UK NCEO work on Global Forest

SDCG-10: Reading, 7-9 September, 2016

CEOS
Committee on Earth Observation Satellites

GEO GROUP ON EARTH OBSERVATIONS

GFOI

Examples from NCEO-University of Leicester

Pedro Rodriguez-Veiga, Heiko Balzter, Kevin Tansey, Ciaran Robb, Ana Maria Pacheco, Ramesh Ningthoujam

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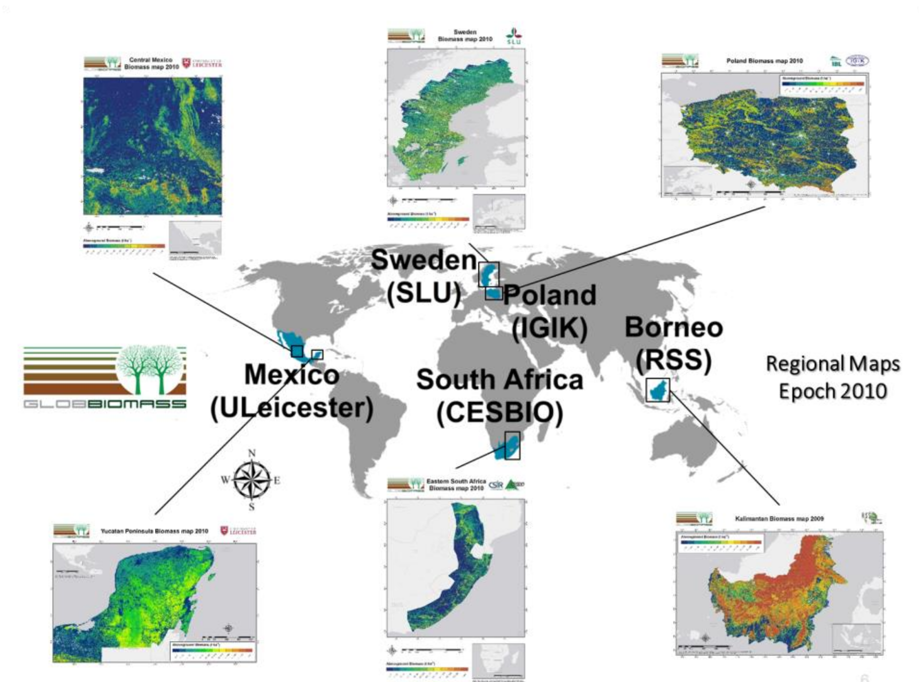
ESA DUE GlobBiomass

- Improved quantitative biomass maps at regional and global scale
- Provision of associated uncertainty maps
- Validation including major user organisations and establishing common practices and standards
- Contribution of new scientific results with respect to biomass stock and change estimation
- Identification of the limitations of current data and methods to estimate biomass by historical, recent and future global Earth observation data (Sentinels, BIOMASS, SAOCOM, ALOS-2)

ESA DUE GlobBiomass

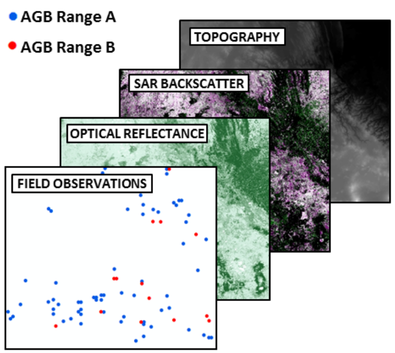


- Produce a global map for 2010
- Produce 5 regional maps for 3 epochs
  - Epoch 1: 2005
  - Epoch 2: 2010
  - Epoch 3: 2015
- Spatial resolution < 150 m
- Map the uncertainty of the estimates
- Biomass change maps between Epochs

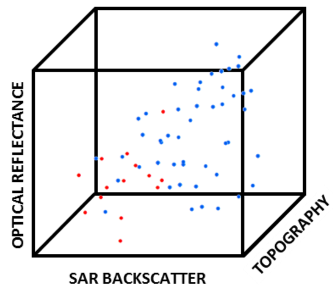
GlobBiomass Regional Mapping

Partner/ Region	Method	Datasets
UniLeicester Mexico	MaxEnt	ALOS PALSAR dual polarization, Landsat Surface Reflectance, Landsat Percent Tree Cover, SRTM, Field data
CESBIO South Africa	WCM + MIPERS	ALOS PALSAR dual polarization, Landsat Percent Tree Cover, SRTM, Field data
IGIK Poland	Random Forest Regression	ALOS PALSAR dual polarization, SRTM, Landsat, Field data
RSS Kalimantan	Regression	ALOS PALSAR dual polarization, SRTM, Airborne LiDAR, Field data
SLU/GAMMA Sweden	kNN / BIOMASAR	SPOT 4 and SPOT 5, Field data / ALOS PALSAR dual polarization

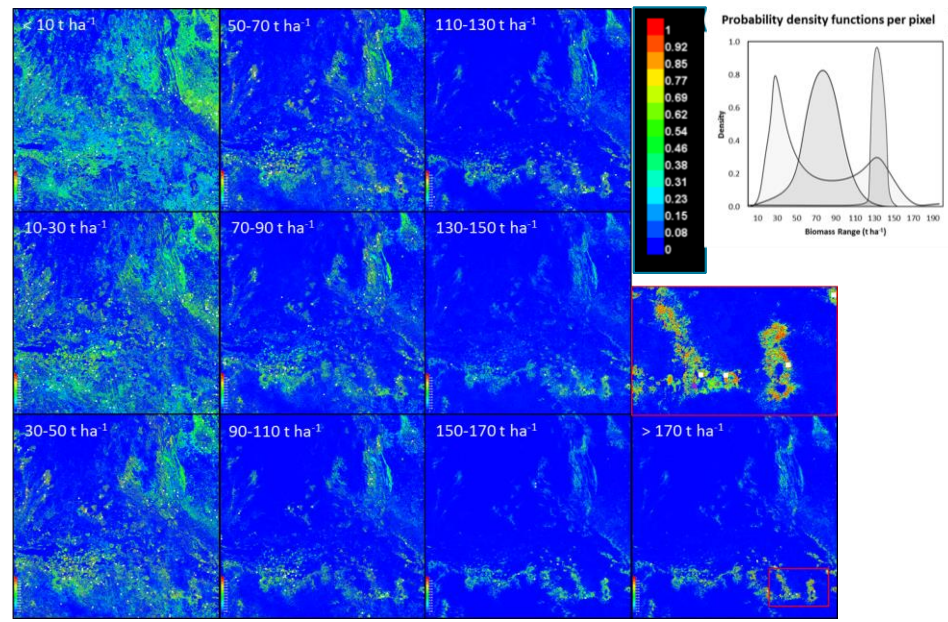
Focus: Mexico regional



Geographical Space



Environmental Space



Model Prediction Geographical Space

Maximum probability weighted mean for each pixel

$$\widehat{AGB} = \frac{\sum_{i=1}^{N} P_i^n AGB_i}{\sum_{i=1}^{N} P_i^n}$$

P_i is the MaxEnt probability estimated for each biomass range class AGB_i (median value of the range), and $\widehat{AGB}$ is the predicted value of AGB for each pixel

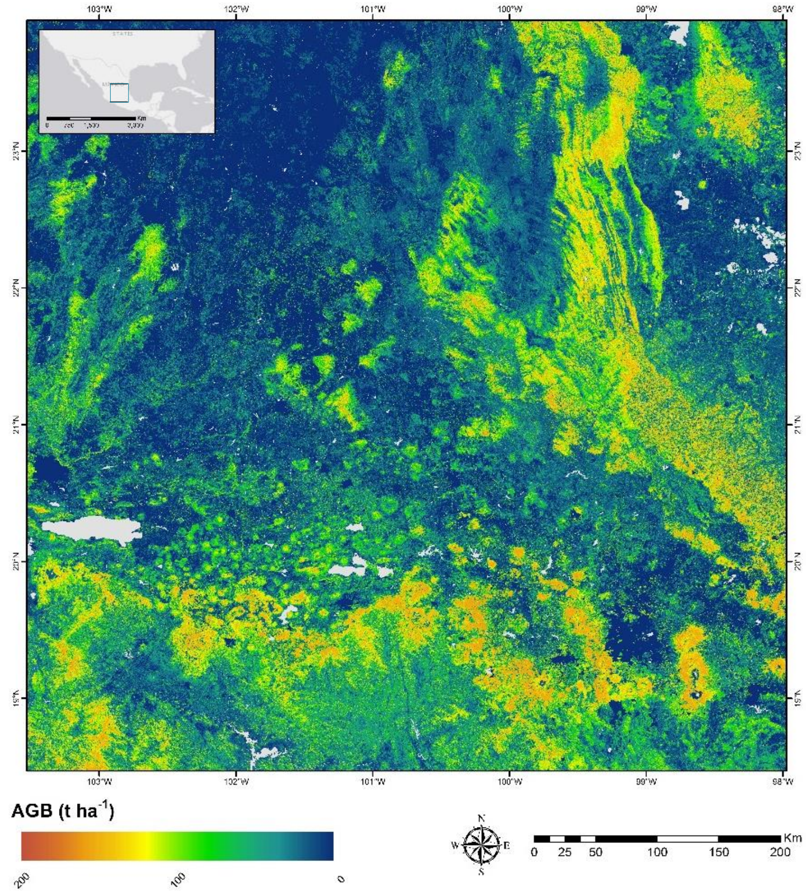
Prediction Error:

