Small scale reforestation in eastern DRC: the role of remote sensing in the REDD+ mechanisms (MORECA)

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REDD+

- UN funding programme for reforestation
- Deforestation and forest degradation due to logging, agricultural expansion, …
- Account nearly for 20% of global greenhouse gas emissions

UN-REDD
PROGRAMME
FAO UNDP UNEP

The United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries

Eco Makala

- 2007-2012 (WWF-BE)
- Reforestation of 4000 ha
- Surroundings of the ViNP (Eastern DRC)
- Small fields (0,5-5ha)
- Charcoal provision to the local population
- Executed by WWF Goma (WWF ESARPO)
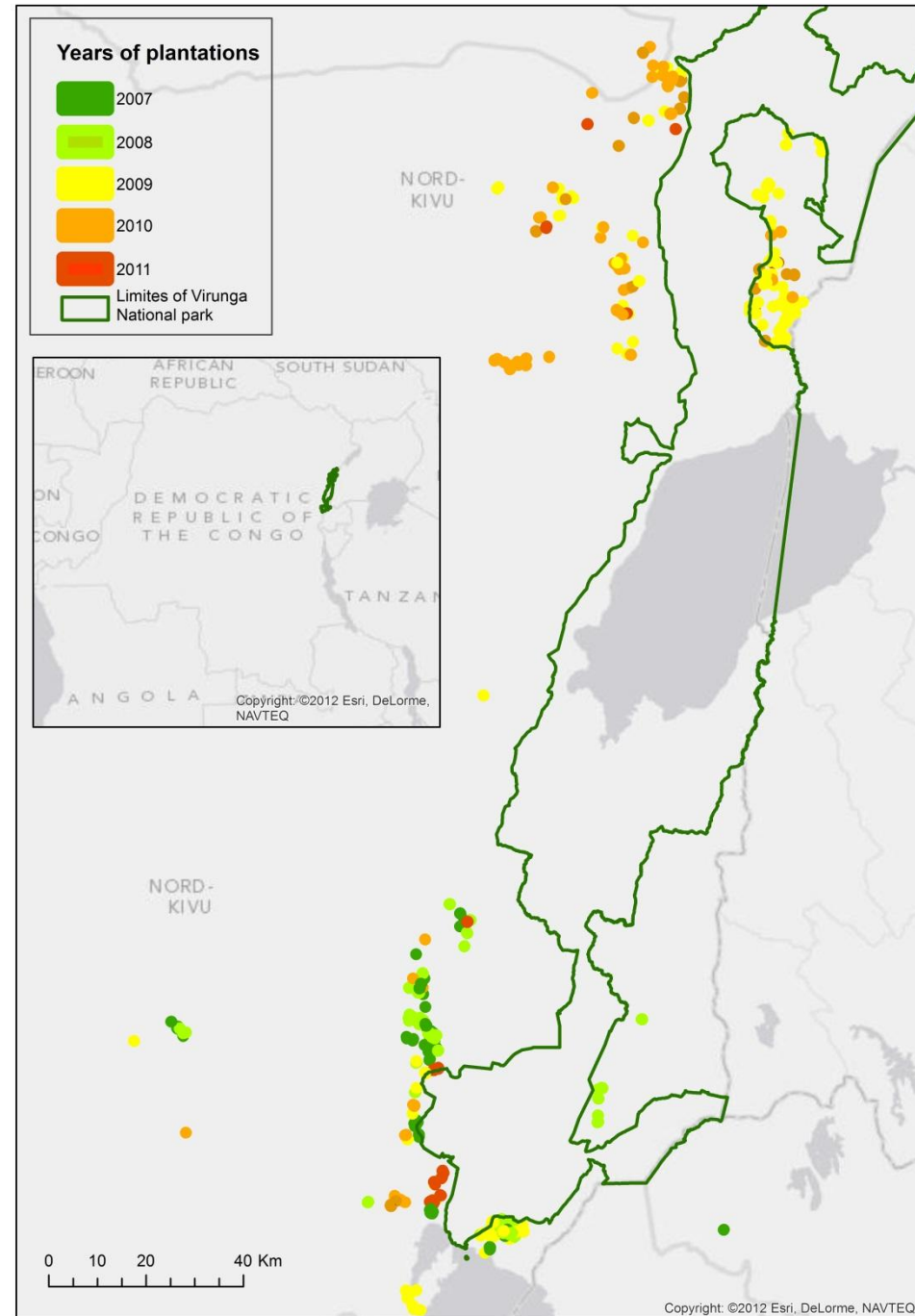
Objectives

