

Forest Biomass and Land Use Change in Central Africa: Reducing Carbon Uncertainty

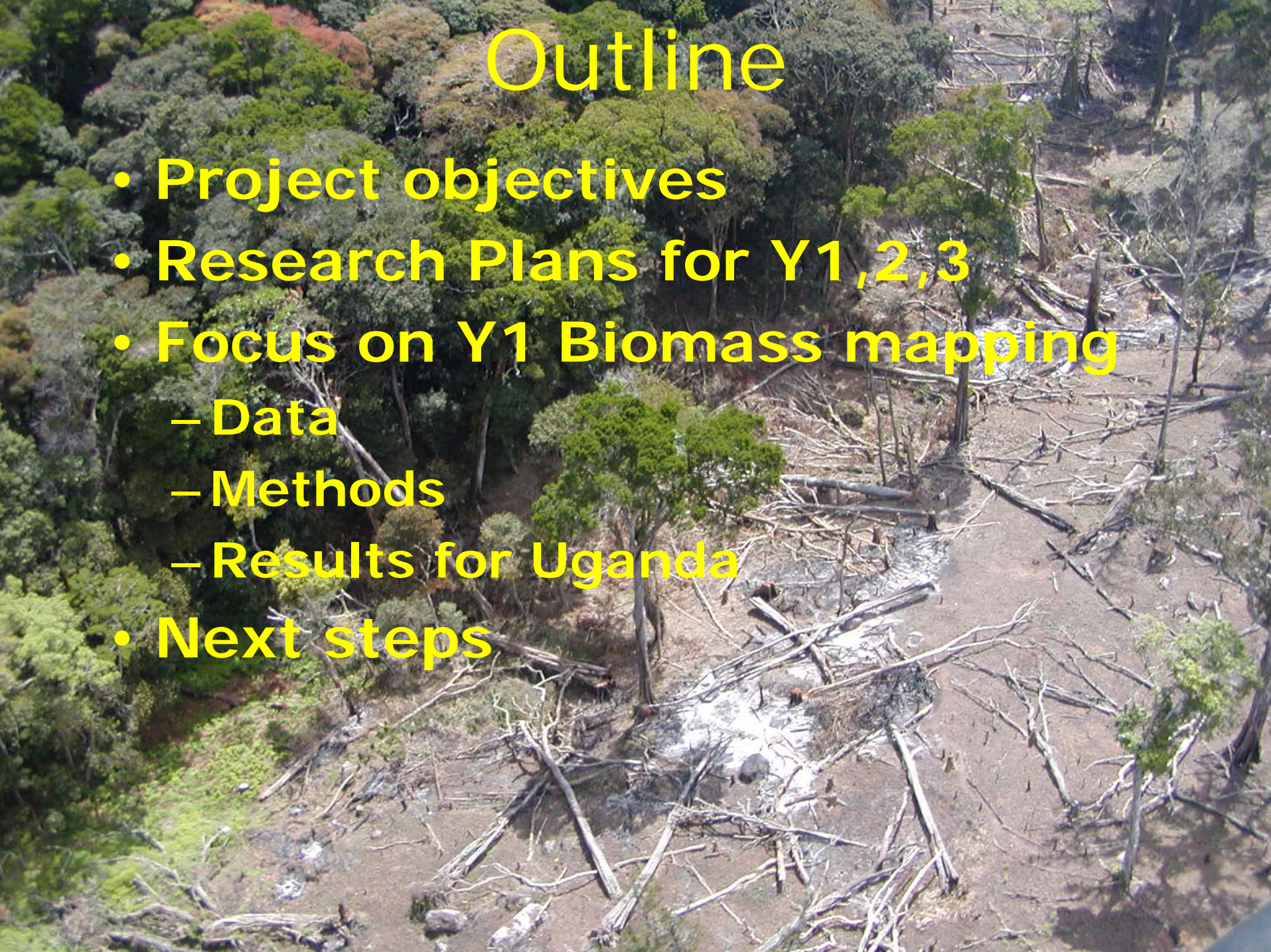
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NASA-LCLUC Maryland, April 2006