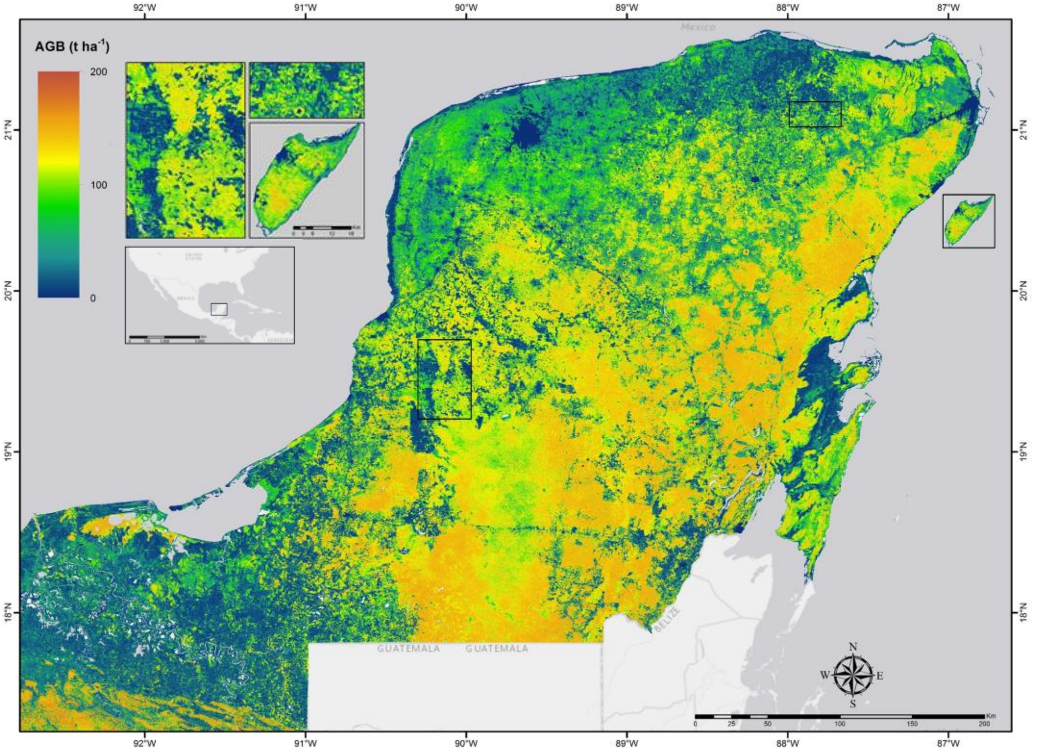
$$\varepsilon_{prediction} = \sigma_{\widehat{AGB}} / \widehat{AGB}\, x100$$

where $$\sigma_{\widehat{AGB}} = \sqrt{\frac{\sum_{i=1}^{N} (AGB_i - \widehat{AGB})^2 P_i}{\sum_{i=1}^{N} P_i}}$$

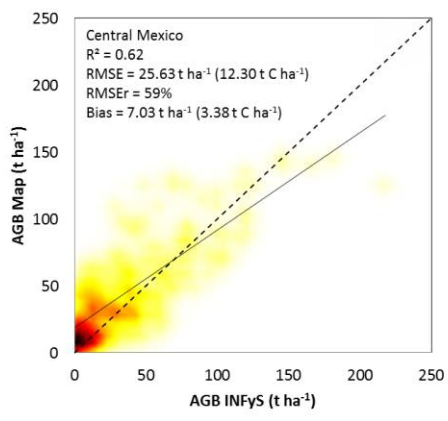
Error Propagation:

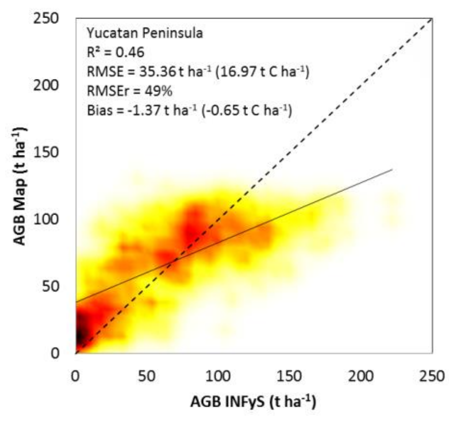
$$\varepsilon_{AGB} = (\varepsilon_{measurement}^2 + \varepsilon_{allometry}^2 + \varepsilon_{sampling}^2 + \varepsilon_{prediction}^2)^{1/2}$$

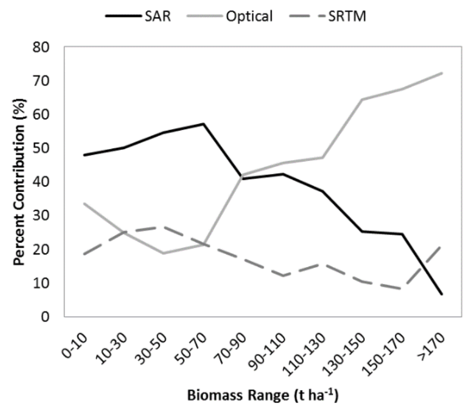


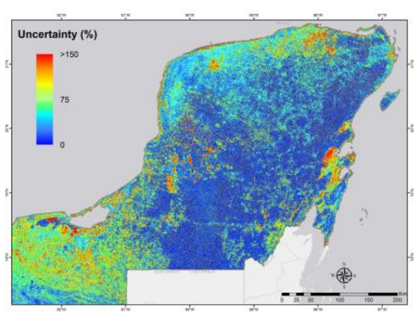


Aboveground Biomass and Uncertainty maps at 25m spatial resolution for the reference year 2010 for the regional sites of Central Mexico and the Yucatan peninsula