- To be funded: **a plot not forested since 12/31/1989**
- Forest definition (UNFCCC):
    - Surface of 0.5 hectares
    - Tree crown cover of 30%
    - Potential tree height at maturity of 3 meters
- Remote sensing advertised in the Kyoto Protocol

1/ Eligible maps

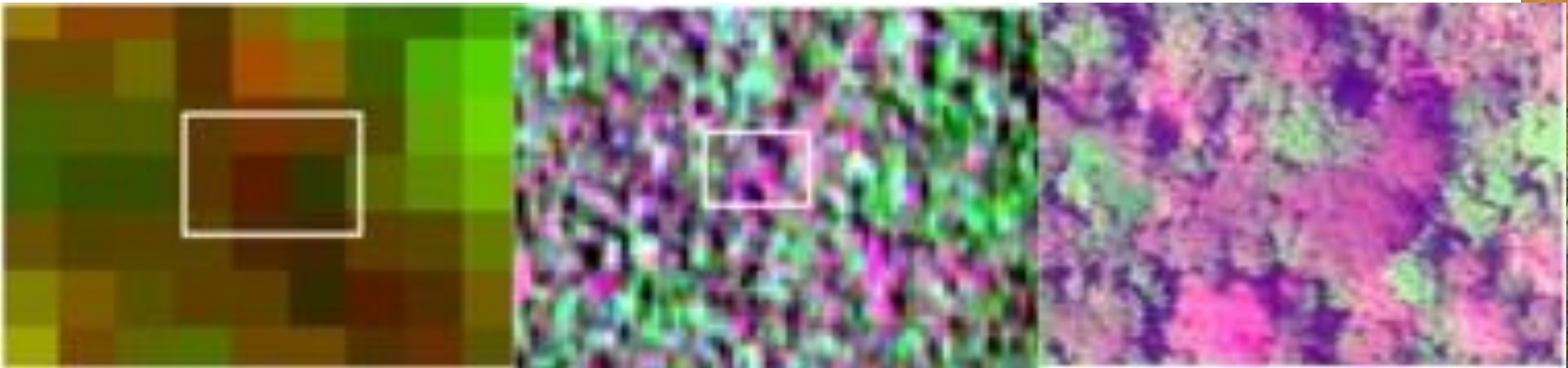**2/ Monitoring reforestation (in a difficult context)**

State of the art: forest monitoring

| Low spatial resolution (MODIS) | High spatial resolution (SPOT-5) | Very high resolution (GeoEye) |

Pixel-based classification

Achard et al., 2001; FAO, 2001; Hansen and DeFries, 2004

Pixel-based classification
Or
Object-based classification

none of both methods clearly outperforms the others
Gao and Mas, 2008; Wang et al., 2004

Object-based classification

Matinfar et al., 2007; Myint et al. 2011; Yan et al., 2006

Images from: Couteron P., 2012, *Linking Remote-Sensing Information to Tropical Forest structure: The Crucial Role of Modelling* http://www.earthzine.org

1. Eligible map : methodology

Pixel-based classification Or Object-based classification?

