Knowledge of the resource

Role of the satellite imagery will be essential for this strategic axis

Which Objectives / Challenge ?:

- Monitoring of forest cover and their dynamics

- Estimation of biomass

- Estimation of carbon stock

- Evaluation of carbon tax ?

Two possibilities:

- Ground studies (inventory and measurements)
- Use of the satellite imagery

Inventory on ground and measurements

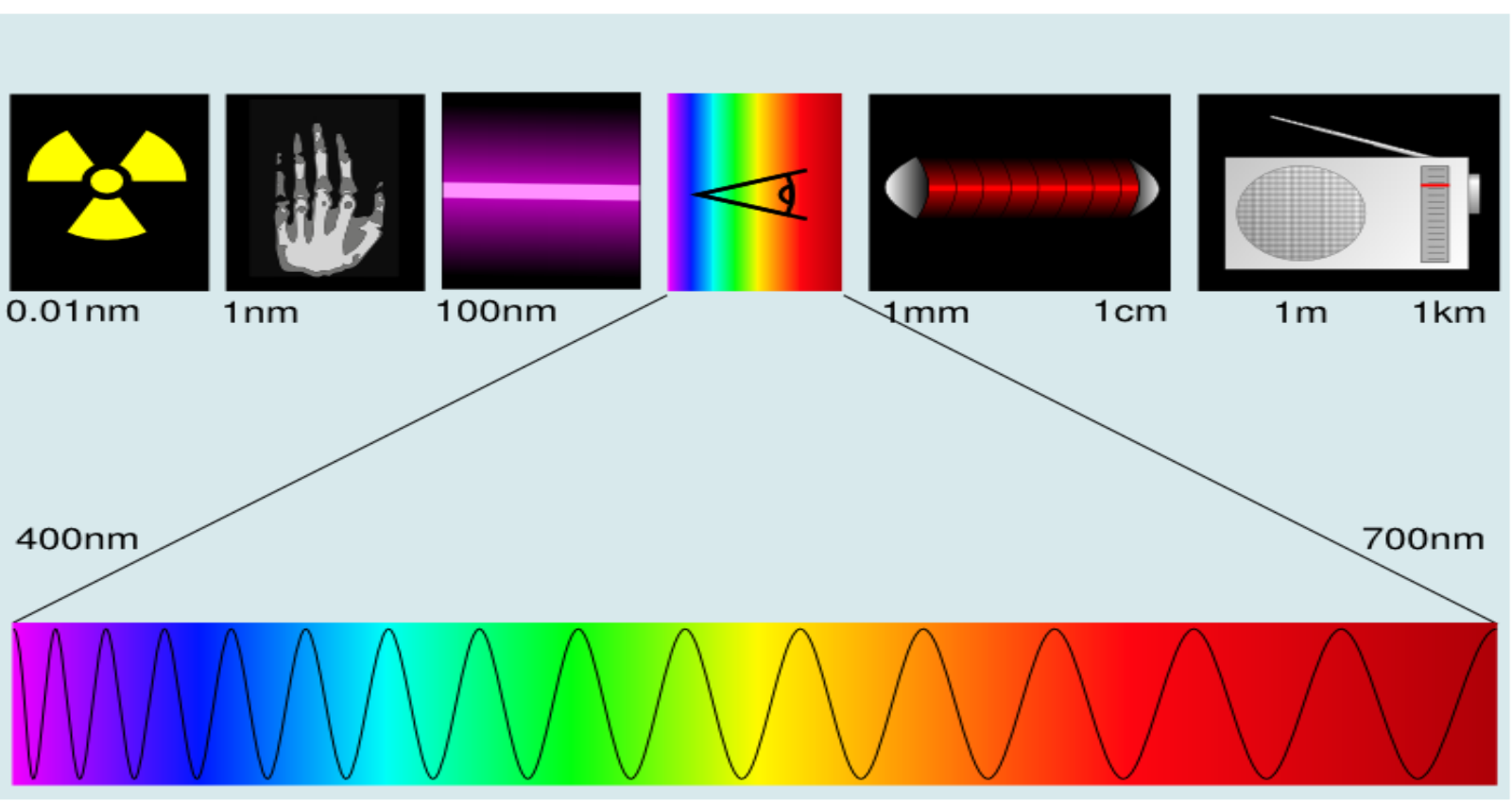
What does one measure?

- Experimental plot
- Diameter
- Height
- Density: tree number per unit of area
- Taxonomy: diversity (species number)

Source : Jean Rémy Makana, WCS, DRC)

Remote sensing: Principles and methods

The electromagnetic spectrum is the continuum of energy whose wavelength range extends from nanometers to kilometers.



The visible field of the electromagnetic spectrum

Advantages of using satellite imagery

- Simultaneous coverage of large areas
- Potential for regular, systematic updates for monitoring land cover and land use change.
- Relatively inexpensive (compared to field data collection)
- Access to remote areas

Earth Observing Satellites with Vegetation Mapping Applications

Satellite	Sensor(s)	Spatial Resolution	Revisit Frequency	Application
	Optical			
NOAA	AVHRR	1 km	Daily	Global NDVI
SPOT	VEGETATION	1 km	Daily	Global
Terra / Aqua	MODIS	250 m – 1 km	Daily	Global, Regional
Envisat	MERIS	300 m – 1 km	3 days	Global, Regional
CBERS-2	CCD, IRMSS, WFI	20 – 260 m	5 / 26 days	Regional, Local
IRS-P6	LISS, AWiFS	5.8 – 56 m	5 / 24 days	Regional, Local
Landsat 5 / 7	TM / ETM+	15 - 60 m	16 days	Regional, Local
SPOT- 4 / 5	HRVIR / HRG	10 – 20 m	26 days	Regional, Local
Terra	ASTER	15 – 90 m	On demand	Local
EO-1	ALI	10 – 30 m	16 days	Local
Ikonos		1 m	3 days	Community
	ALI	10 – 30 m	16 days	Local
	Radar		Orbit overpass	
ERS-2	SAR (C-band)	30 m	35 days	Regional
Envisat	ASAR (C-band)	30 m	35 days	Regional
ALOS	PALSAR	7 – 88 m	46 days	Regional
RADARSAT	SAR (C and X-band)	25 m	24 days	Regional