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GLOBBIOMASS

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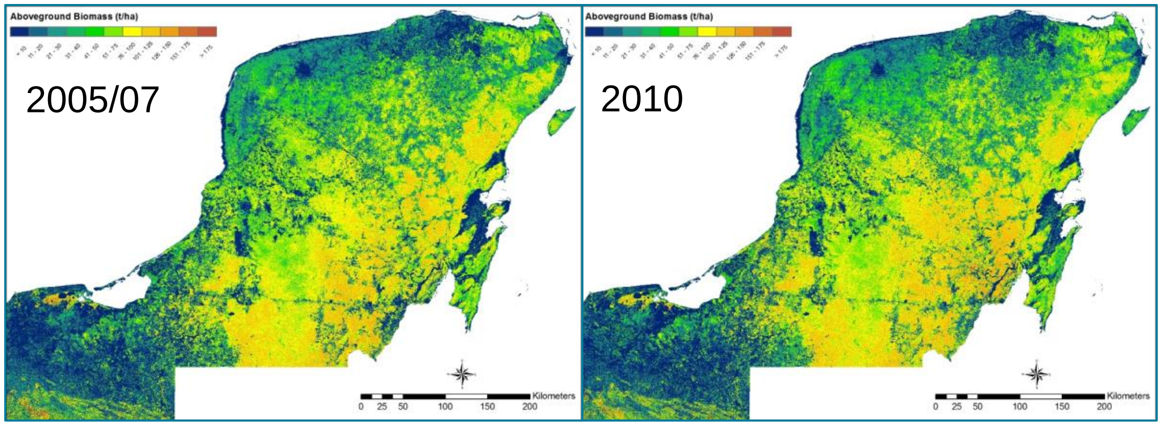
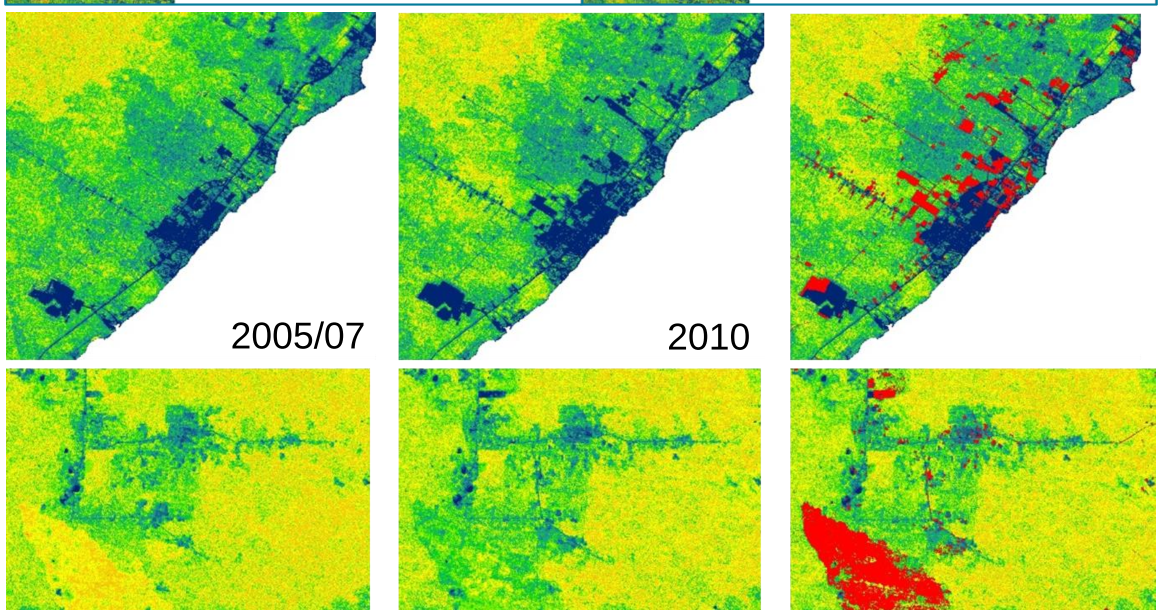
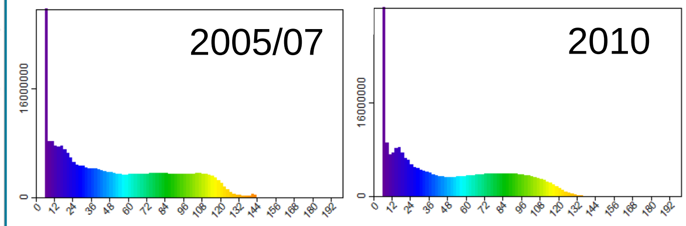
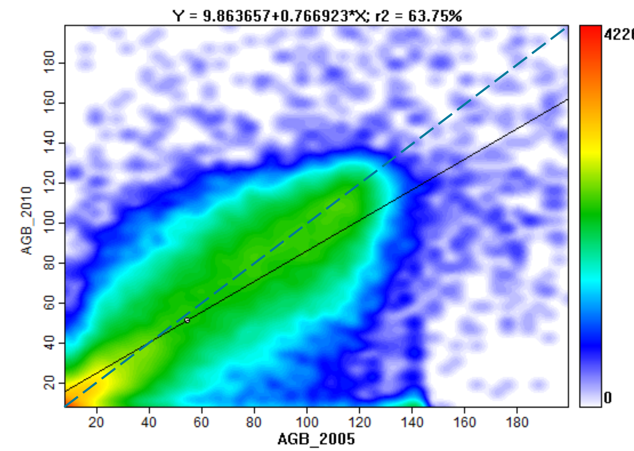
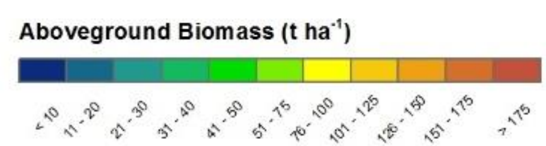
Biomass change











Bright Red: Hansen *et al*, (2013) 2005-2010 forest loss

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On-going project: REDD+ Monitoring Services with Satellite Earth Observation - Community Forest Monitoring Pilot

- Kenya's economy is losing US$ 68 million annually from deforestation and aims to achieve afforestation to 10% forest cover by 2030.
- To protect forest resources, capacity is needed for timely deforestation monitoring
- 360° communication: Users have to be able to add photos, text annotation, feedback on validation and other local information to the deforestation alerts
- The Sentinel-1&2 and Landsat data (in future potentially also NovaSAR-S) enable much more frequent event detection
- The edge of our product is the customisable mobile app combined with satellite-derived and user-entered information