Depending on:
- Plots size → 0,5 ha
- Vegetation of interest → trees vs forest patches (open forest, closed forest)
- Forest fragmentation → high
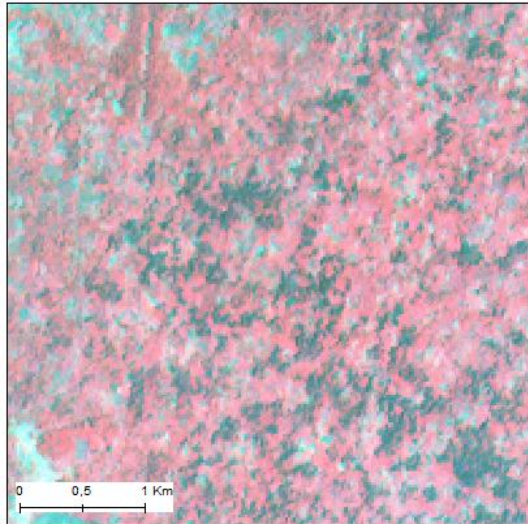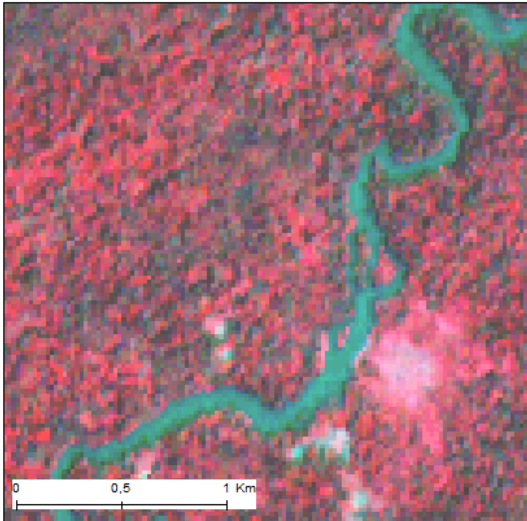
1. Eligible map : methodology

- Comparison of per-pixel and OBIA approaches:

