Combining satellite, aerial and ground measurements to assess forest carbon stocks in Democratic Republic of Congo

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EO4REDD

Earth observation for Reducing Emissions from Deforestation and forest Degradation

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EO4REDD – BUILDING AN INNOVATIVE REDD+ MONITORING SERVICE

A SERVICE IN THREE STEPS

The EO4REDD project aims at **developing a robust, operational and cost-effective service for monitoring carbon stocks changes at regional scale**.

- [1] Forest Cover Changes Mapping ← Very High Resolution Satellite Data
- [2] Above Ground Biomass Quantification ← Aerial Images & Ground Measurements
- [3] Carbon Stocks Changes Assessment

A CASE STUDY IN DEMOCRATIC REPUBLIC OF THE CONGO

- West of Maï Ndombe region – North of Kinshasa, Capital city of DRC.
- Emission Reduction Program Idea Note (ER-PIN) & Program Document (ER-PD) development area of DRC.
- Many scientific studies.
- High pressure on the environment (proximity to Kinshasa) and high diversity of deforestation and forest degradation drivers.

From intact forest… *to degraded forest …* *to deforested areas.*

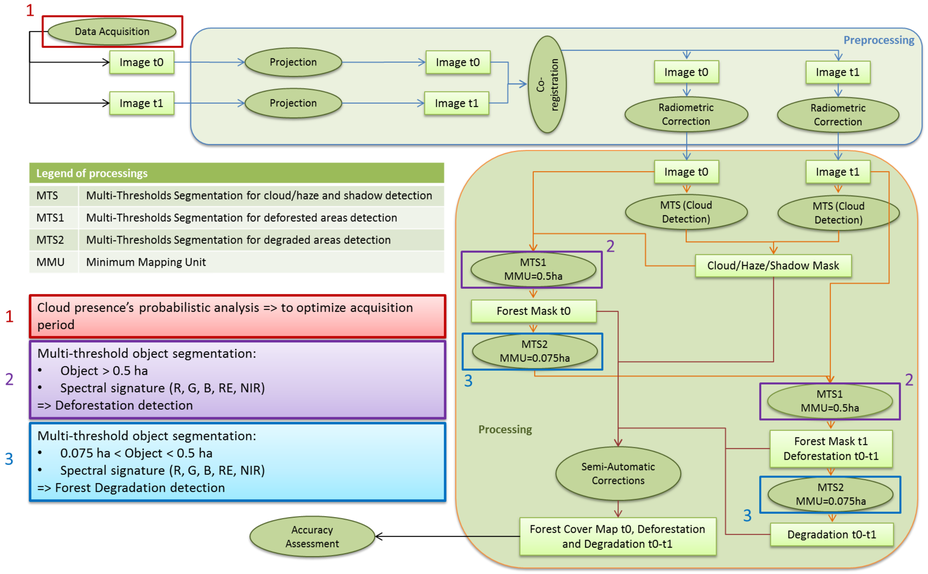
CONCLUSION & OUTLOOK

Given the high accuracies obtained in [1] (*> 80% for deforestation and ≃ 77% for forest degradation*) and the suitable model (*R^2 of 0.7*) obtained in [2] : **EO4REDD products can be seen as a valid and replicable option for carbon stocks monitoring in tropical forests**.

Further developments are needed to strengthen the cost effectiveness value and the REDD+ suitability of the service. These developments (including the use of Sentinel data time series, mapping of the "+" of REDD+, application to other geographical contexts …) will be assessed in future projects.

[1]

Object-based semi-automatic change detection methodology developed on ≃ 3.000 km² of **RapidEye** images (2011-12-13 ; 5 m spatial resolution)



Legend of processings	
MTS	Multi-Thresholds Segmentation for cloud/haze and shadow detection
MTS1	Multi-Thresholds Segmentation for deforested areas detection
MTS2	Multi-Thresholds Segmentation for degraded areas detection
MMU	Minimum Mapping Unit

1 Cloud presence's probabilistic analysis => to optimize acquisition period

2 Multi-threshold object segmentation:
- Object > 0.5 ha
- Spectral signature (R, G, B, RE, NIR)

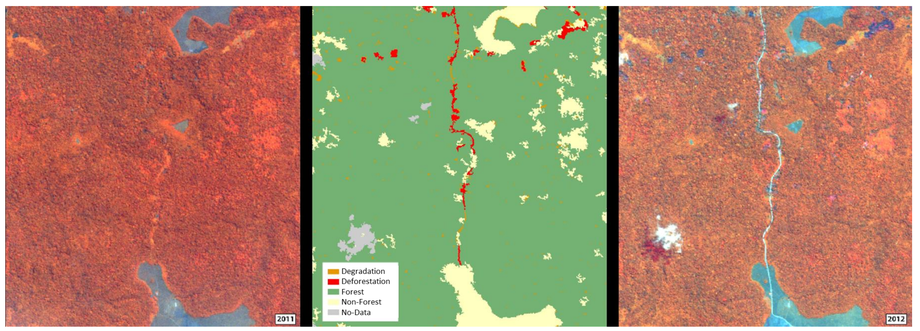
=> Deforestation detection

3 Multi-threshold object segmentation:
- 0.075 ha < Object < 0.5 ha
- Spectral signature (R, G, B, RE, NIR)

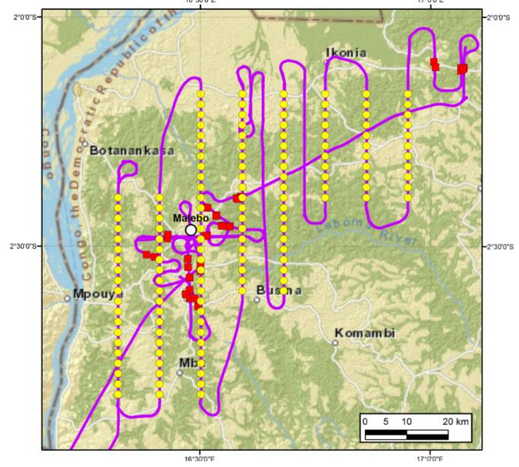
=> Forest Degradation detection

Detection of deforestation & **forest degradation** with high accuracies:
- **38.7 % of the forest cover losses are due to degradation**
- Overall accuracy = 90.7 %; Producer and user accuracies > 80 % for deforestation and = 77% for degradation

Classes	Area (ha)	% of total area	% of forest area
Forest	156.193	54.03	
Non forest	103.673	35.86	
Deforestation *(MMU = 0.5 ha)*	438	0.15	0.28
Degradation *(MMU = 0.075 ha)*	276	0.10	0.18
No data *(Cloud cover)*	28.491	9.86	
Total	**289.072**	**100**	



Allometric linear model developed for **Above Ground Biomass measurements** in Maï Ndombe (with R^2 = 0.7) [UCL] based on **dendrometric parameters** (tree crown areas and heights) extracted from more than **1000 airborne stereoscopic image pairs** acquired in September 2013 and calibrated using ground measurements of individual trees on a data set of 18 one hectare plots [ULg & ULB].



[2]

[3]

Combining [1] & [2] to measure **carbon stocks changes at national/regional scale**

[1] Forest Cover Change Maps + [2] AGB Estimation using Aerial Images = [3] National/Regional Estimation of Carbon Stocks Changes

Using extrapolation by forest types

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