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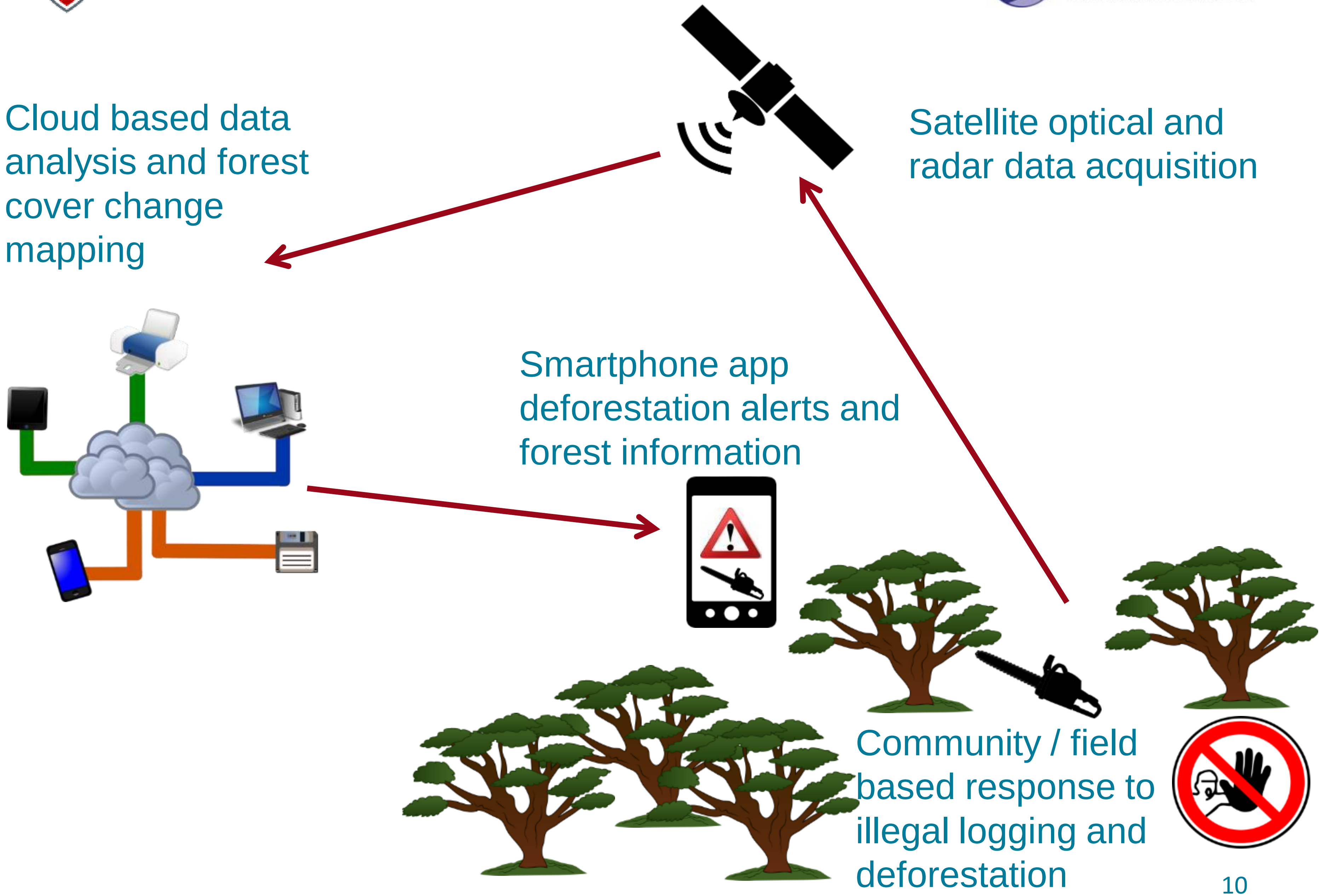
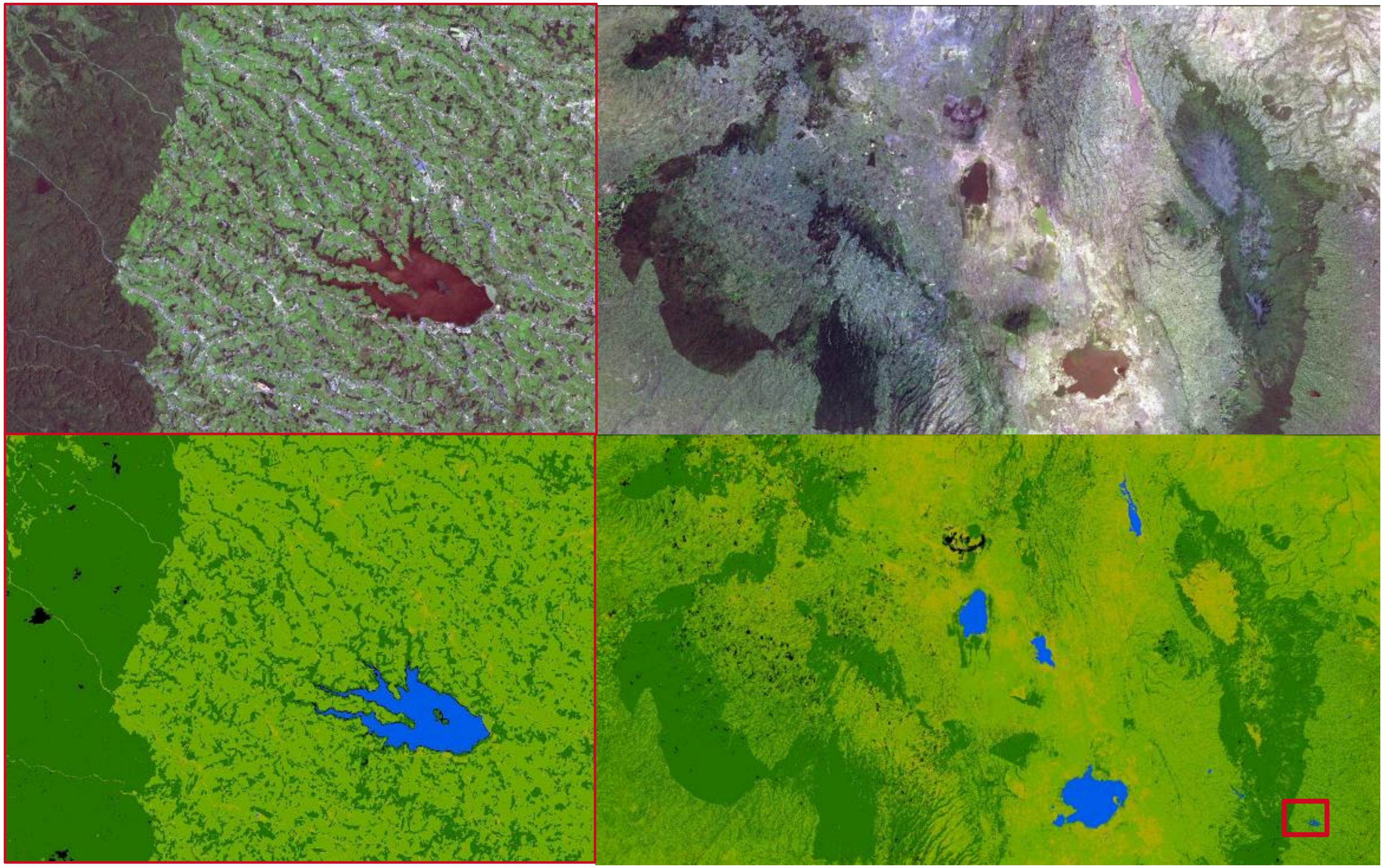
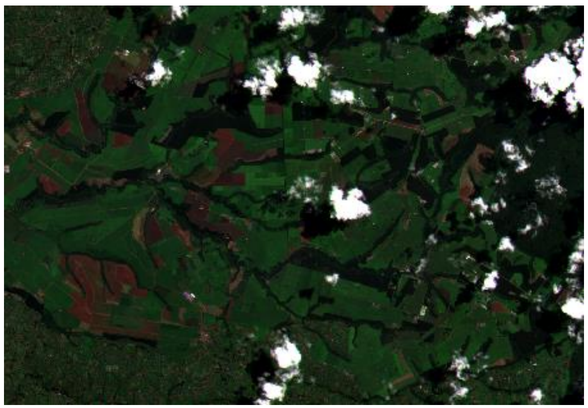


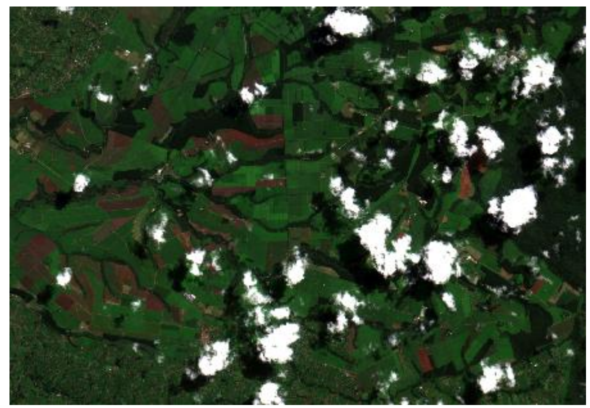
University of Leicester | National Centre for Earth Observation, Natural Environment Research Council

