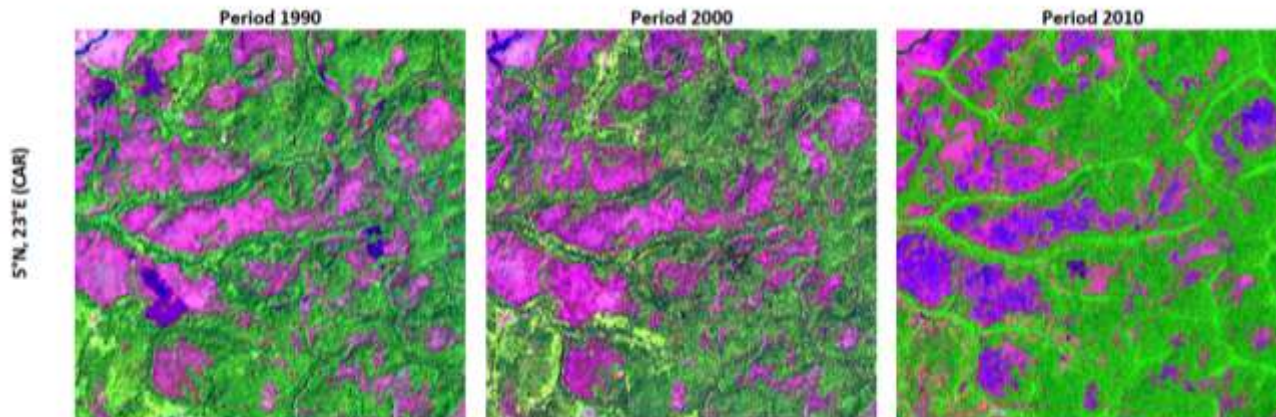# Regional forest monitoring with remote sensing on basis of a regular sampling grid

A.Verhegghen, B. Desclée, F. Achard, H. Eva, P. Defourny, P. Mayaux
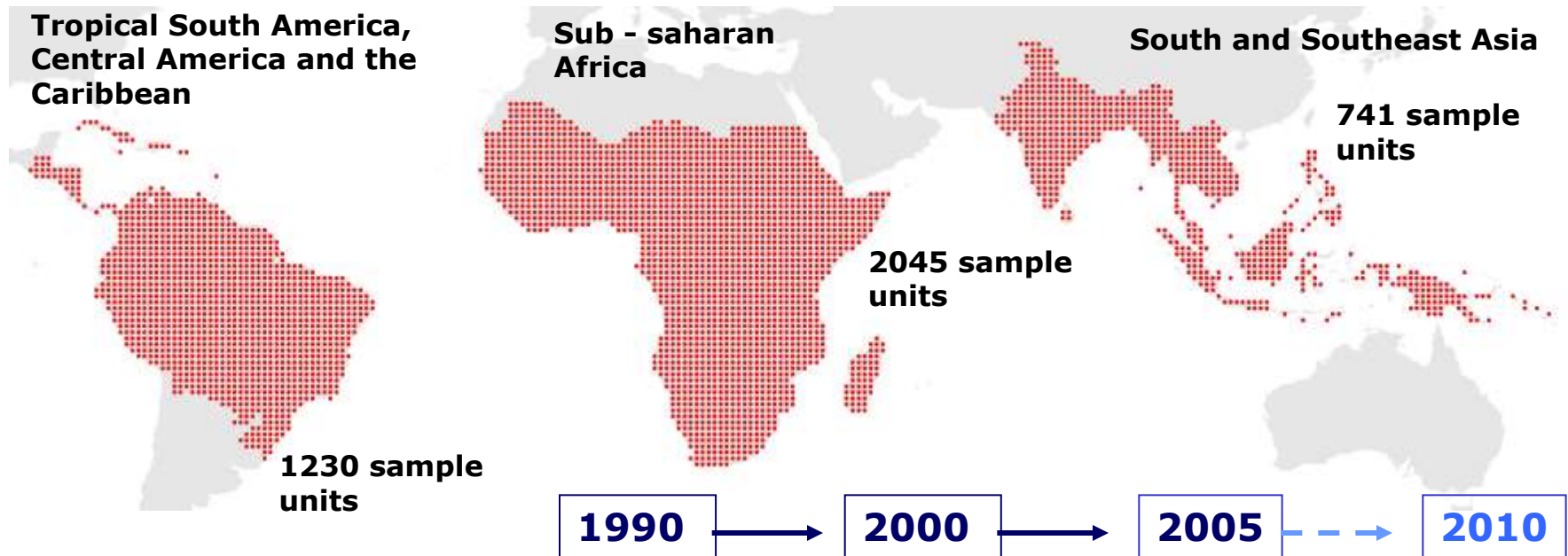
Joint Research Centre

*Université catholique de Louvain*

Global Monitoring of Tropical Forest Cover Changes

GLOBE-TREES: Systematic sampling at every full degree confluence point on land in the tropics (covering 106 countries) -> 4016 sample units