→Best accuracy with pixel based classification

OBIA

Per-pixel

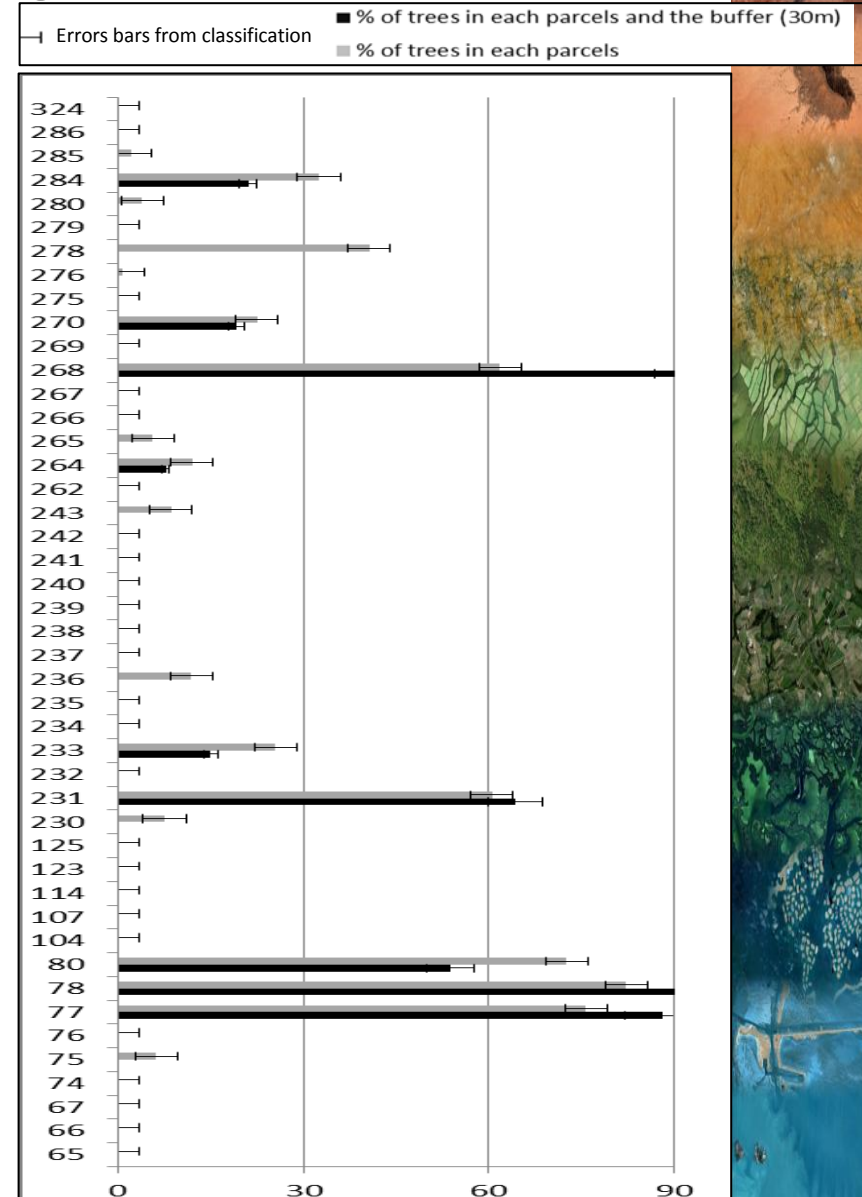| Legend	
	River
	bare soil
	other vegetation
	Forest
	Urban Area
	Clouds
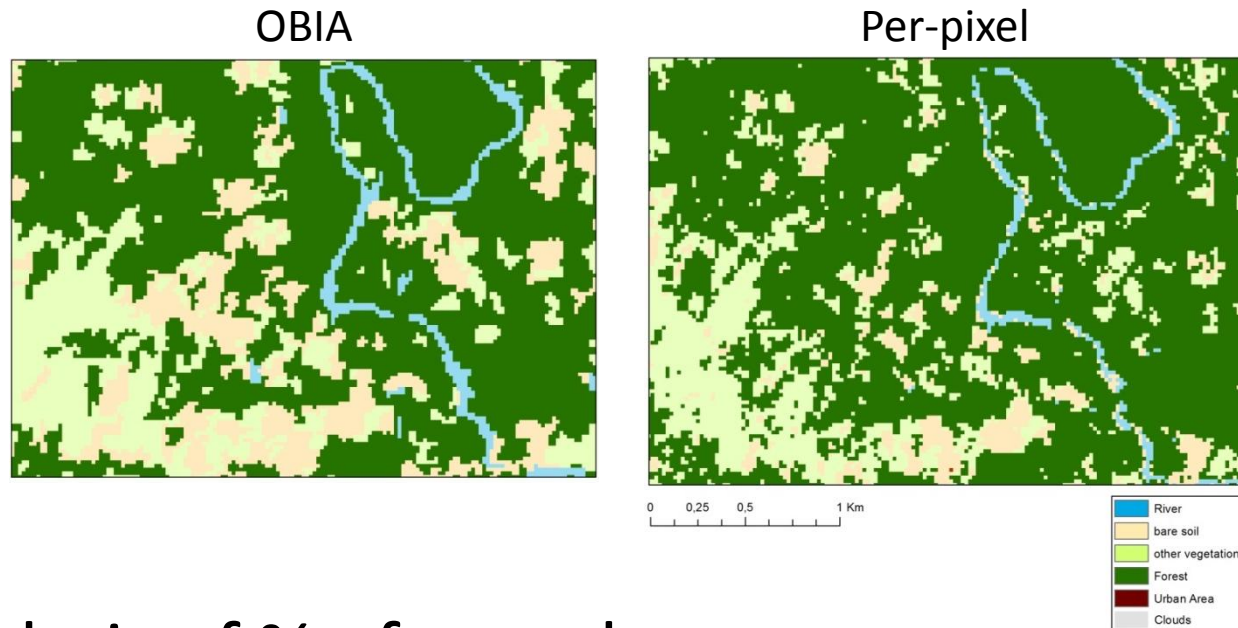
→Analysis of % of trees land-cover within a buffer larger than localisation errors

1. Eligible map : results

- plots not eligible if forest >30% (1991 or 2008)