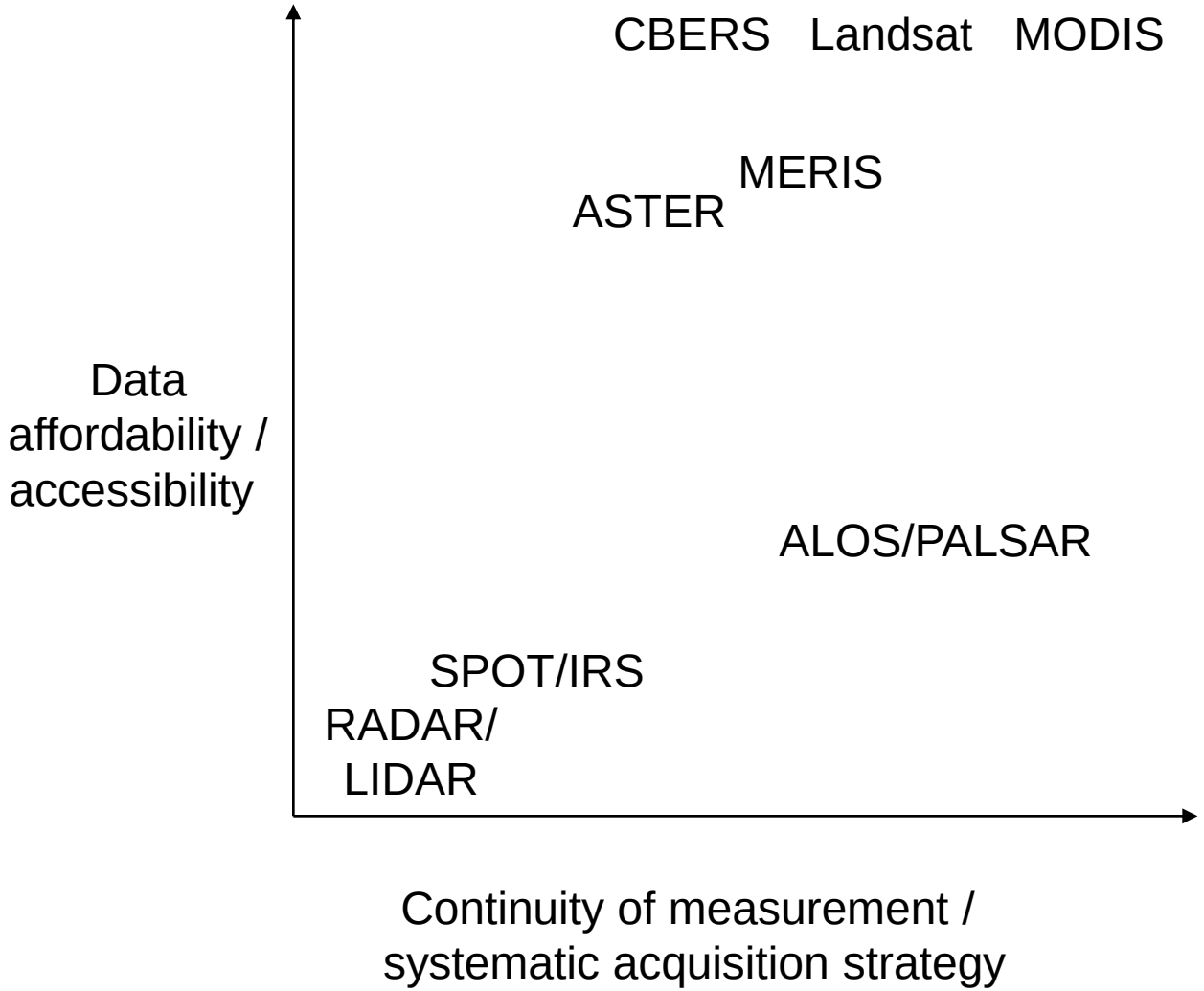
- **Optical Remote sensing** (depending on solar radiation : passive)
- **Radar Remote sensing** (independent of solar radiation : active)

Selection of Remote Sensing data types to use

- **Choice depends on :**
  - Purpose of the study (land cover and land use mapping, differentiation of species of plants, etc.)
  - Desired precision (spatial scale, temporal scale)
  - Wavelength (e.g. bands, radar)
  - Data affordability and access
  - Operational requirements - human and technical capacity for processing data

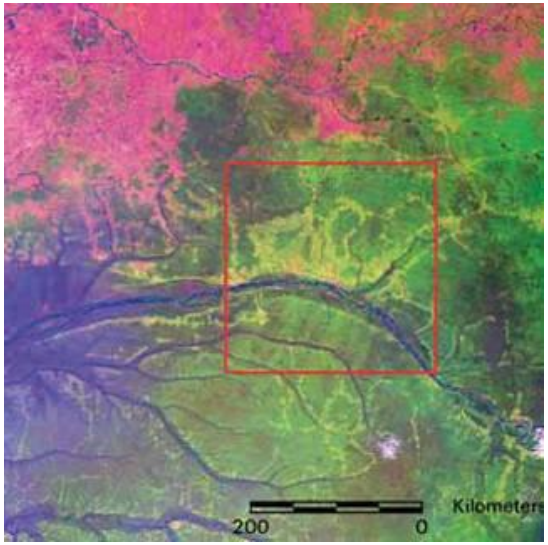
High resolution image ? or Low resolution image?