Tropical South America, Central America and the Caribbean

Sub - saharan Africa

South and Southeast Asia

741 sample units

2045 sample units

1230 sample units

| 1990 | → | 2000 | → | 2005 | ⇢ | 2010 |

Global (pan-tropical) and (sub-)regional forest cover change statistics

Input for FAO's global Forest Resource Assessment 2010 – Remote Sensing Survey (FRA 2010 – RSS)
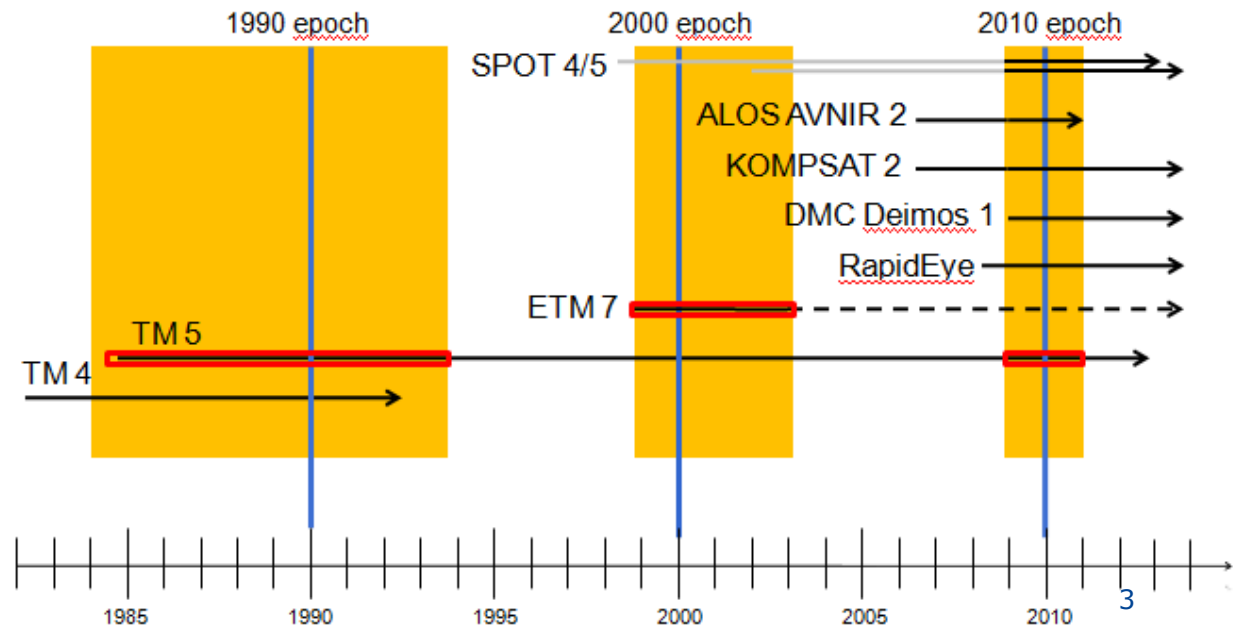
Data selection
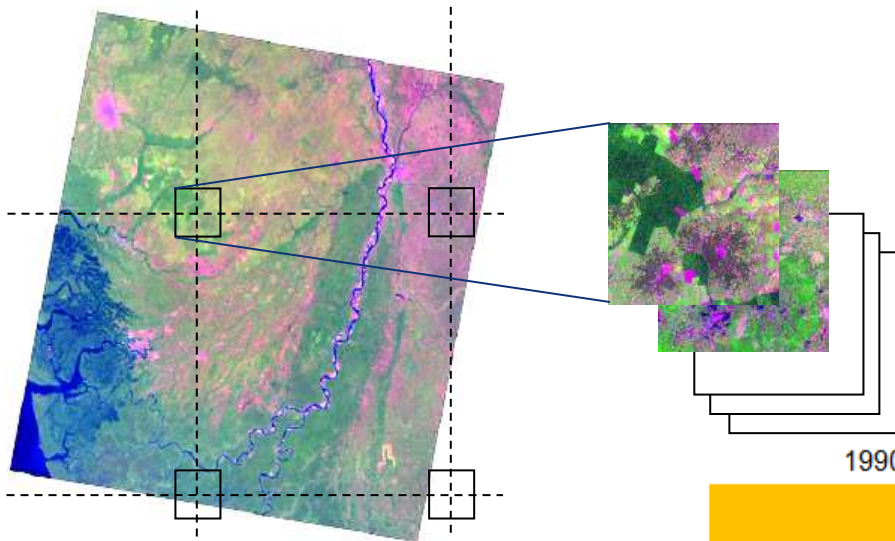
Sample sites automatically extracted

Sample frame: Geographical grid
                 (a sample at each 1º x 1º)
Sample size: 10x10 km^2

➤ 1990: 1984-1994
➤ 2000: 1997-2003
➤ 2010: 2008-2012

3

Land cover class definitions
(in accordance with FAO)

Tree cover: plants with wooden stems ≥ 5 m, ground coverage higher than 30%, ≥ 70% tree cover portion in mapping unit (MU)

Tree cover mosaic: between 30% and 70% tree cover portion in MU
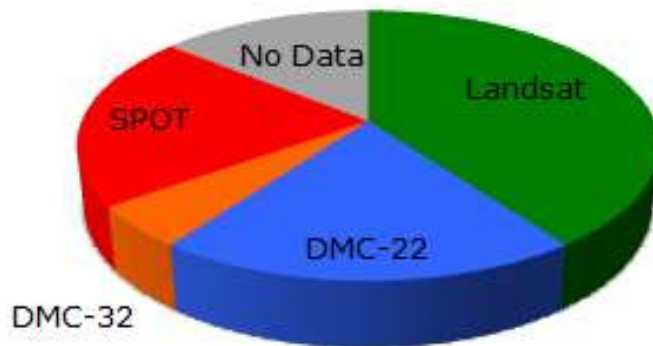
Other wooded land: plants with wooden stems between 0.5 and 5 meters, above 50% ground coverage, above 50 % portion of MU

Other land cover: urban areas, bare soil, agricultural areas, sand, rock, with or without some sparse cover of trees or other wooded land