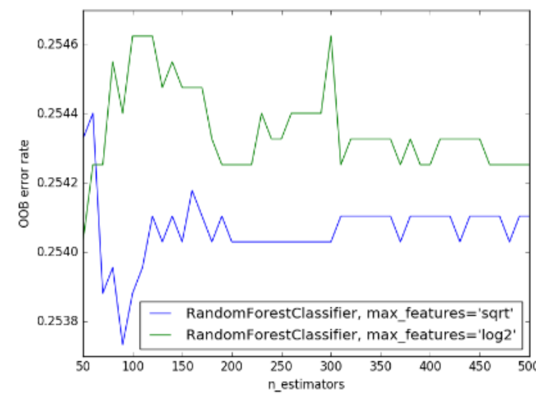
Initial results

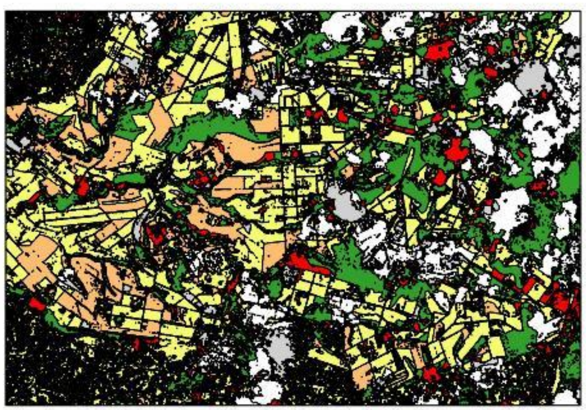


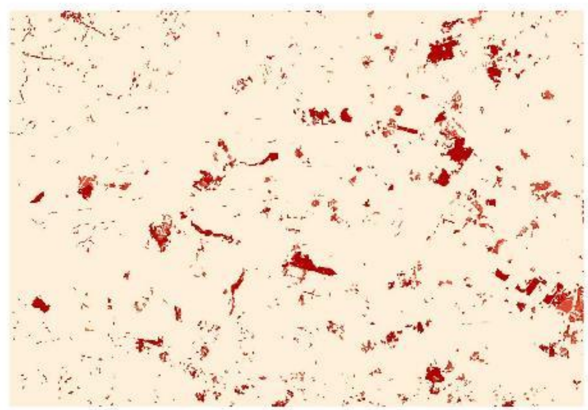
Initial results











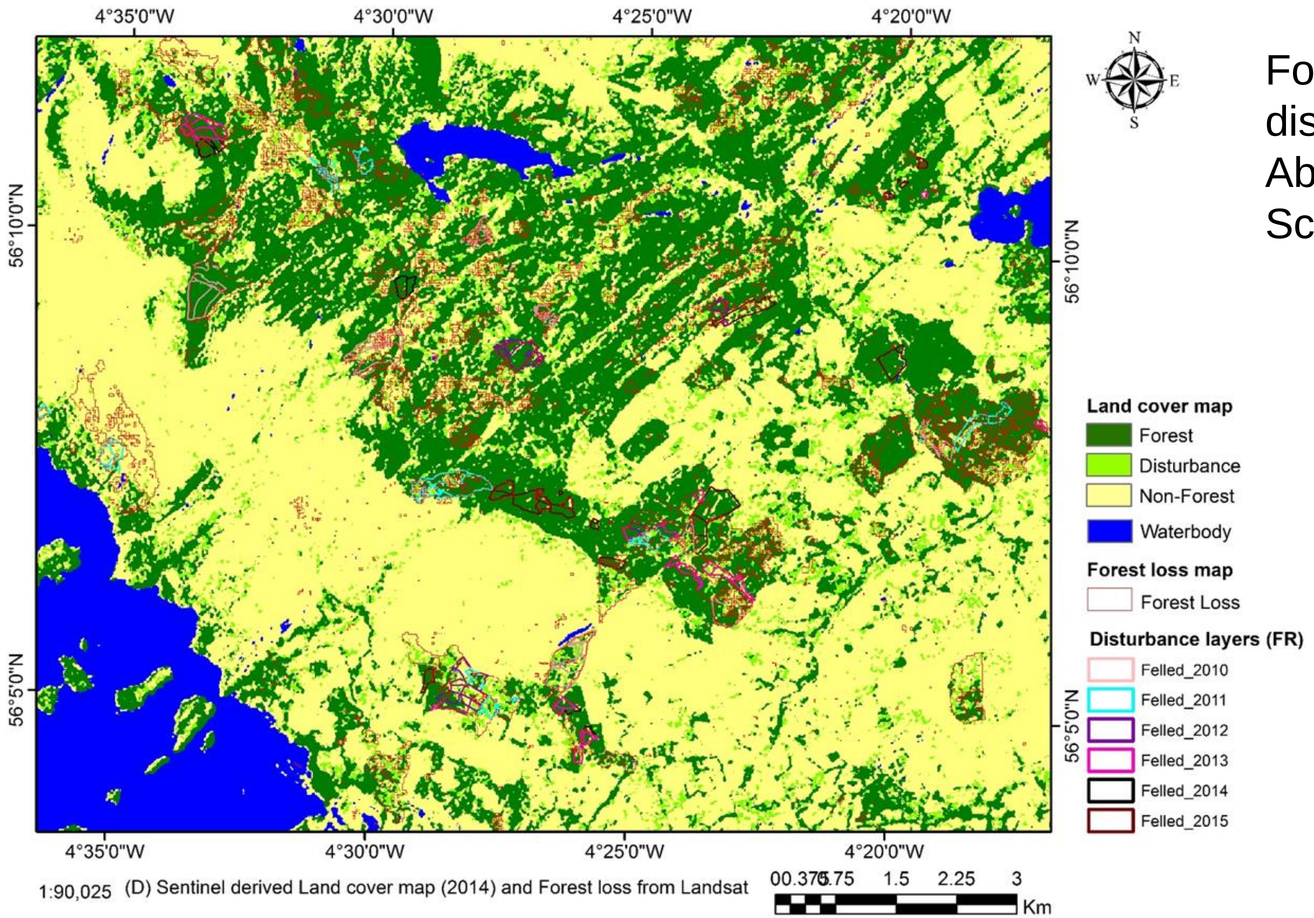
Clearance Probability
- 0.000000
- 0.138750
- 0.277500
- 0.416250
- 0.555000

Change classification
- Cleared forest
- Stable forest
- Stable non forest veg
- Stable low veg/impervious
- Non forest veg change
- Cloud

1 0 1 2 3 4 km

N

EODIP Project: Sentinel-1 C derived Forest Cover Map



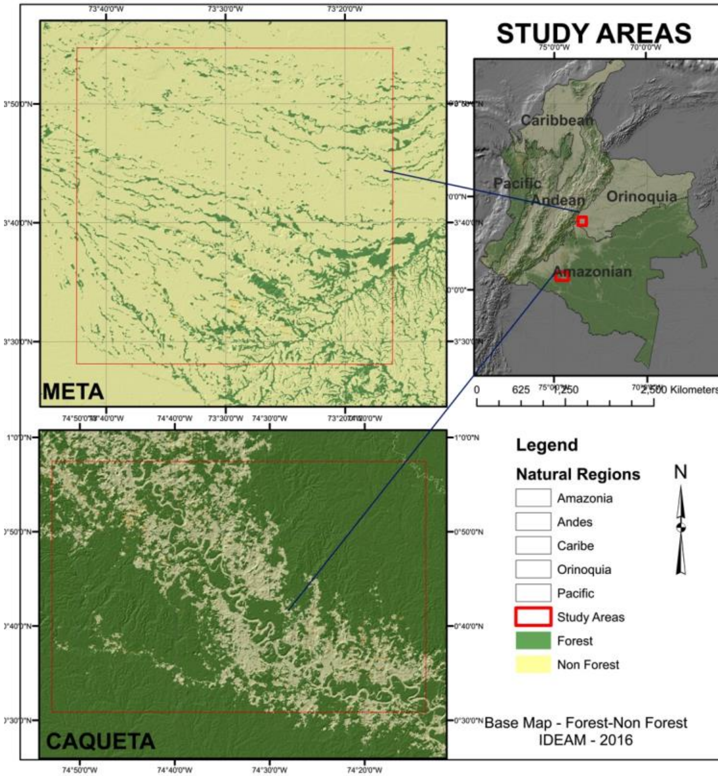
Forest cover and disturbance map of Aberfoyle area in Scotland

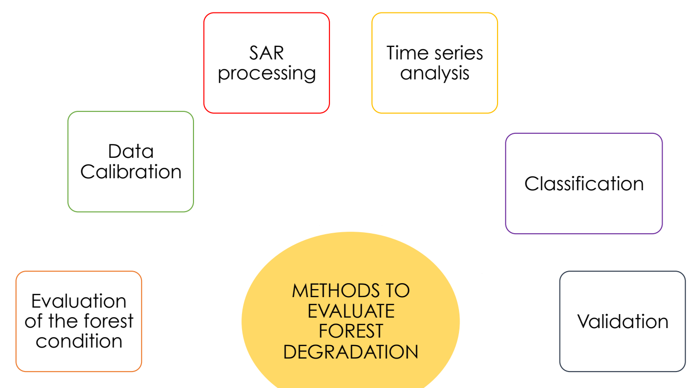
Measuring Forest Degradation in Colombia

OBJECTIVE: Explore the capabilities of SAR bands L (Alos PalSAR, Alos 2) and C (Sentinel 1A and 1B), in order to measure forest degradation in Colombia:

Specific objectives:

- Understand the intrinsic characteristics of forests and its changes in structure and carbon stocks.
- Recognize patterns of forest degradation and forest regeneration to improve the carbon emissions estimates from forest loss and regrowth?
- Analyse temporal series complemented with field data observations.





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Thanks

The University Of Sheffield.

Mapping tropical forest processes using Earth Observation data

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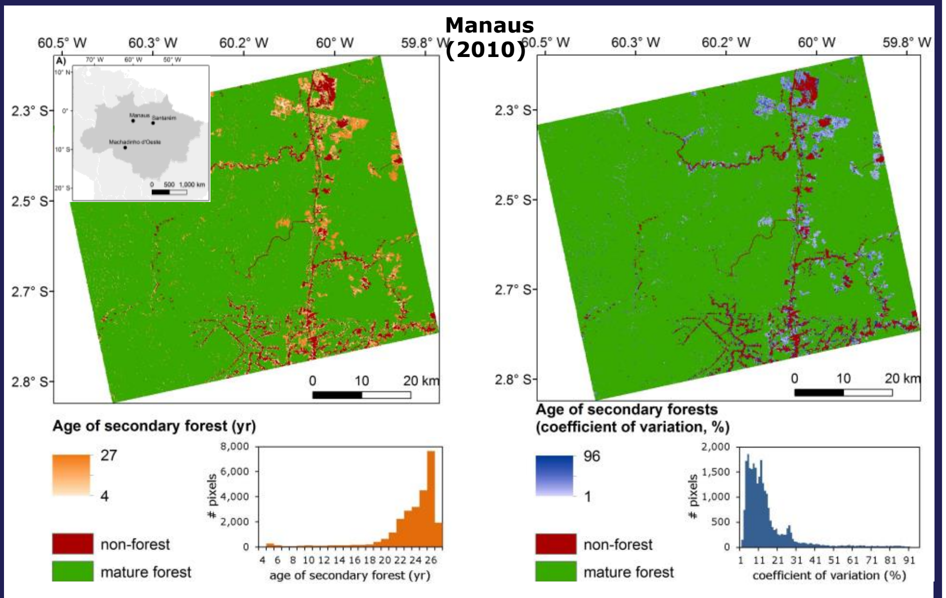
João Carreiras & Shaun Quegan
j.carreiras@shef.ac.uk | s.quegan@shef.ac.uk