Operational Monitoring



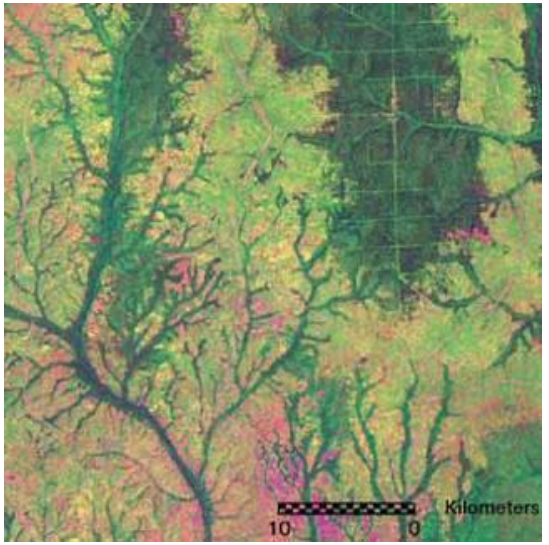
SDSU

Examples of satellite data used for vegetation mapping at different spatial resolutions



A. SPOT VEGETATION 1 km

B. MODIS 250 m



C. Landsat 30 m

Source : D. Devers SOF, 2006

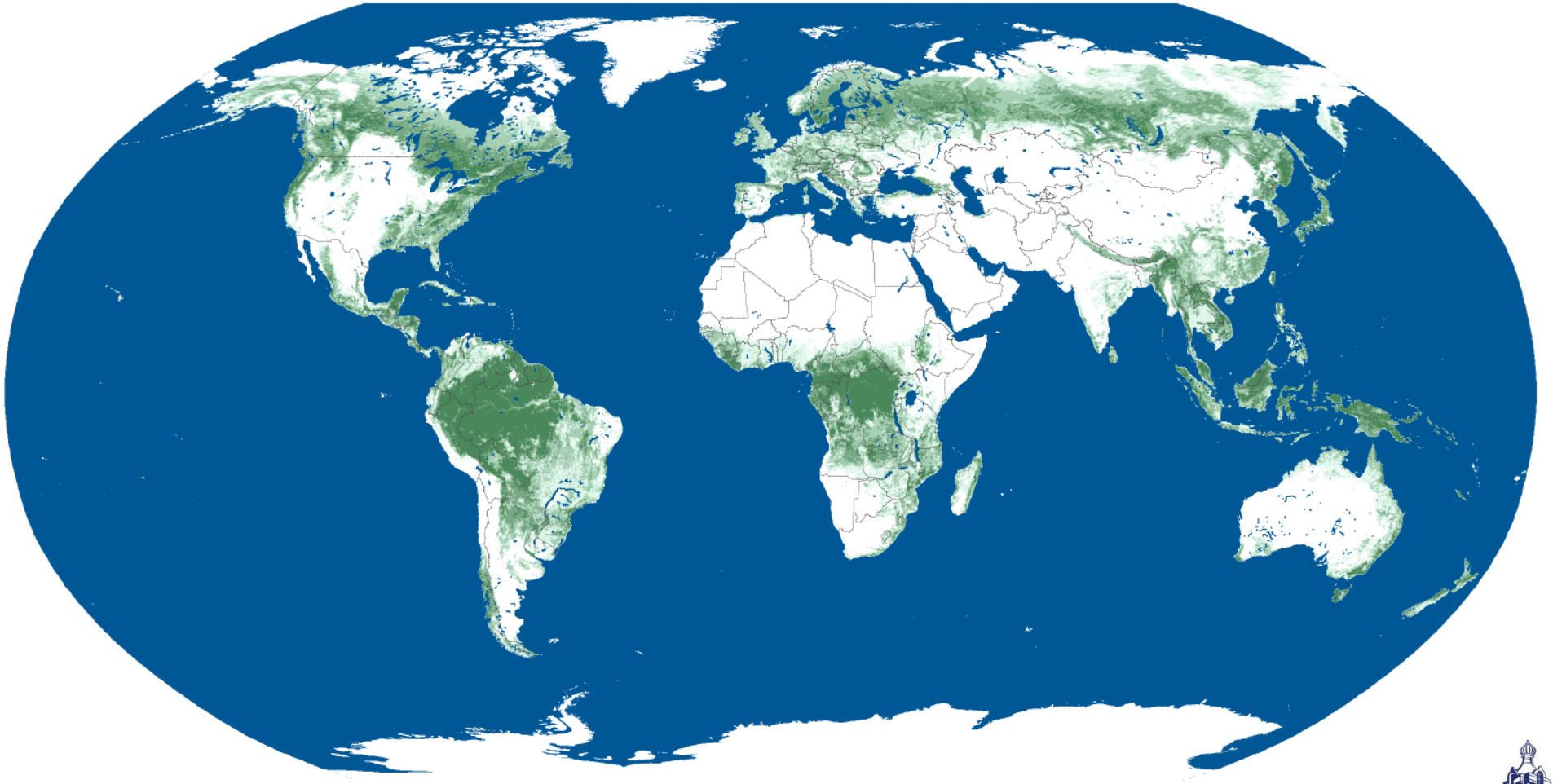
Operational requirements for the use of satellite data

- Availability of data
- Quality of data acquired (Cloud issue)
- Infrastructure for storage and data processing
- Expertise and human resources for the satellite data processing

Global Forest Cover monitoring

(MODIS satellite data)