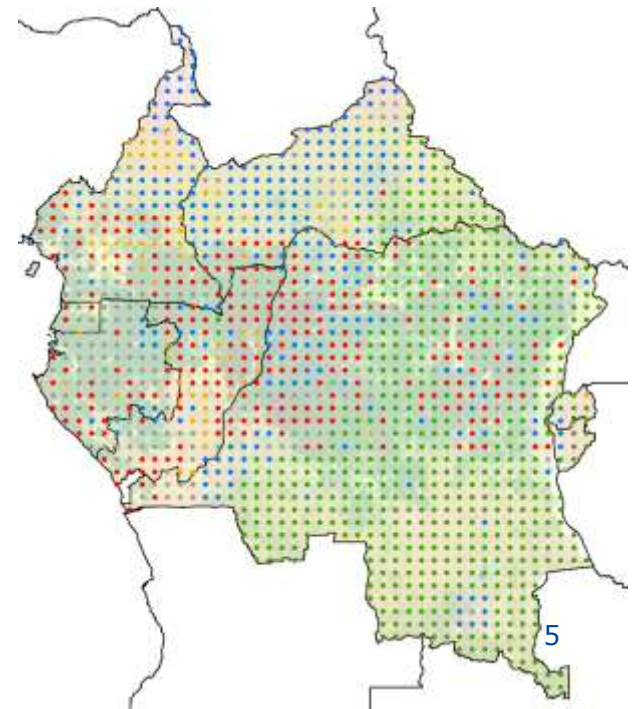# Forest Cover Changes in Central Africa

Period of monitoring 1990 – 2000 - 2010

- Harmonization of data UCL/TREES 1990-2000
- Regional estimations for the Congo Basin (Mayaux et al. 2013)
- National estimations (to be published in next SOF – B.Desclee)
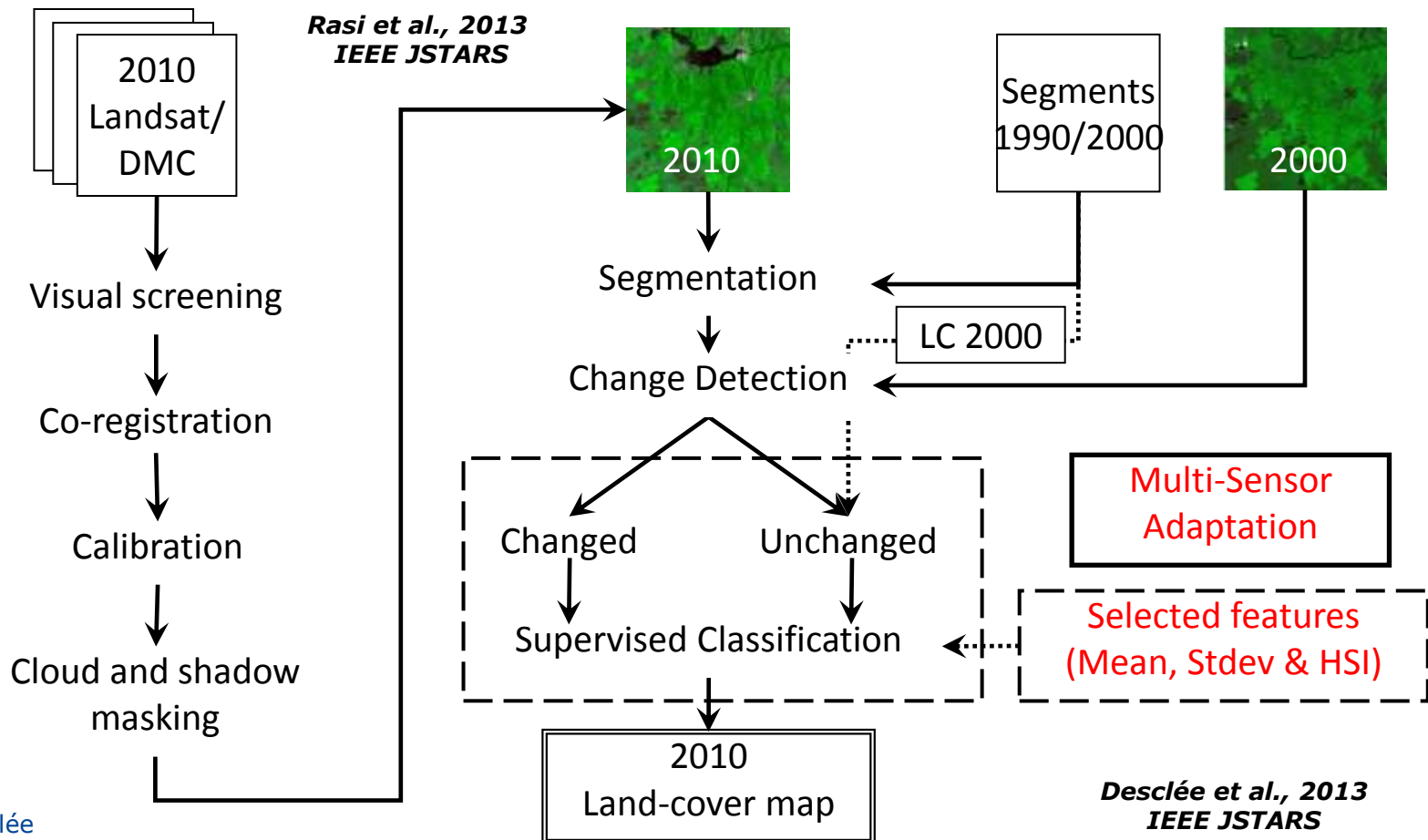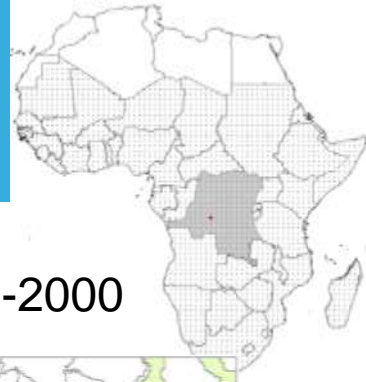- Image availability for 2010