Outline

- Project objectives
- Research Plans for Y1,2,3
- Focus on Y1 Biomass mapping
 - Data
 - Methods
 - Results for Uganda
- Next steps

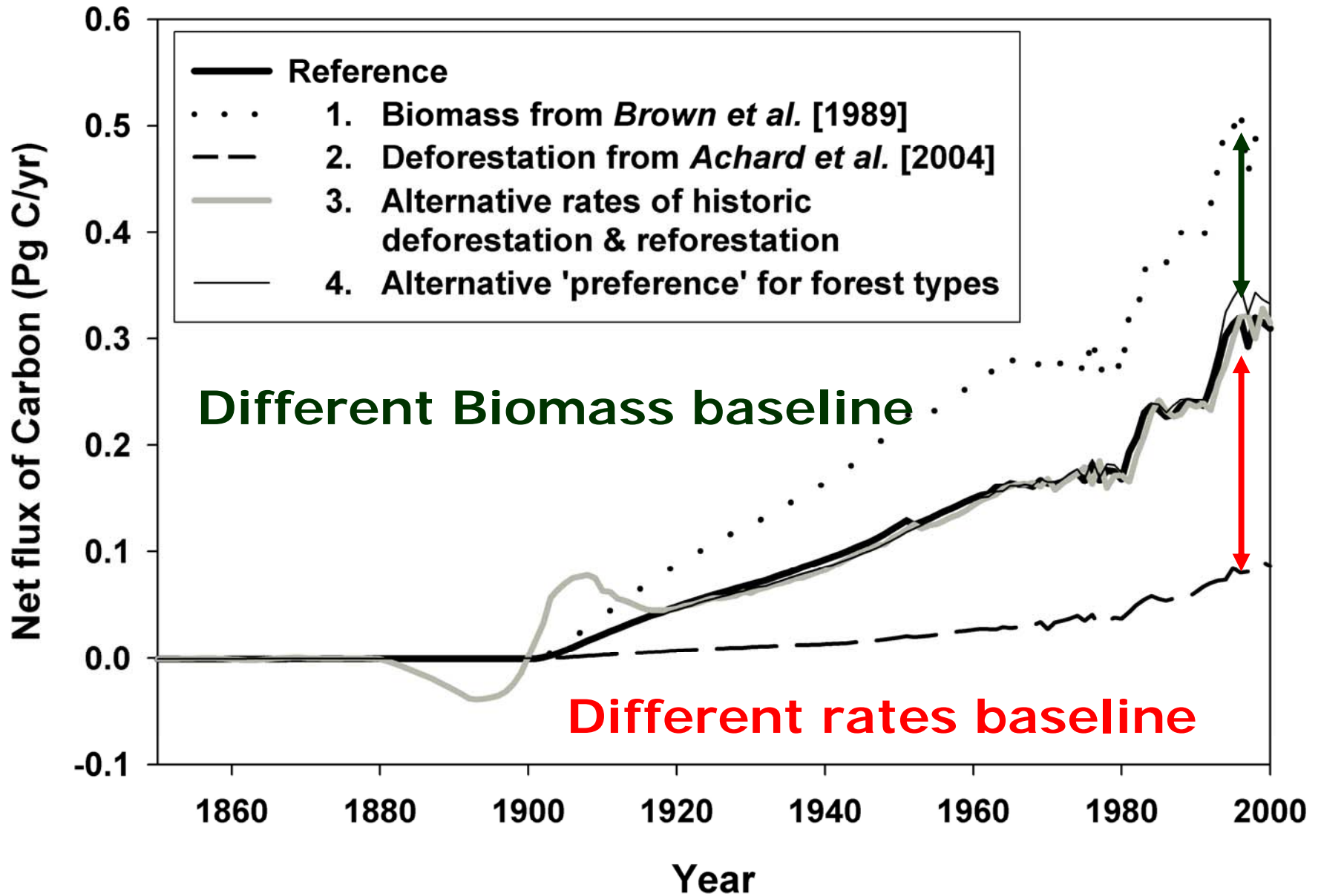


Objectives

1. Determine the rates of deforestation, forest degradation, and regrowth
2. Estimate above-ground biomass at multiple scales & across different disturbance regimes
3. Calculate the annual fluxes of carbon from land cover change using a “bookkeeping” & spatial model (CARLUC)

Why Central Africa ?