Percent forest cover, 2000

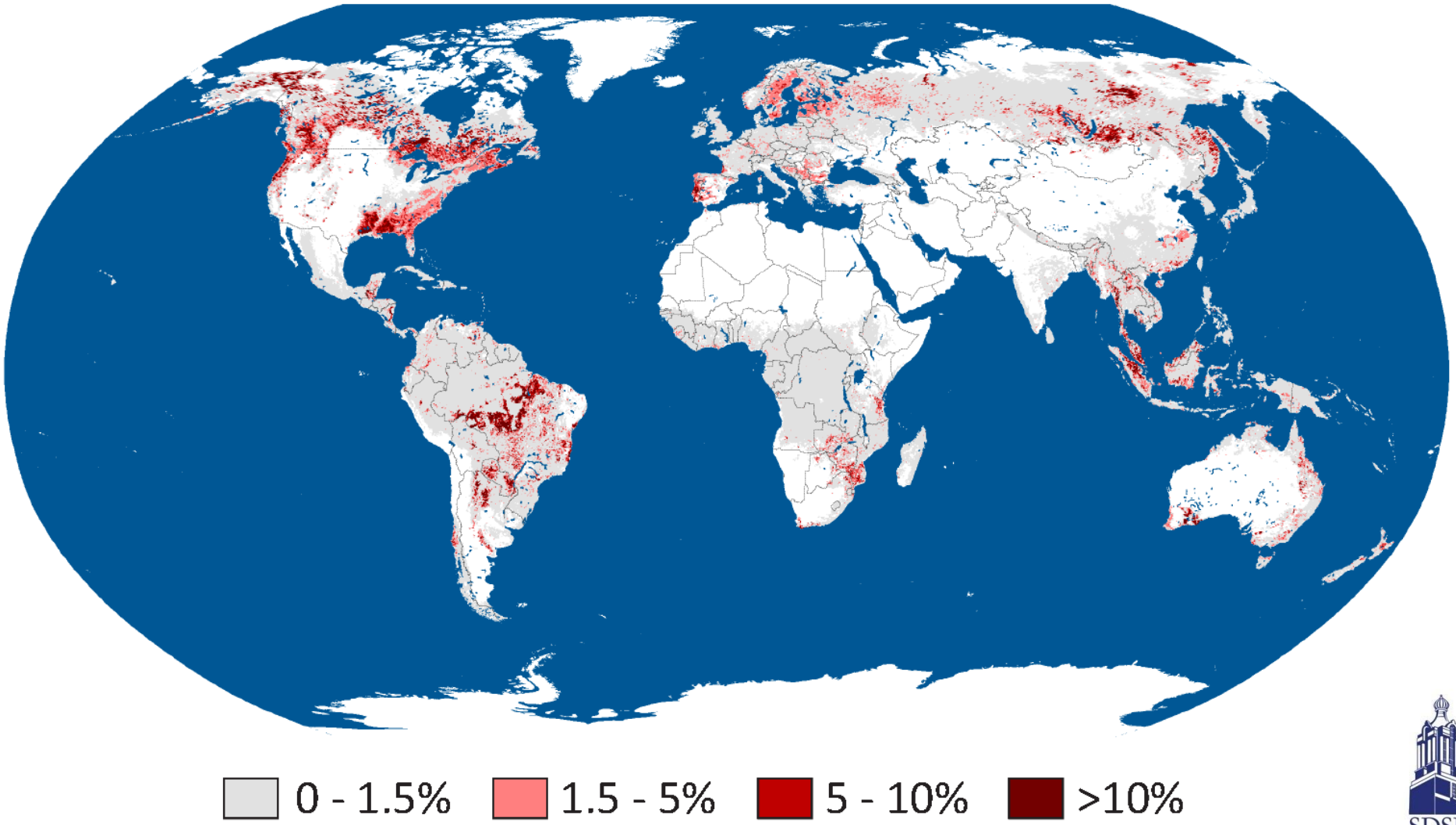


0 - 10% 10 - 25% 25 - 50% 50 - 75% 75 - 100%

Global Forest Cover monitoring

(MODIS satellite data)

Percent forest cover loss, 2000 to 2005



Regional applications of satellite data use in Congo Basin

Monitoring forest cover and change

- FAO FRA 2010 / UCL

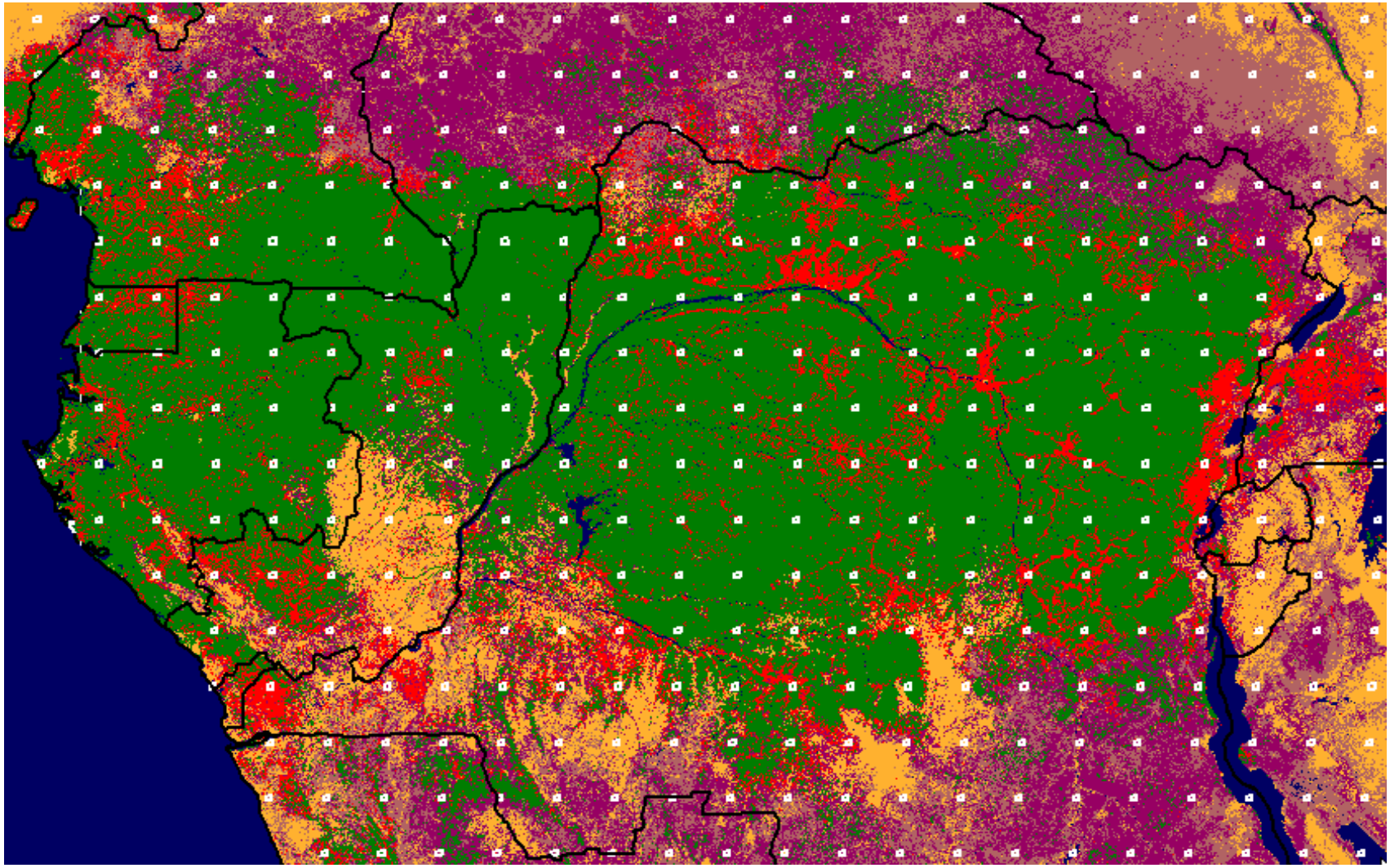
Samples of 20X20 km over varying intervals (1 °, ½ °) depending on country area