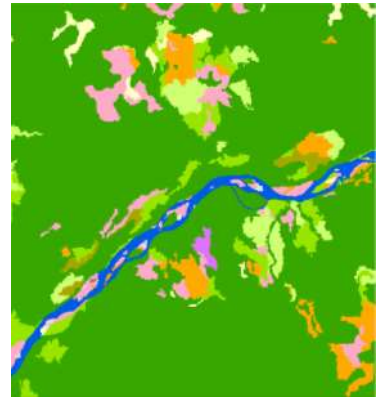
Sensor

- Landsat
- DMC-22
- DMC-32
- SPOT
- No Data

B. Desclée

Adapted JRC process chain

Rasi et al., 2013 IEEE JSTARS

2010 Landsat/ DMC

Visual screening

Co-registration

Calibration

Cloud and shadow masking

2010

Segments 1990/2000

2000

Segmentation

LC 2000

Change Detection

Changed   Unchanged

Multi-Sensor Adaptation

Supervised Classification

Selected features (Mean, Stdev & HSI)

2010 Land-cover map

Desclée et al., 2013 IEEE JSTARS

B. Desclée

Land cover maps

1990

2000

Change Map 1990-2000
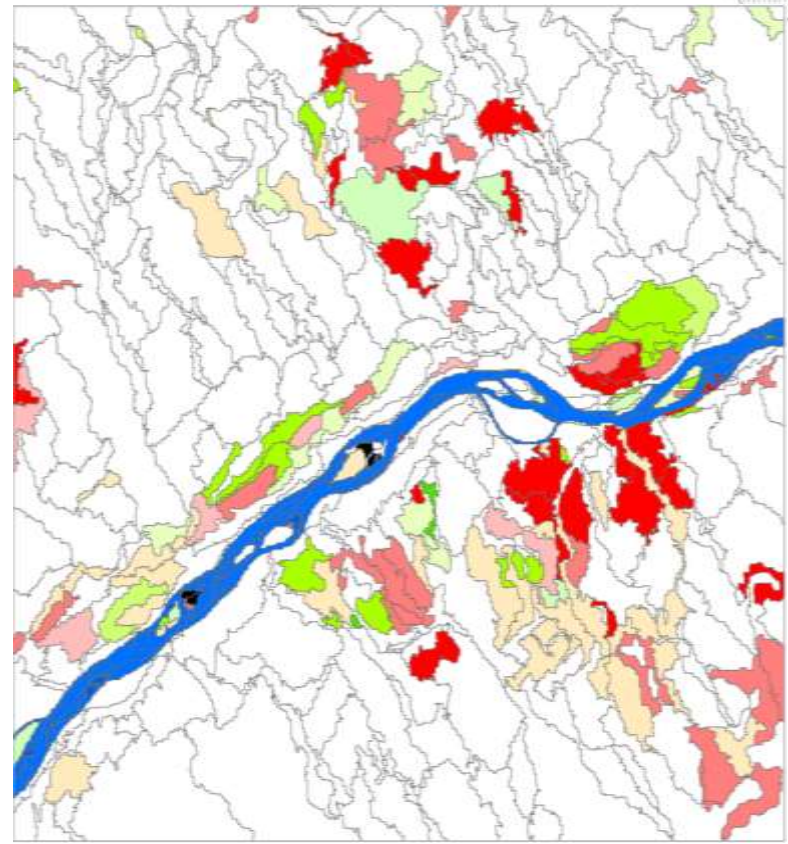
Legend (land cover):
- TREE COVER
- TREE COVER MOSAIC
- OTHER WOODED LAND
- OTHER LAND COVER
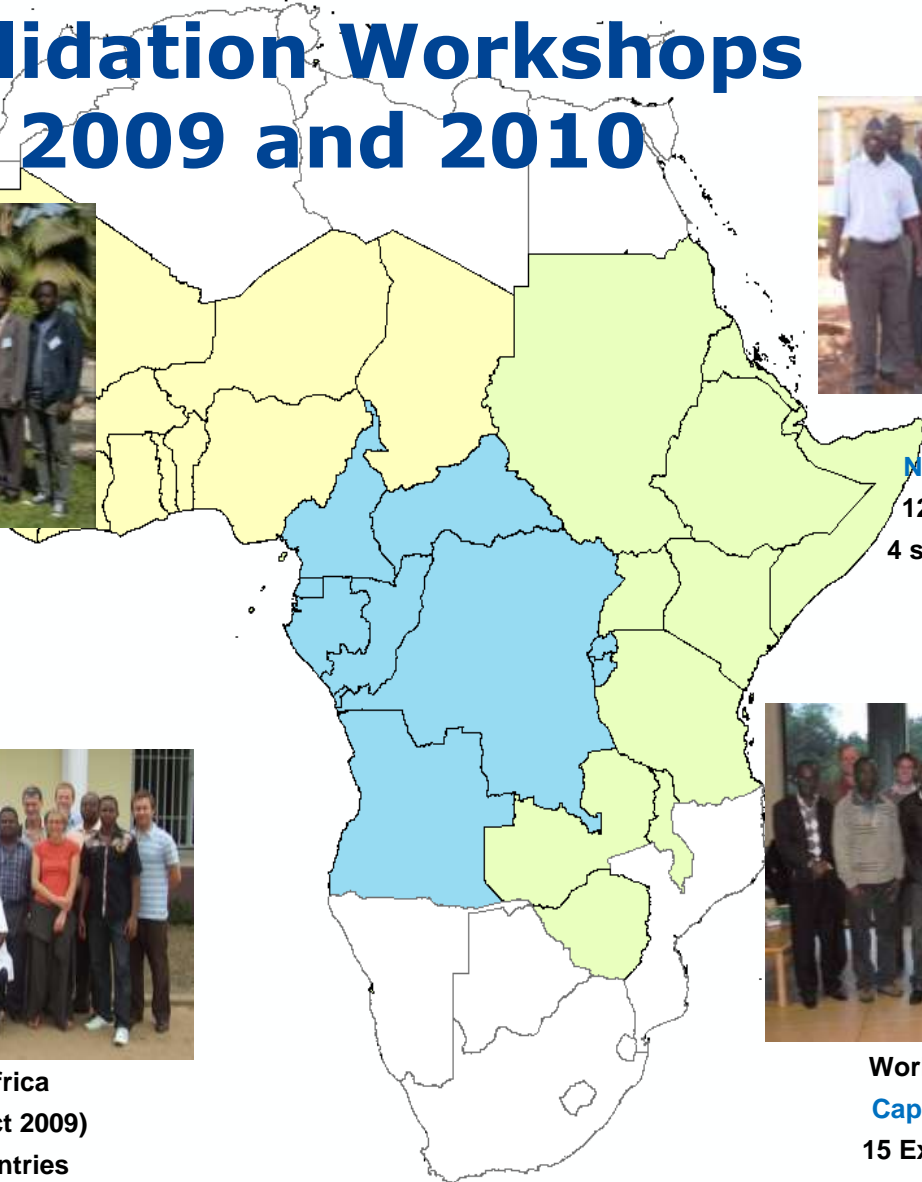- BURNT COVER
- WATER
- CLOUD & SHADOW
- NO DATA
- UNCLASSIFIED