- **CA has the largest continuous rainforest, after the Amazon**
 - Amazon (4.5 million km²)
 - Central Africa (1.8 million km²)
- **High uncertainties in Africa Carbon stocks and C flux contributions**
- **CA is the largest reservoir of carbon and biodiversity in Africa**
- **>70% of population relies on forest resources**
- **Need for sustainable forest management**

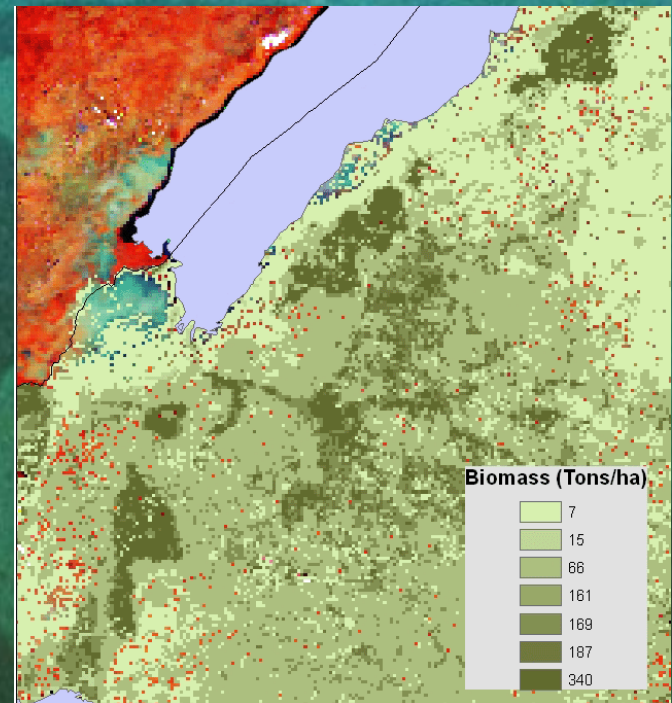


From Houghton, 2005

Y1: 2005 Focus

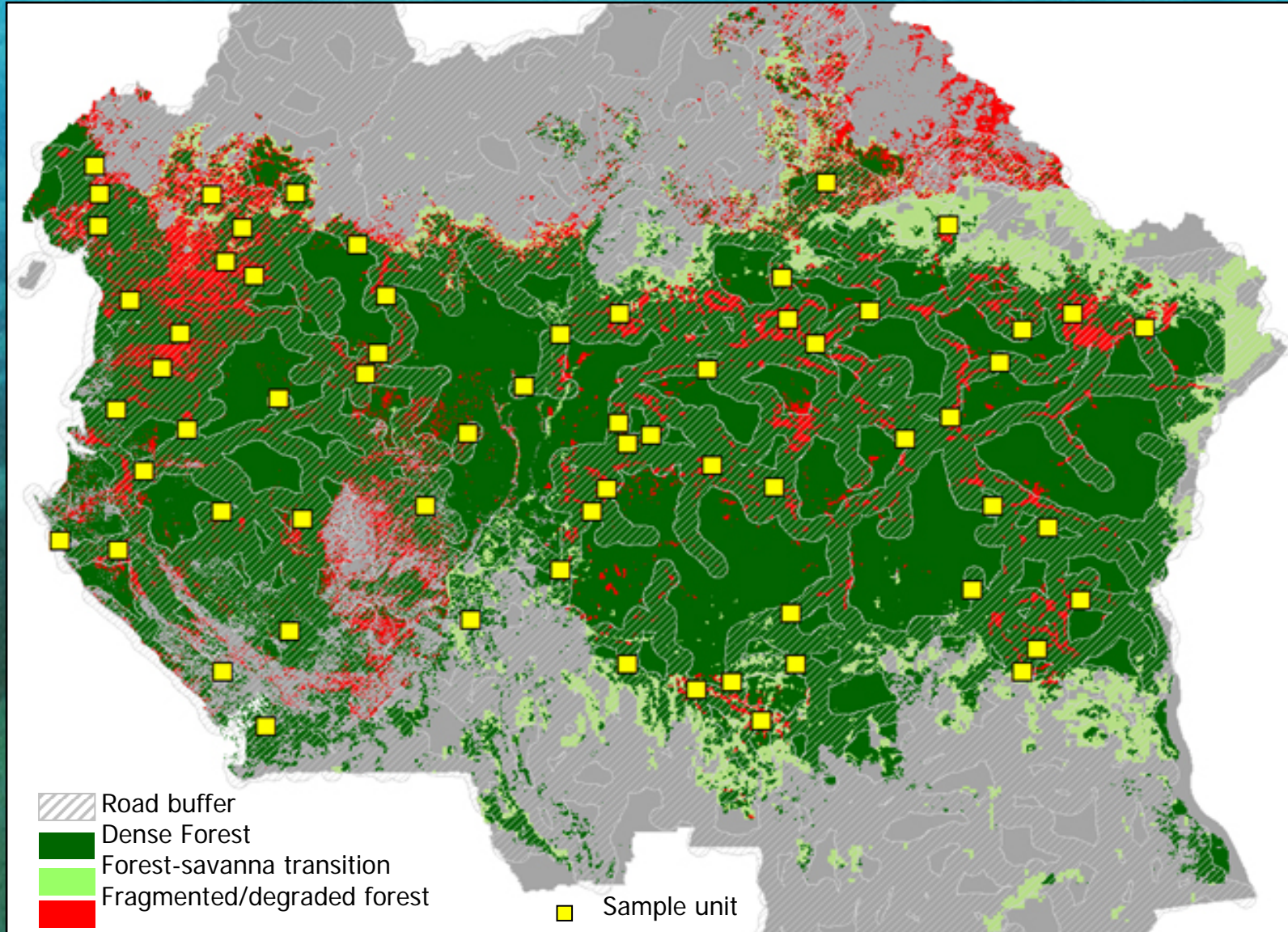
Estimate above-ground biomass

1. Compile field data of forest structure (forest inventories)
2. Establish relation between RS variables and field measured biomass