Landsat data are used for this study

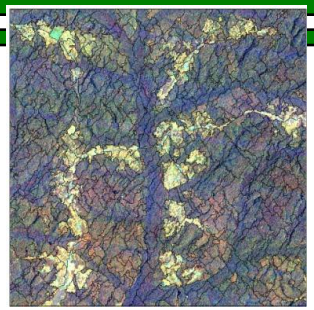
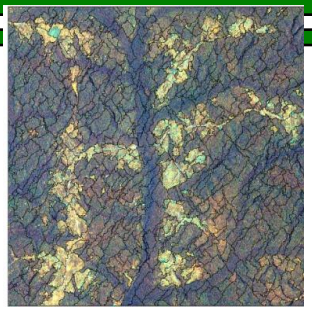
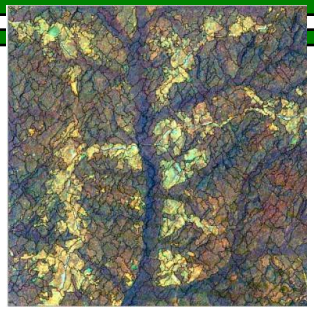
- CARPE/UMD /SDSU

"Wall to Wall" methodology, use of low resolution data from **MODIS** (250 m) and high resolution **Landsat** data (30 m)

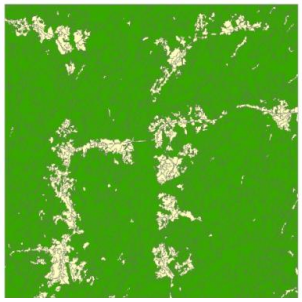
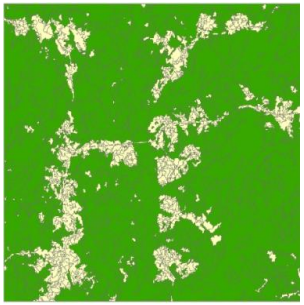
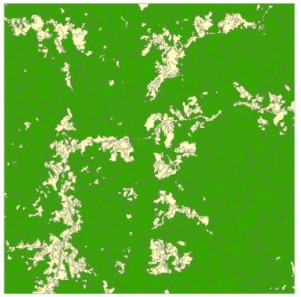
FAO FRA 2010 / UCL Remote Sensing Survey

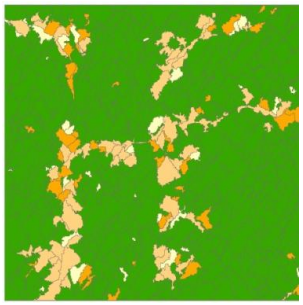
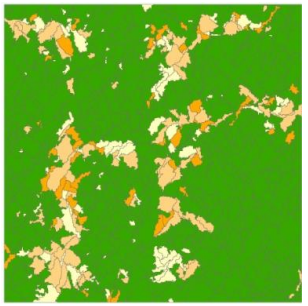


Results of monitoring Congo Basin forest using UCL methodology

AGGREGATION LABELS (L1) at Level (L2)