Change map legend:
- LCC From Forest
- LCC To Forest
- No change

Regional Validation Workshops for Africa in 2009 and 2010

Workshop West Africa
Dakar (08-13 March 2010)
15 Experts from 14 countries
3 JRC support staff

Workshop East Africa
Nairobi (28 Sept- 2 Oct 2009)
12 Experts from 10 countries
4 support staff including 3 JRC

Workshop Central Africa
Kinshasa (28 Sept- 9 Oct 2009)
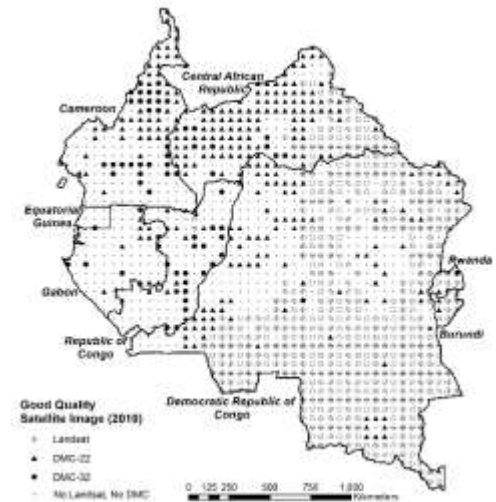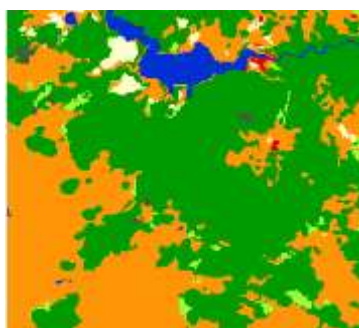15 Experts from 7 countries
6 support staff from FAO, UCL & JRC

Workshop Southern Africa
Cape Town (3-7 May 2010)
15 Experts from 8 countries 8
3 support staff including 2 JRC

Production of deforestation estimates

Processing and Validation of 548 sites

DMC 2010   **Adapted**

S03_E016
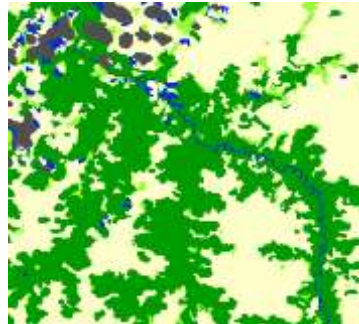
Sensor	Samples	Percentage
Landsat	178	48%
DMC-22	169	46%
DMC-32	60	16%
SPOT	117	32%
No Data	24	7%
	548	**100%**