- Study area :105 plots
  - Covering 74 ha
  - Mean size of plots: 0,9ha
  - 27 plots rejected

2. Monitoring reforested plots : GeoEye Goma area

- Very fragmented landscape ➔ pixel-based classification
- The legend is adapted and discriminates eucalyptus from bananas
- Overlay of each plot on the classification and extraction of classes percentages

Eucalyptus
Banana
Crops
Bare soil
Dwellings
Lava
Clouds
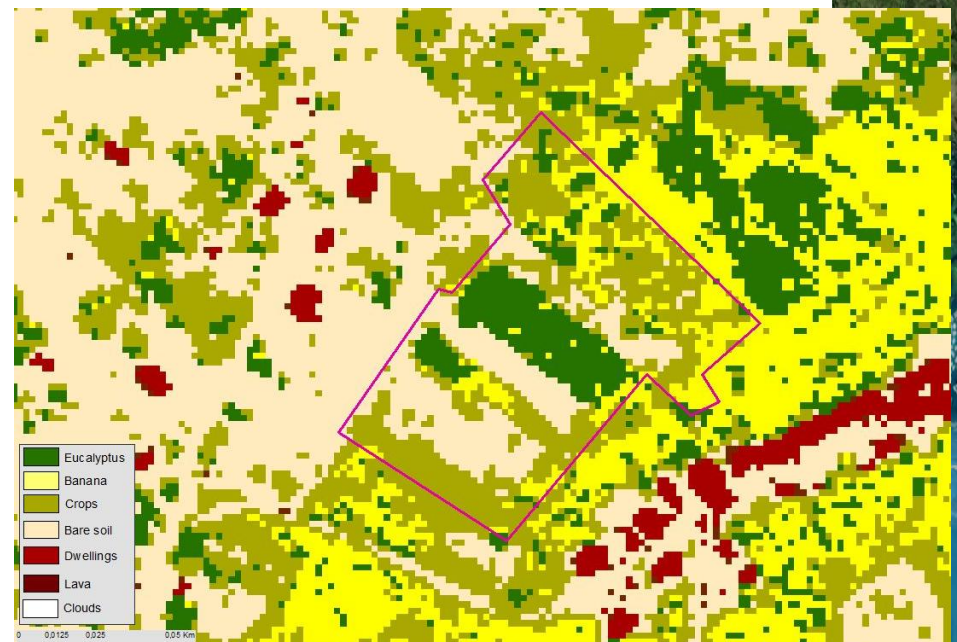
2. Monitoring reforested plots : GeoEye Goma area

- Some conclusions :
  - Area with young volcanic soil
  - Carbon estimation → not possible
    - Parcels too different (space between trees, year of plantation, …)
    - Weak growth of trees
  - Expensive imagery
- Perspective
  - Pleiade
  - Spot 6 (9th September 2012) XS= 8m; P= 1,5m

SAR contribution

- Few ecoMakala plots available on our images
- Very low link between density & Sigma0 (Radarsat & Terrasar-X)
  - ➔ work on regionale scale
- New Terrasar-X data (dual polarization VV & VH)

OBJECTIVES

- Methodology for Mapping forest/no forest (single date)
- SAR contribution to segmentation & classification in terms of polarization, band, satellite type
- SAR + Optical data

Multi-polarization composition

- 2008/2012 change map

- Deforestation & afforestation noticeable

- Segmentation limited

- To be used in combination with optical data, but no data overlap with optical images