Shrub

Forêt

Non Forêt

Mosaïque basse

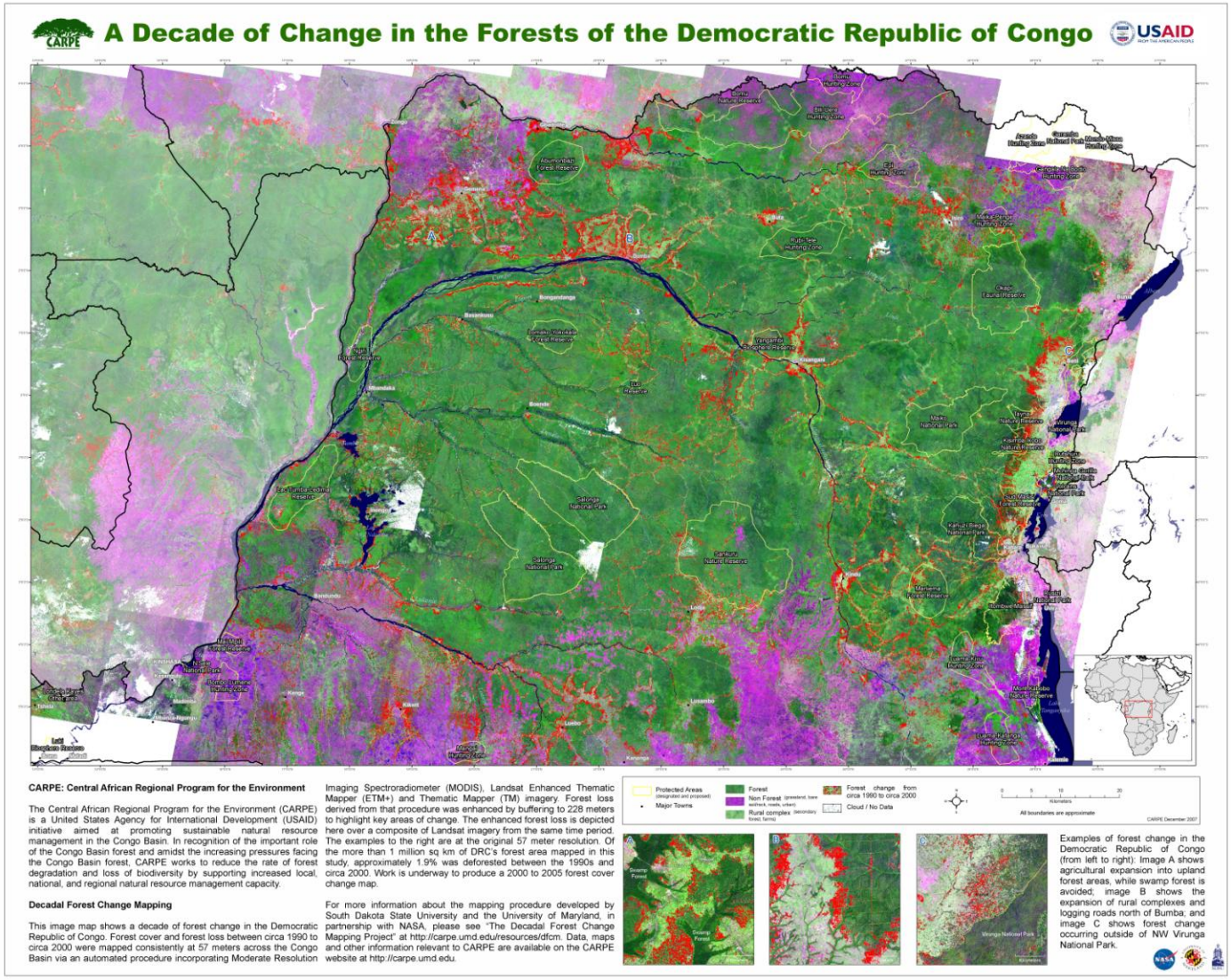
Mosaïque haute

Eau

No data

(cloud, shadow)

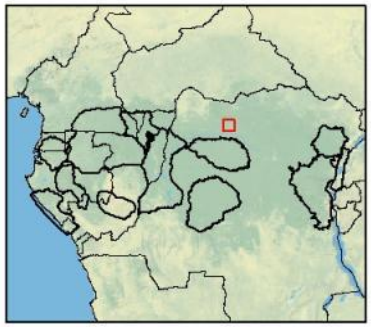
Results of monitoring Congo Basin forest using CARPE/UMD/SDSU methodology