B. Desclée

20/03/2014

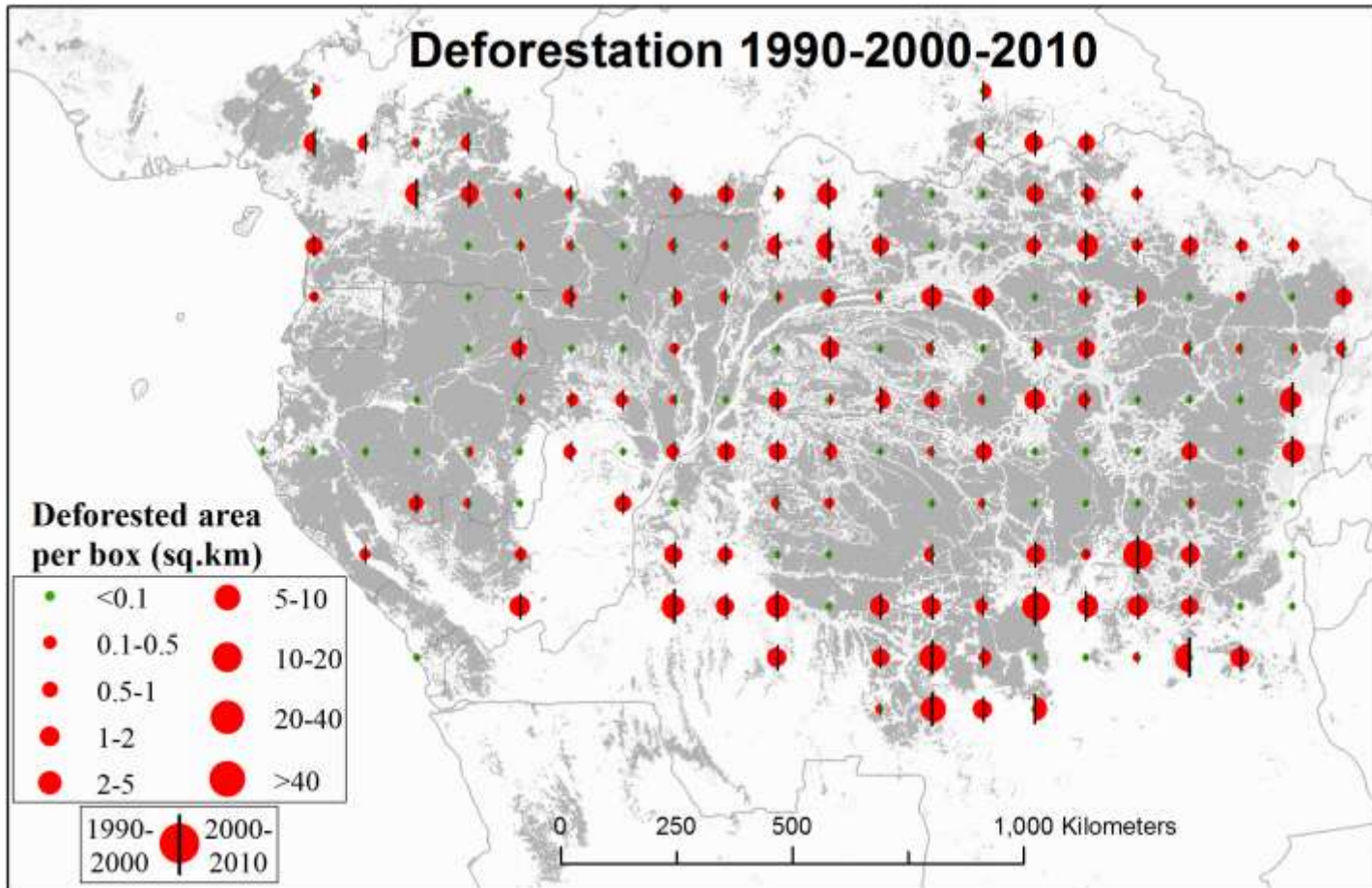# Results for the Congo Basin

Deforestation 1990-2000-2010

Deforested area per box (sq.km)

- • <0.1
- • 0.1-0.5
- • 0.5-1
- • 1-2
- • 2-5
- ● 5-10
- ● 10-20
- ● 20-40
- ● >40

1990-2000 | 2000-2010

0   250   500   1,000 Kilometers

Annual Deforestation Rates

	Country	n	Gross Deforestation	Gross Reforestation	Net Deforestation
1990-2000	Cameroon	45	0.13% (0.04%)	0.04% (0.01%)	0.09% (0.04%)
	Congo	65	0.09% (0.02%)	0.03% (0.01%)	0.05% (0.02%)
	Gabon	63	0.07% (0.02%)	0.02% (0.00%)	0.05% (0.02%)
	Eq. Guinea	7	0.13% (0.08%)	0.10% (0.06%)	0.03% (0.07%)
	CAR	26	0.11% (0.03%)	0.03% (0.01%)	0.09% (0.03%)
	DRC	114	0.24% (0.05%)	0.03% (0.01%)	0.22% (0.04%)
	Congo Basin		0.19% (0.03%)	0.03% (0.01%)	0.16% (0.03%)
2000-2010	Cameroon	45	0.08% (0.03%)	0.02% (0.01%)	0.06% (0.04%)
	Congo	65	0.07% (0.02%)	0.00% (0.00%)	0.07% (0.02%)
	Gabon	63	0.03% (0.01%)	0.01% (0.00%)	0.01% (0.01%)
	Eq. Guinea	7	0.04% (0.03%)	0.05% (0.03%)	-0.01% (0.02%)
	CAR	26	0.06% (0.02%)	0.01% (0.00%)	0.05% (0.02%)
	DRC	114	0.20% (0.04%)	0.00% (0.00%)	0.19% (0.04%)
	Congo Basin		0.14% (0.03%)	0.00% (0.00%)	0.14% (0.03%)