Sentinel (1 and 2) and L-band SAR (**ALOS-2 PALSAR-2, SAOCOM, NISAR)** imagery, together with the **long-term Landsat archive**, offer an unprecedented opportunity to build a **pan-tropical system capable of tracking forest processes**, such as:

- secondary forests establishing on abandoned farmland
- wildfires occurring over peatland dominated regions

Mapping non-forest, age of secondary forest, and mature forest in the Amazon with single-date Landsat TM and ALOS PALSAR data

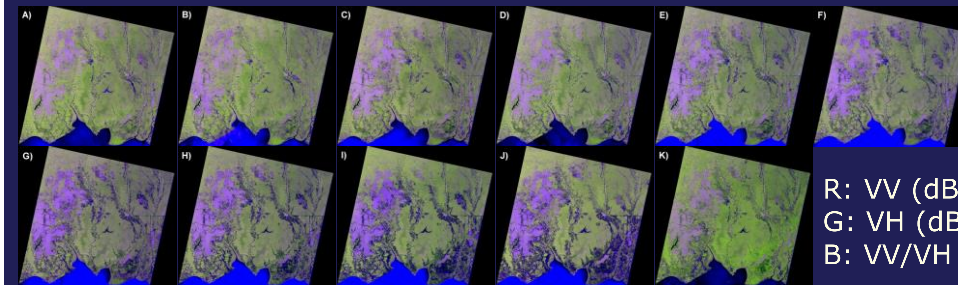


- Discriminating non-forest, secondary forest and mature forest with overall accuracy of 98%
- Retrieving the age of secondary forests with RMSE = 3.84 yr and bias = -0.06 yr

In combination with biomass accumulation curves, this approach offers an alternative source of information to estimate the carbon stocks and fluxes in the above-ground biomass pool of tropical secondary forests

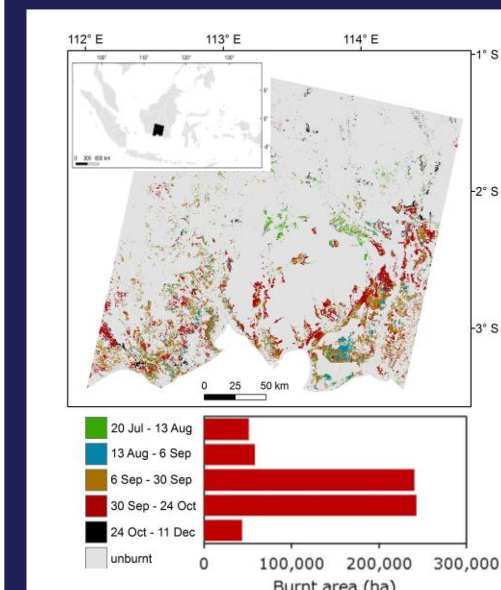
Carreiras et al. (2016). *Remote Sensing of Environment* (under review)

Mapping the 2015 burnt areas in Central Kalimantan with monthly time-series of Sentinel-1A (VV+VH) data



R: VV (dB)
G: VH (dB)
B: VV/VH

Sentinel-1A data acquired between March – December 2015



- Burnt area mapping with overall accuracy between 75-95%
- 11% of the study area burnt in 2015, with the majority (75%) in a 7-week period (6 Sep – 24 Oct)

In highly cloud-covered tropical forest regions, monthly time-series of C-band SAR data can play a unique role at estimating not only the annual burnt area extent but also its time-dependent distribution

Forest Monitoring from Earth Observation: Examples from Aberystwyth University

SDCG-10: Reading, 7-9 September, 2016

Peter Bunting, Richard Lucas, Ake Rosenqvist, Nathan Thomas, Sizwe Mabaso, Joshua Jones and Joao Carreiras

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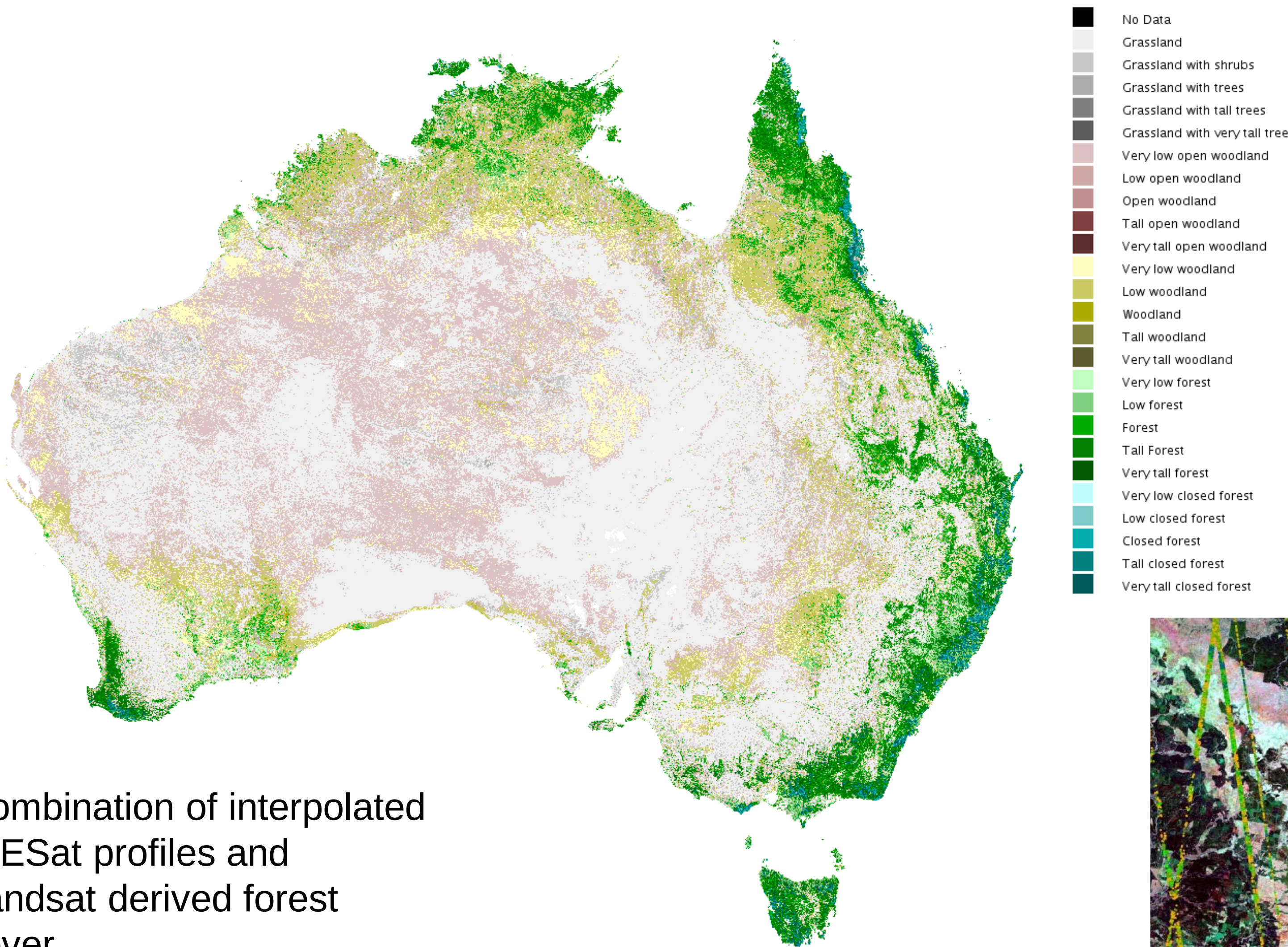
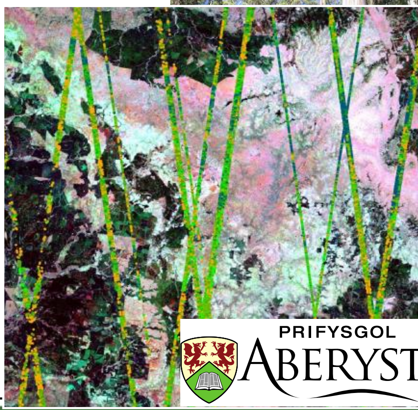
Carnahan Classification Based on Height and Cover





Combination of interpolated ICESat profiles and Landsat derived forest cover.