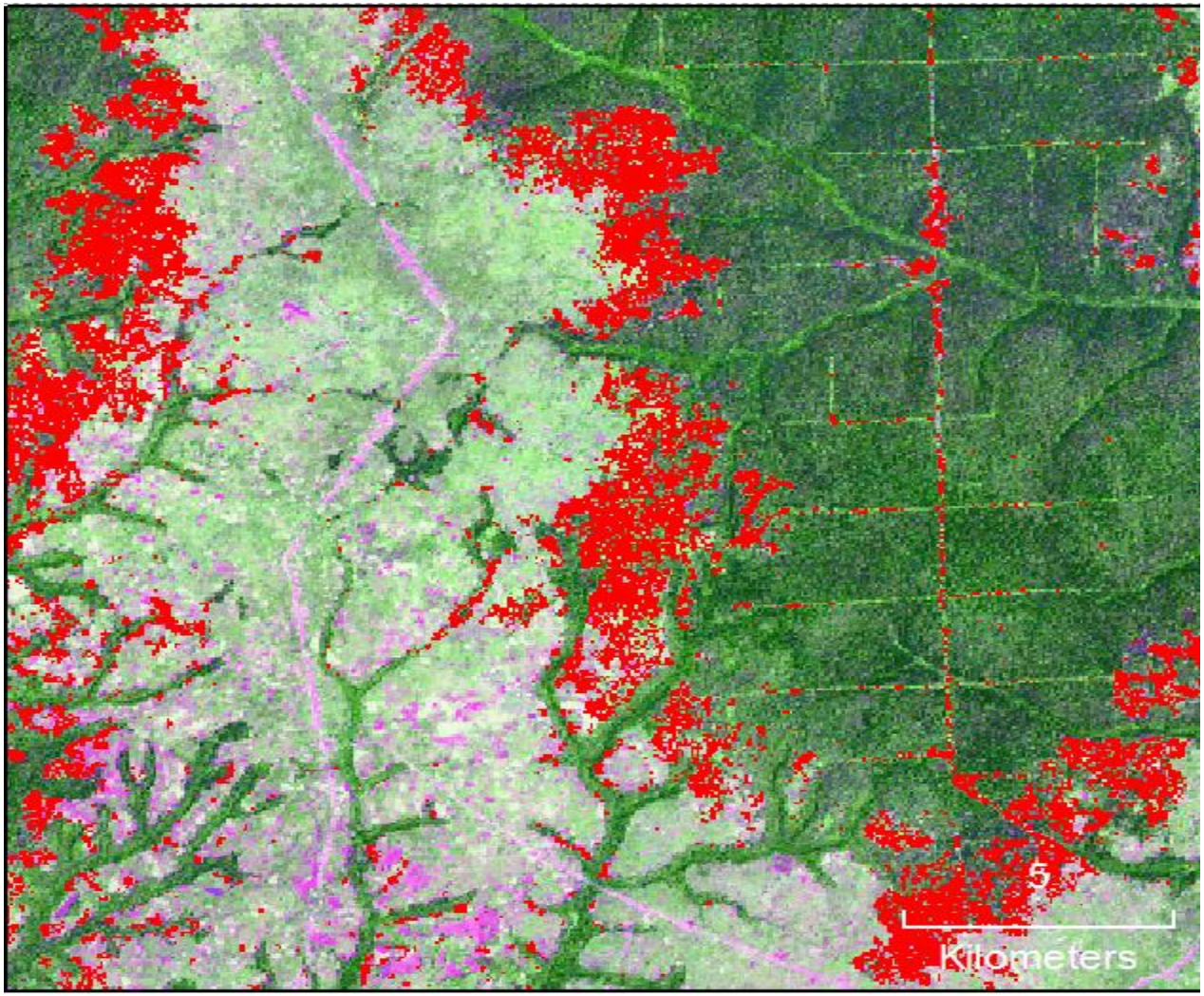


Geospatial Monitoring of Forest Resources…

Expansion of the rural complex and logging roads north of Bumba

Deforestation
1990 – 2000 in red

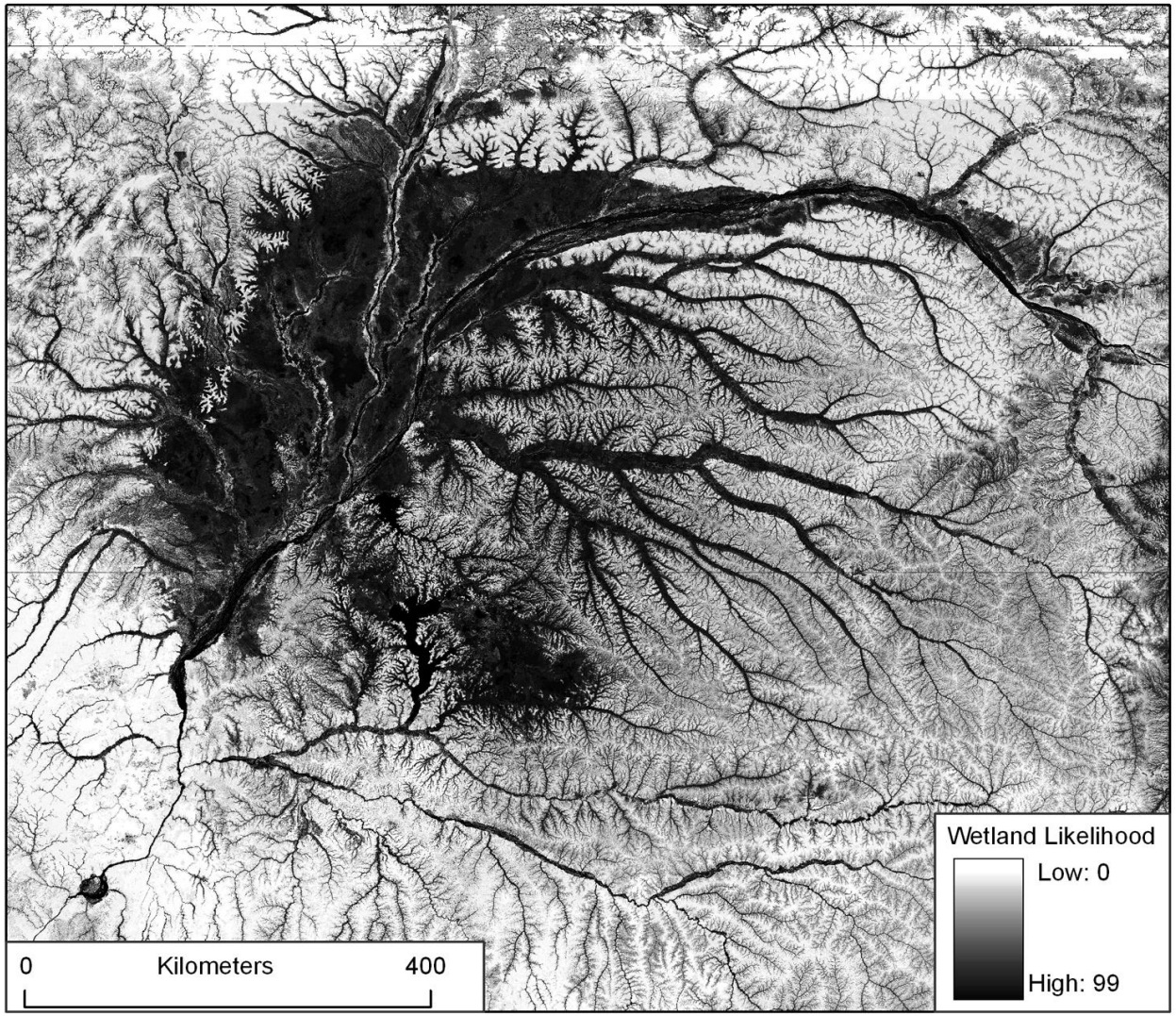




Source : CARPE/UMD/SDSU

Geospatial Monitoring of Forest Resources

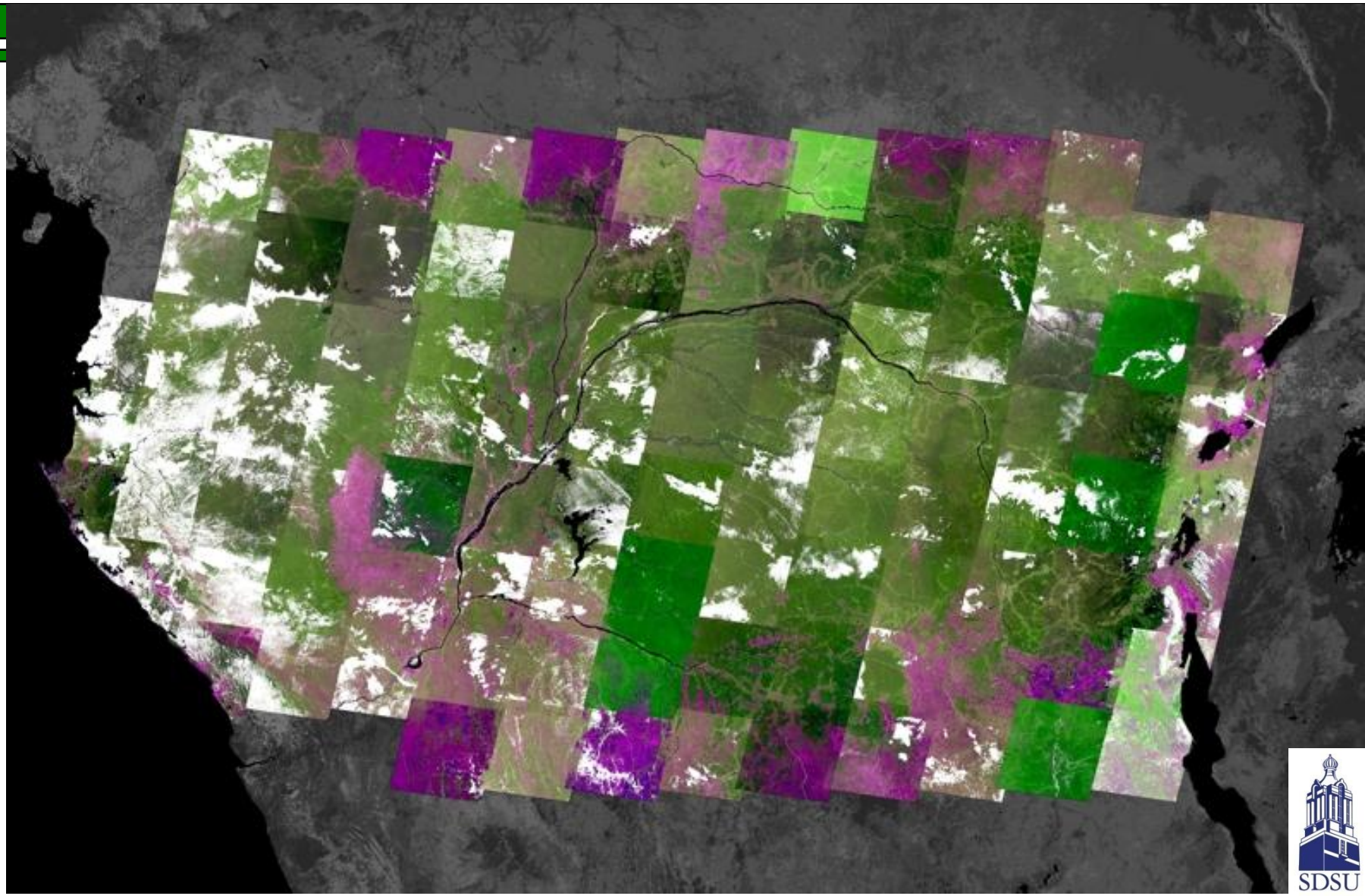
Inundated Forest characterization In Congo Basin