The Forests of the Congo Basin - State of the Forest 2014 (to be published)
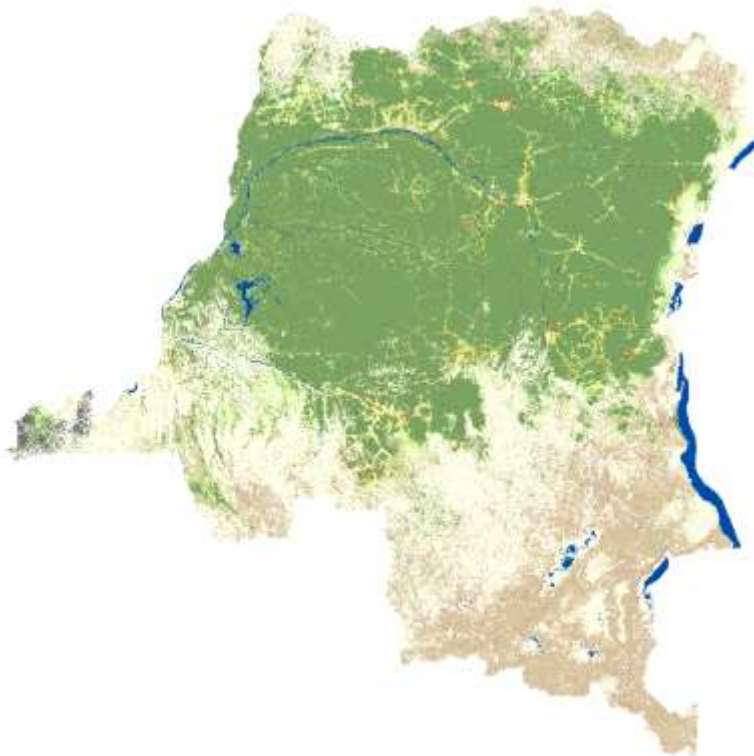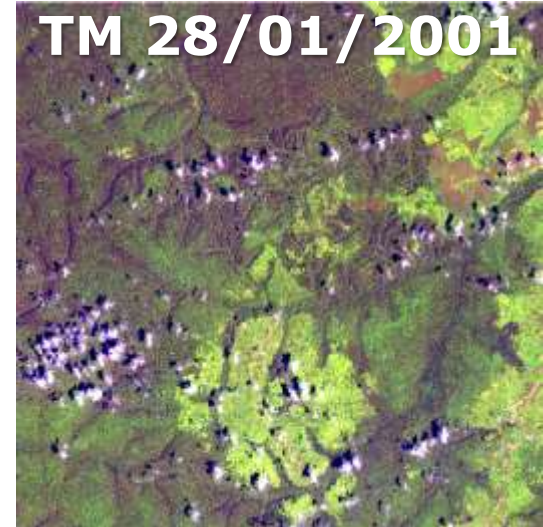
Congo Basin Deforestation
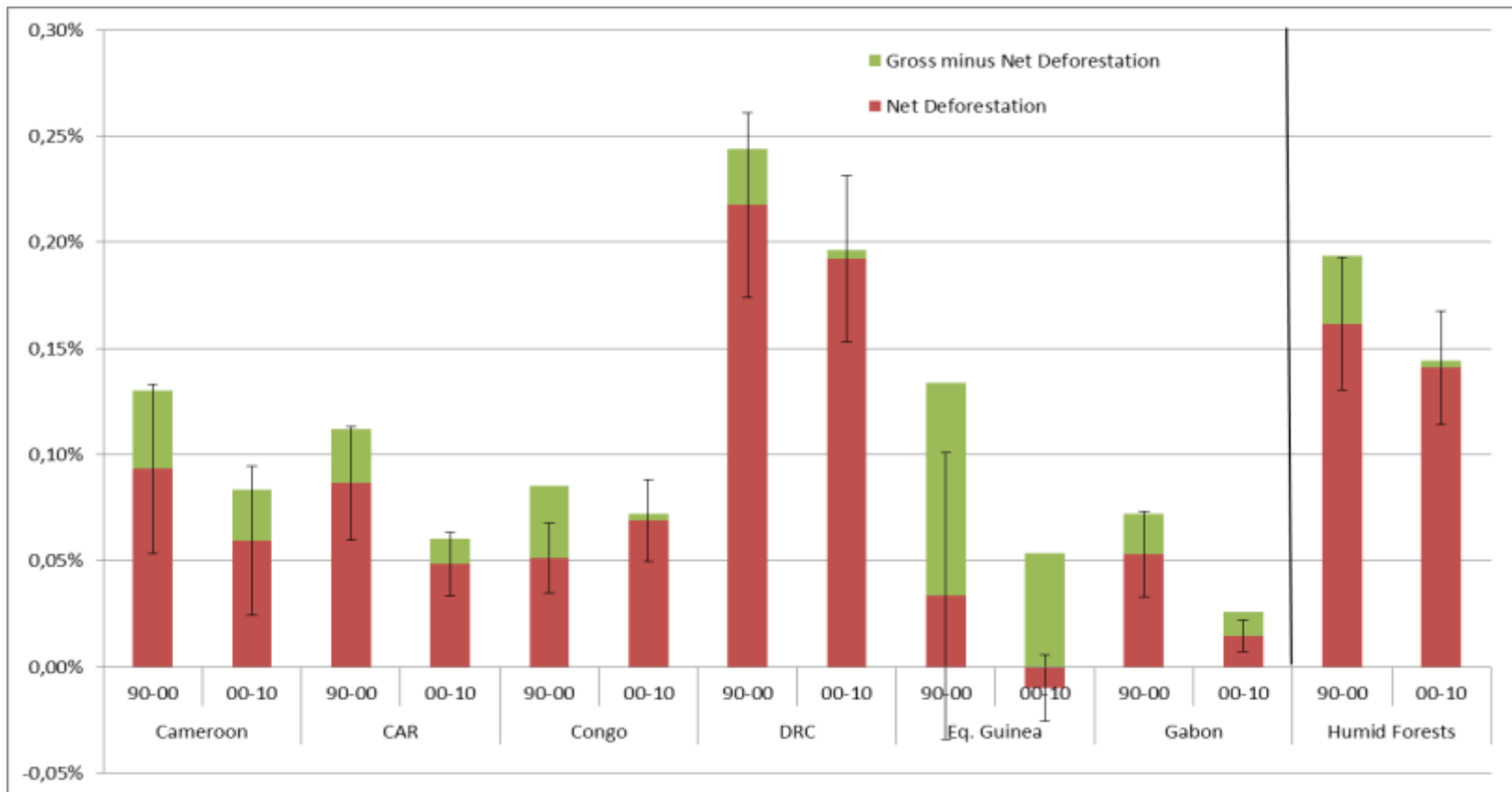
DRC FACET Atlas
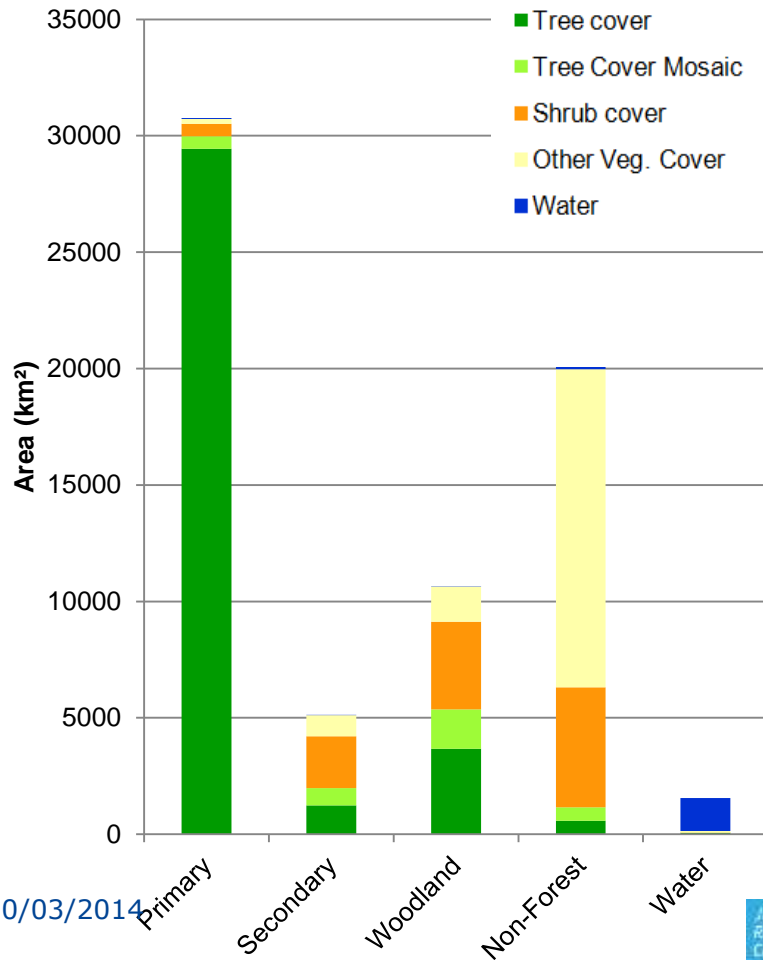
Mosaic 00-05
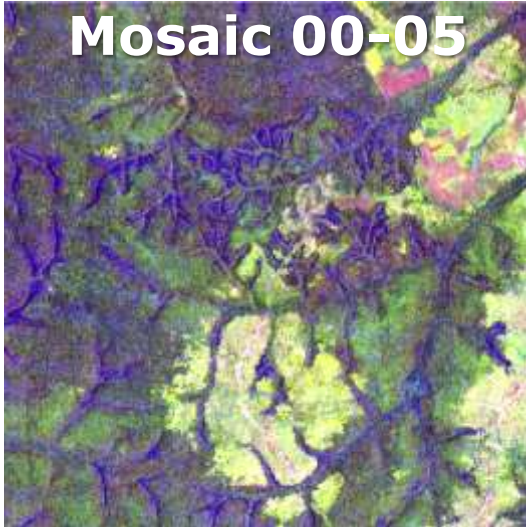
TM 28/01/2001
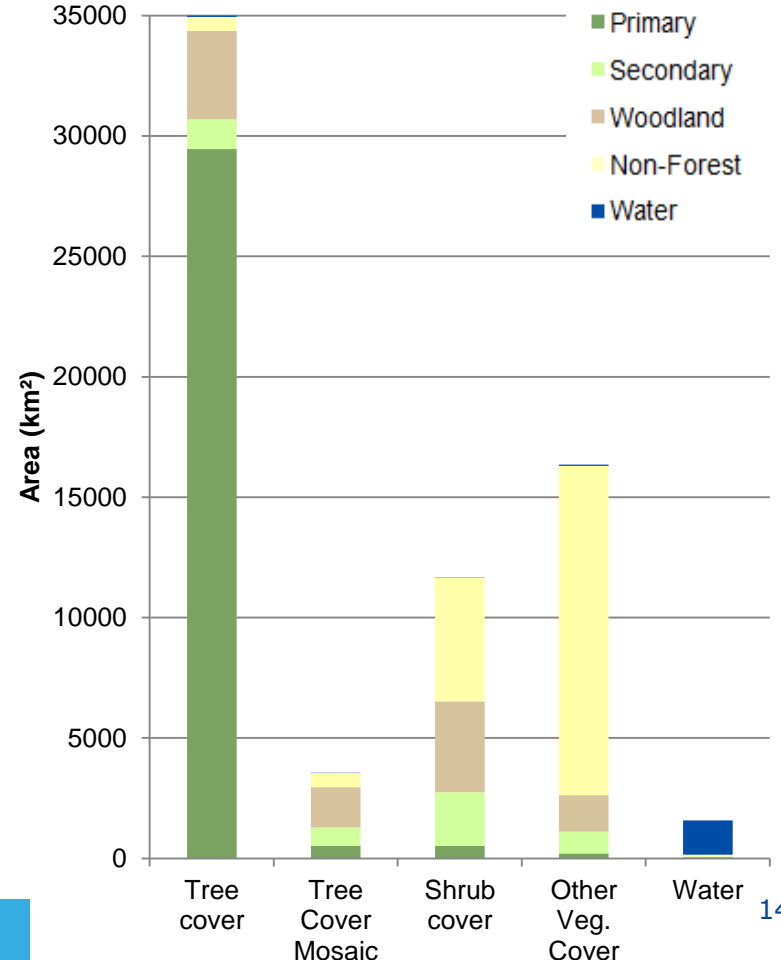
FACET map

TREES map

Potapov et al., 2012 - RSE

Map Comparison for 2000

FACET vs. TREES

TREES vs. FACET

Conclusion and perspectives

- Forest cover change estimates at regional and national scales for 1990-2000-2010
- Multi-sensor analysis (Landsat, Spot, DMC,…)
- Implication of regional experts

- Accuracy assessment with high resolution data
- Comparison with other forest change products
- Preparing new sensors (Sentinel-2): time series approach