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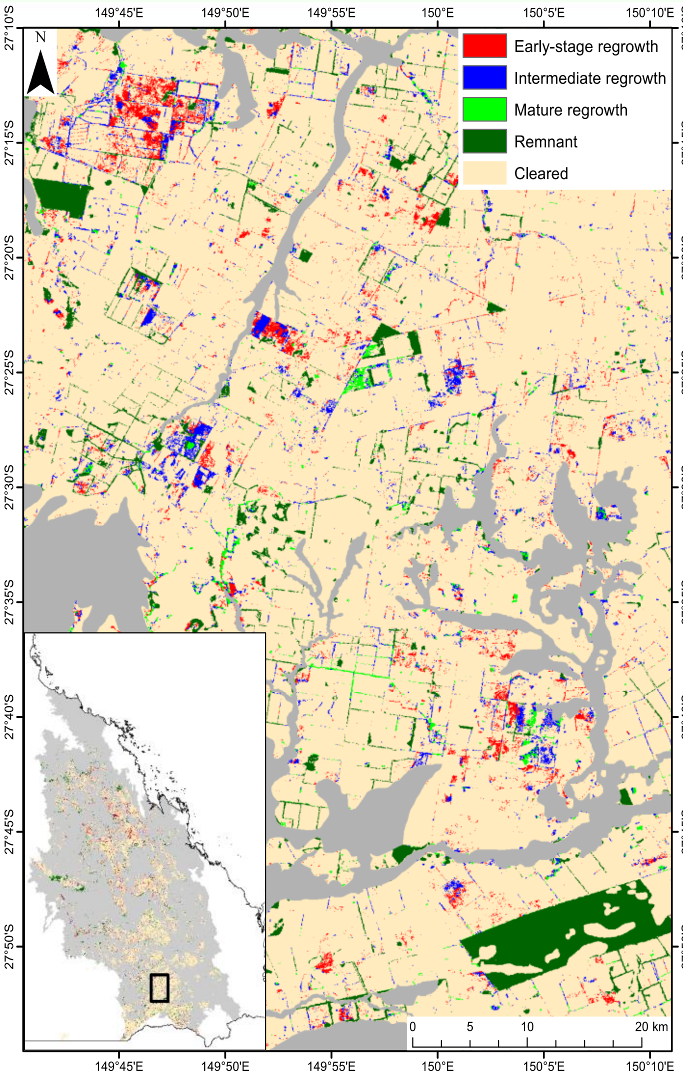
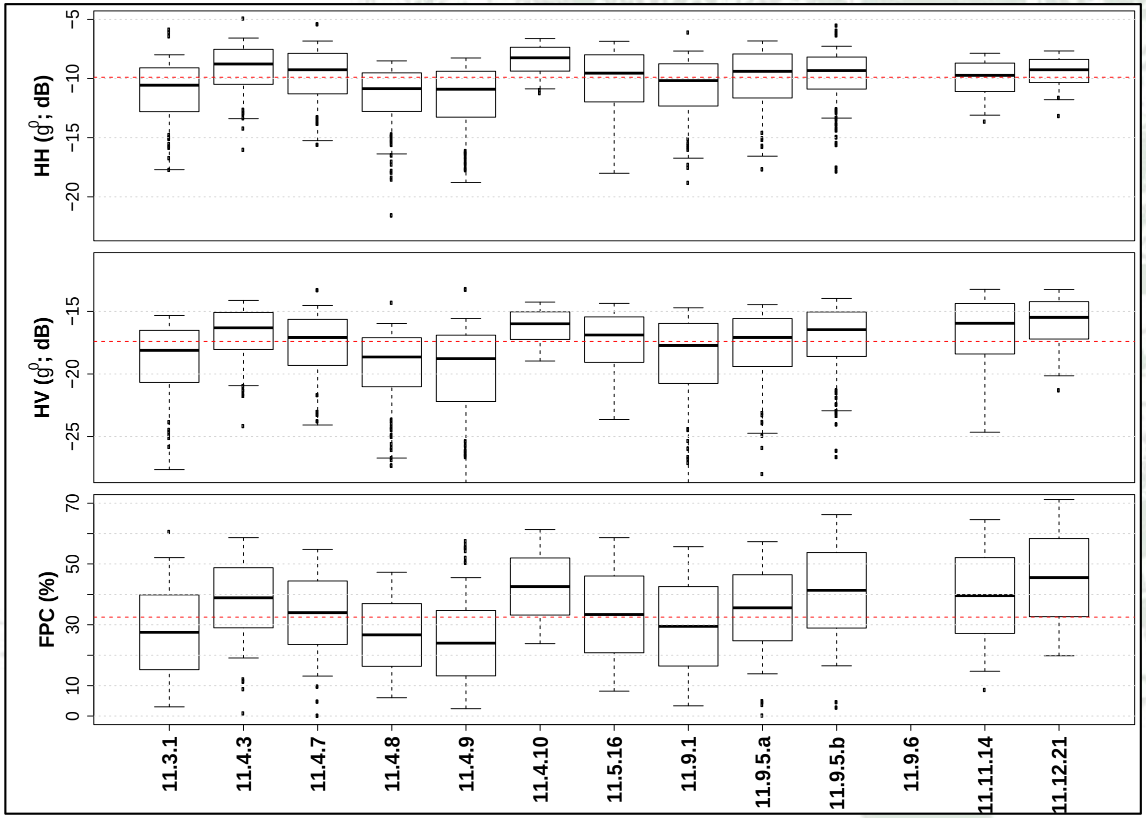
Product at 25m resolution and is the integration of ALOS PALSAR, Landsat and ICESat. Segmentation of PALSAR and Landsat products, populate segments with intersecting ICESat footprints, interpolate ICESat profiles using PALSAR and Landsat = forest height for Australia.

Mapping Forest Growth Stages





Brigalow Belt Bioregion, Queensland, Australia (2009)

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GEO CEOS

Maps of forest regrowth stage generated using Landsat-derived Foliage Projective Cover (FPC) and Advanced Land Observing Satellite (ALOS) PALSAR HH and HV data. All mapping is based on the response relative to that of remnant forest for different regional ecosystems

Global Mangrove Watch

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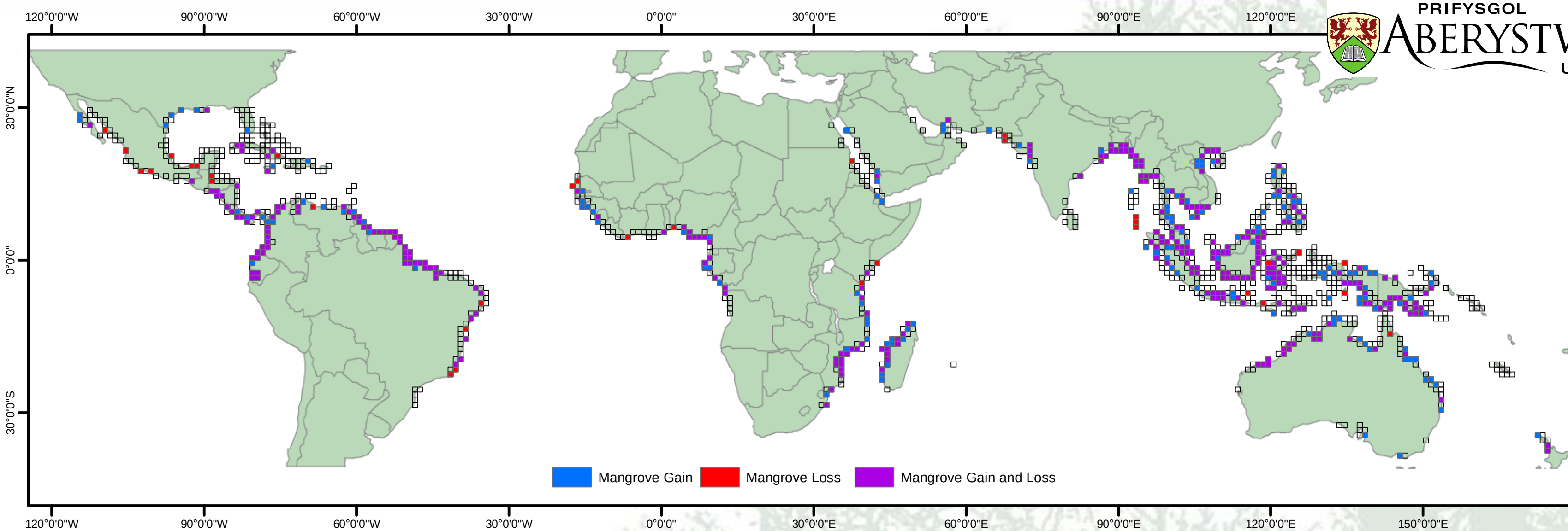
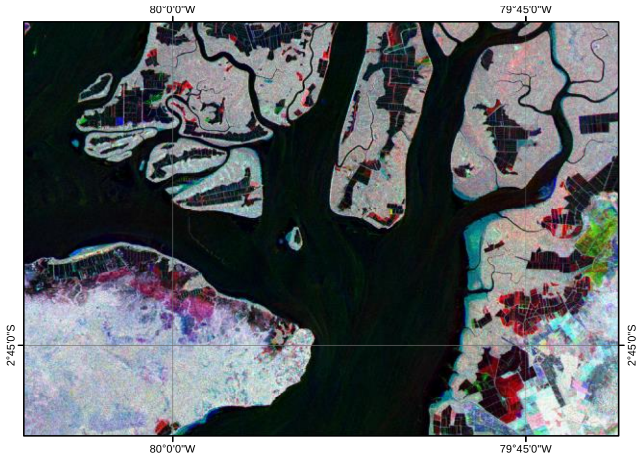
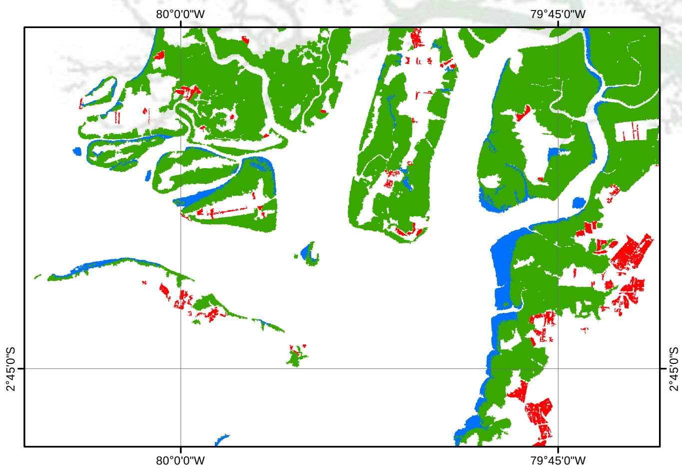