Source : J.R Bwangoy

Constraints of using satellite images…

(Example of Landsat images with clouds)



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Regional Constraints for Satellite-based Forest Monitoring

- Need for systematic data acquisition strategy across the basin
- Challenge of acquiring adequate cloud free data across the basin (optical sensors)
- Need for consistent forest characterization across basin
- Challenge of monitoring forest degradation (vs. deforestation)
- Need to use data from a variety of sensors (e.g., probably not feasible to derive biomass from optical data alone)
- Need for systematic field data collection to supplement and validate remote sensing data products
- Need for a regional satellite data dissemination mechanism (poor internet access)

GOFC - GOLD contribution for data accessibility by networks

Global Observation of Forest Cover (GOFC)

+

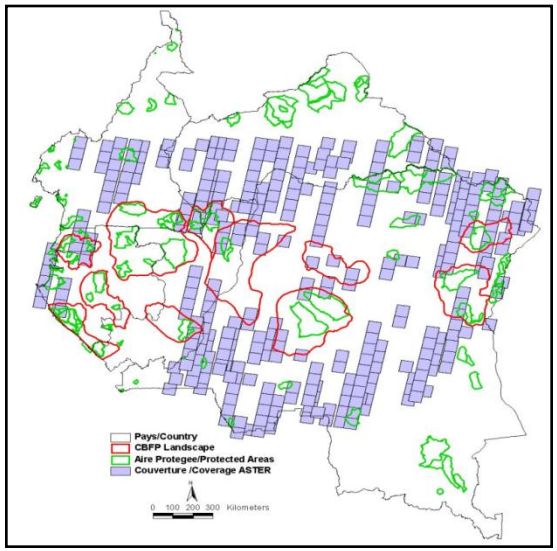
Global Observation of Land cover Dynamics (GOLD)

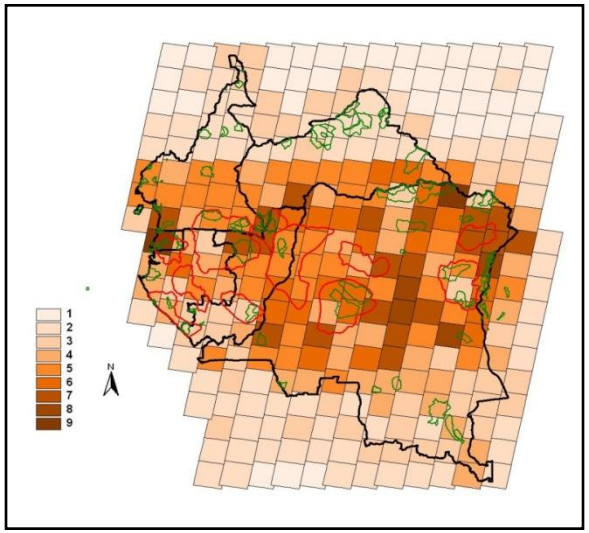
=

GOFC-GOLD

Improve the availability and the access to satellite data for the Central African Region

Distribution of freely-available satellite data and products





ASTER 2000-2008

±2500 images covering the major part of the zones of the congo basin (period: 2000 to 2008

Landsat 1984-2003

+2000 images covering the entirety of the basin (of +1980 to 2008)

SRTM Feb. 2000

± 600 images covering the entirety of the Congo Basin and a mosaic of the totality of the Basin

This presentation has shown through examples the important role played by satellite images in the inventory, monitoring and forest resources characterization

Remote sensing can contribute to the implementation of strategic' axis of the Convergence Plan of COMIFAC, particularly, on aspects relating to "Knowledge of forest resources":

- inventory of forest resources
- geospatial monitoring of forest resources.

Future prospects

For remote sensing plays its full role in the implementation of “Convergence Plan of COMIFAC”, it should necessary to:

- Improve the availability and access to satellite data
- strengthen capacity of forest managers in processing and use of satellite data
- combine field and remote sensing studies for monitoring forest cover, forest dynamics and biomass (carbon stock estimation).
- combine use of the optical and radar data
- have close collaboration between existing (OSFAC,OFAC) and future centers involved in forest monitoring

Recommendations

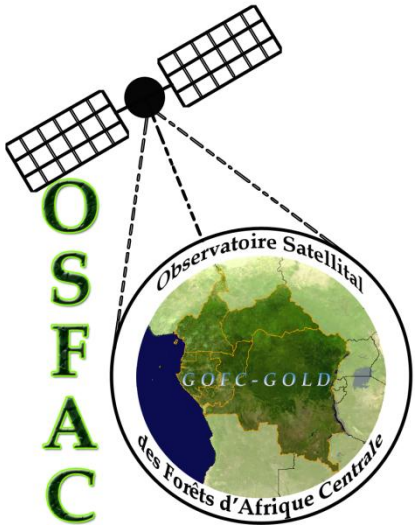
To improve the accessibility of satellite data

- Focus international attention on this critical region and encourage the space agencies to bring this region under continuous monitoring

- Encourage the agencies to consider free and open sharing of data for this region and seek solutions to the current obstacles to data access with special consideration of African internet limitations

- Encourage donors to coordinate their various satellite monitoring activities

Thank You


OSFAC
Observatoire Satellital
des Forêts d'Afrique Centrale
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