0   0,5   1   2 Kilometers
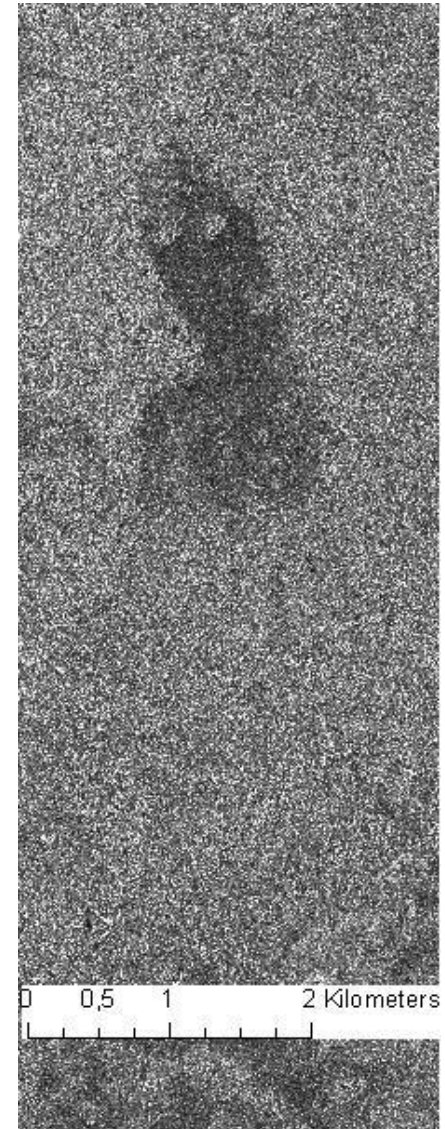
Segmentation & Classification (F/NF)

- 2008 classification (forest/ non-forest) Kappa : 0.66

- 2012 classification (forest/non-forest) Kappa : 0.56

- Contribution to optical segmentation

- Utility of the speckle in classification

| Forest | 🔴 |
| Non-forest | ⚪ |

0,5   1   2 Kilometers
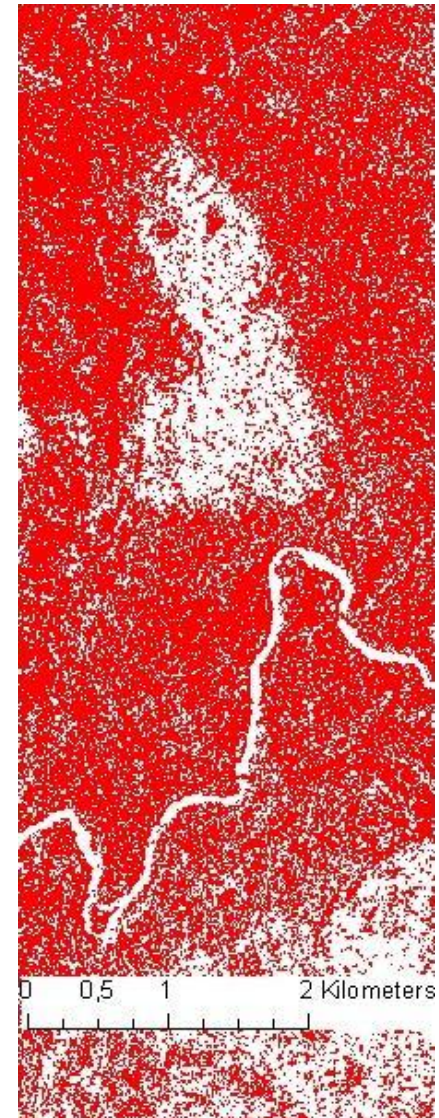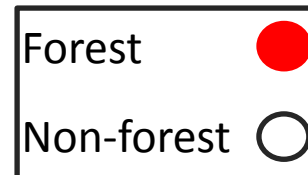
WWF Feedback

- At the WWF office in Goma :
  - Raising awareness on the importance of the data collection, processing and structuration in a geographical DB
  - Usefulness of remote sensing to localize the parcels and monitor the state of the plantation
  - Thanks to intensive exchange with researchers and training sessions :
    - Capacity building
    - Transfer of knowledge
  - Use of ArcGIS 10.1 to georeference images and to produce per pixel classifications

WWF Feedback

- At the national level (RDC), production of relevant data
  - to REDD program for the Virunga NP;
  - to fuel the data stock required
- Perspectives: developed methods to be used in future WWF projects/programs to :
  - eligibility of the lands
  - monitor of reforested parcels
  - scale-up at the national and regional level