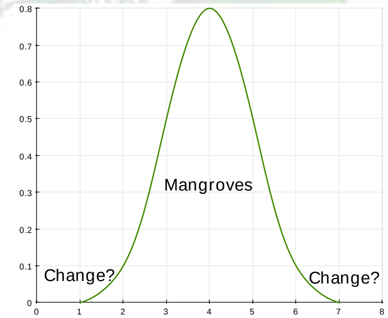




Mangrove Gain 1996-2010

Mangrove Loss 1996-2010

Mangrove Baseline 2010



Global monitoring system for changes in mangrove extent. Built using the Giri et al 2000 product and ALOS PALSAR, PALSAR-2 and JERS-I SAR data. Change is identified using an innovative map-to-image change method.

Forest Regrowth Biomass: Amazon

Landsat

S

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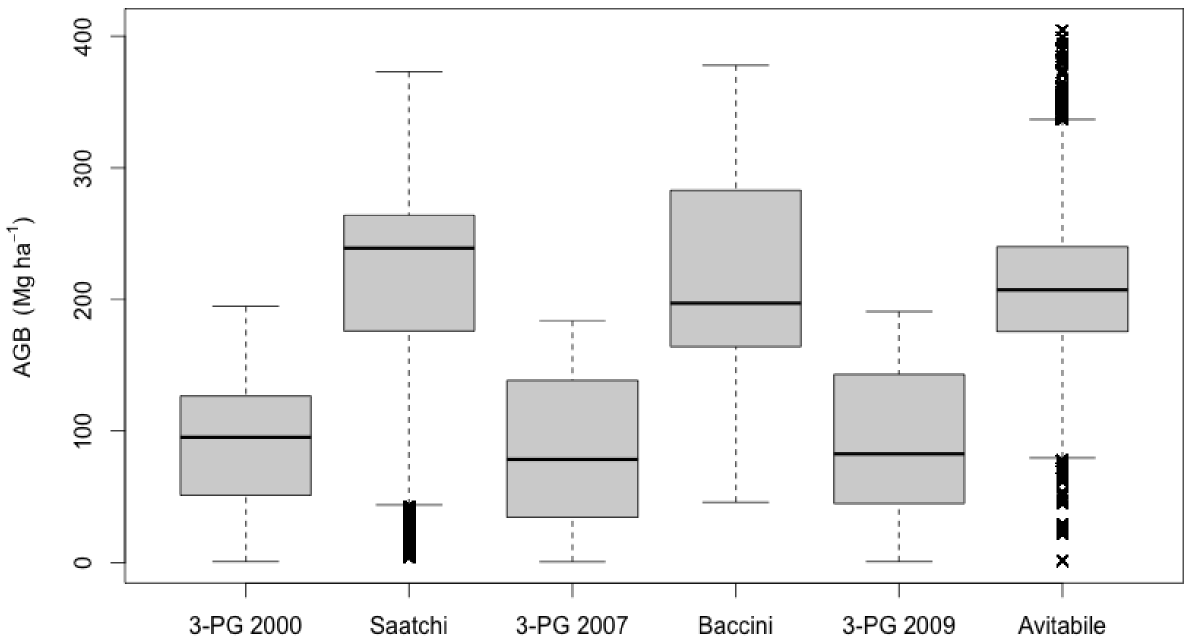


F

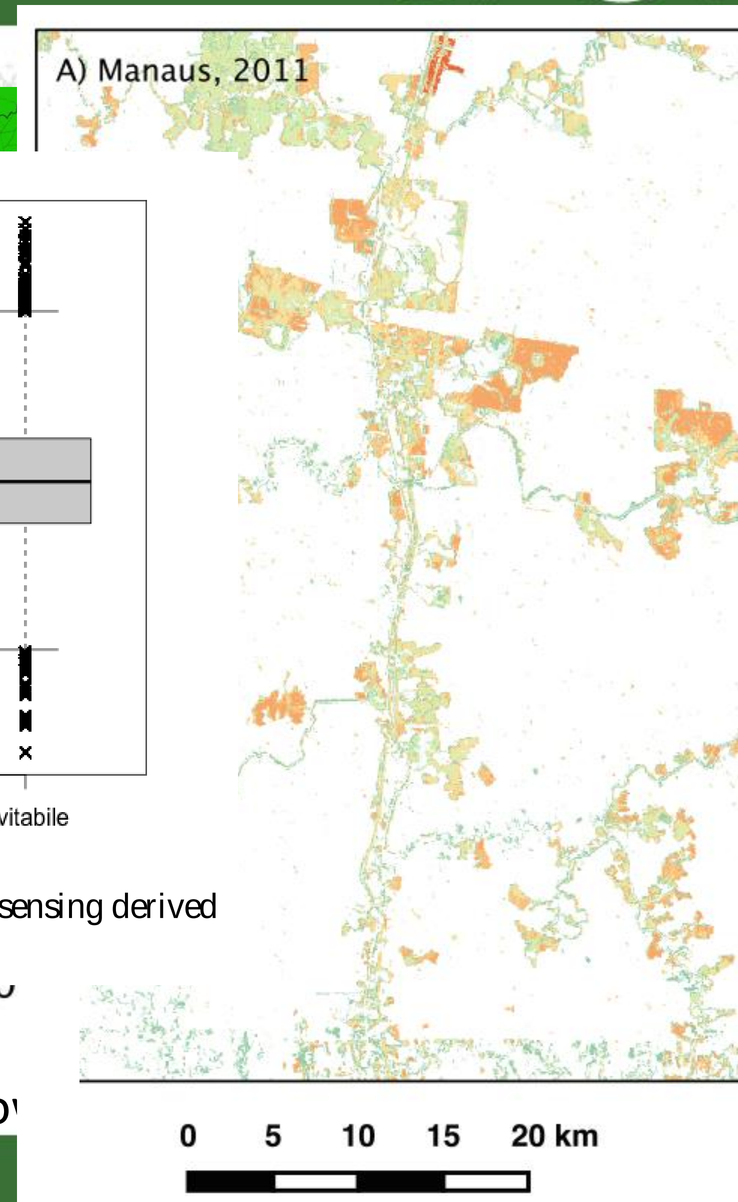
Figure 7.2: Comparison of above ground biomass (AGB) for each remote sensing derived estimate and 3-PG$_2$ simulated AGB for corresponding year at Manaus.

estimate regrowth forest biomass.

150.1 – 200

> 200

– Allo



Thanks

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