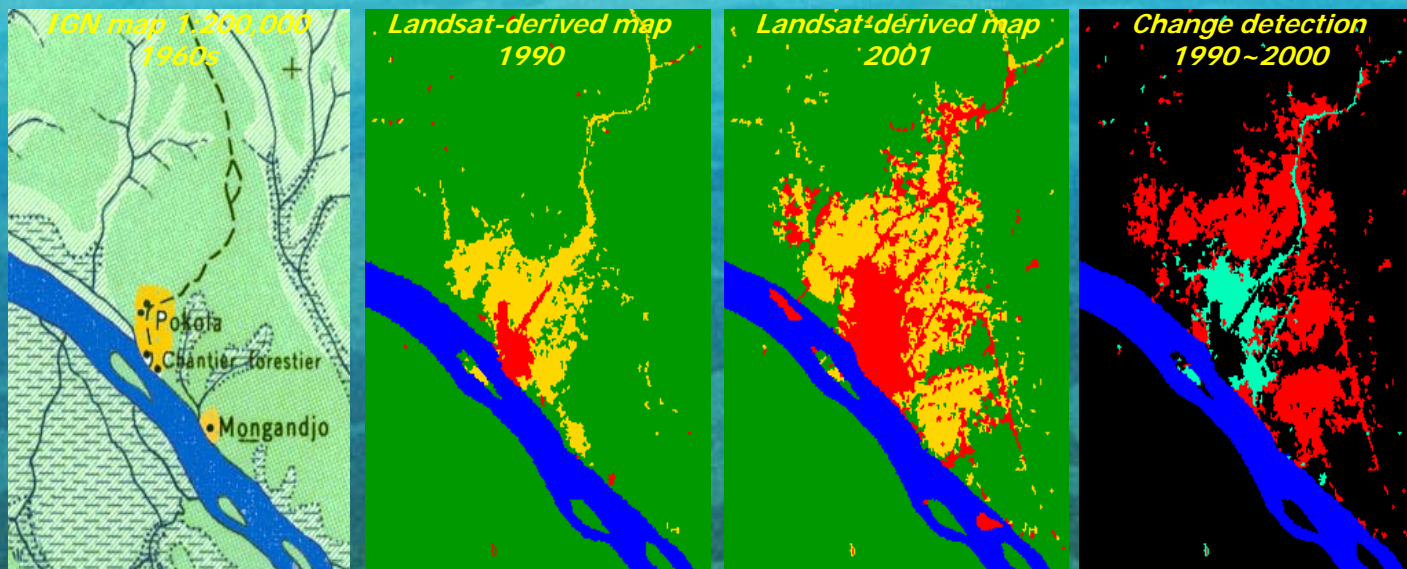


2006 Focus

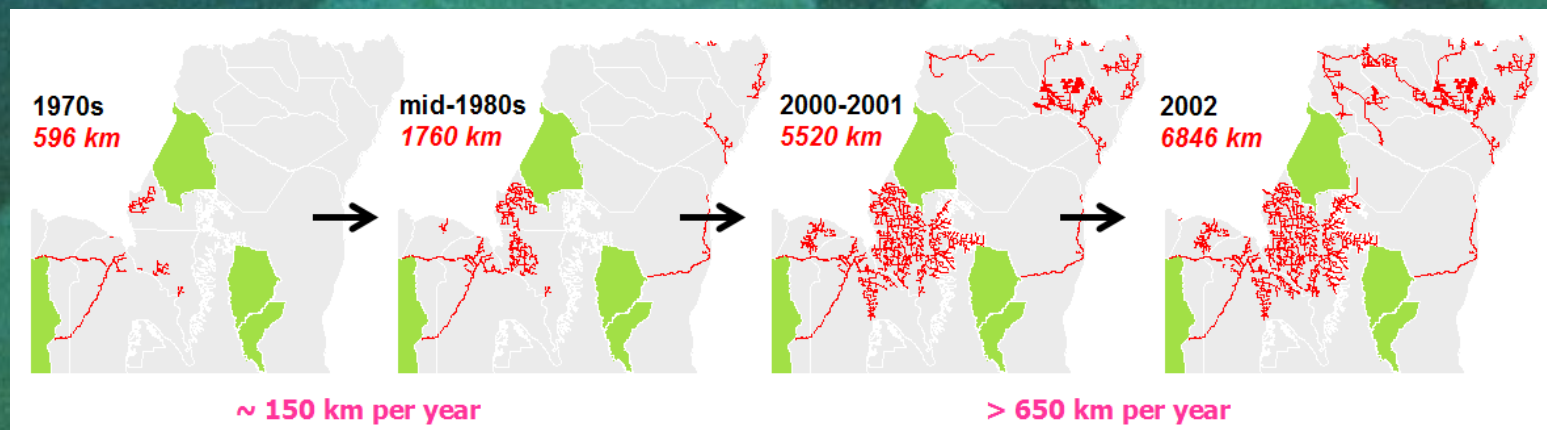
Deforestation Rate Assessment



Determine the rates of deforestation, forest degradation, and regrowth



Deforestation history



Logging history

2007 Modeling: Calculate the annual fluxes of carbon from land-cover change

INPUT

MODEL

OUTPUT

Remote Sensing

Rates of
Clearing / abandonment
of cropland
of pasture
of Shifting Cultivation

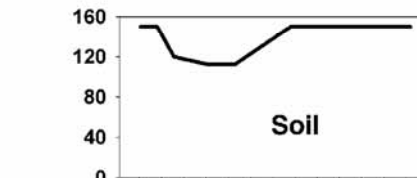
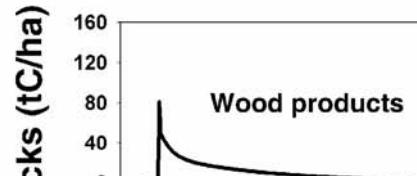
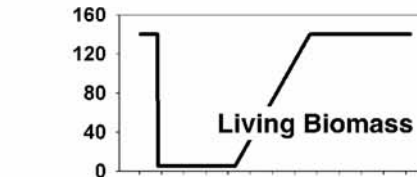
Logging

Fires

Afforestation

Literature and Agricultural & Forestry Statistics

Lands not cleared, cultivated, logged,
afforested or burned are not counted.



Carbon Stocks (tC/ha)

Time

Area

Annual change
in area

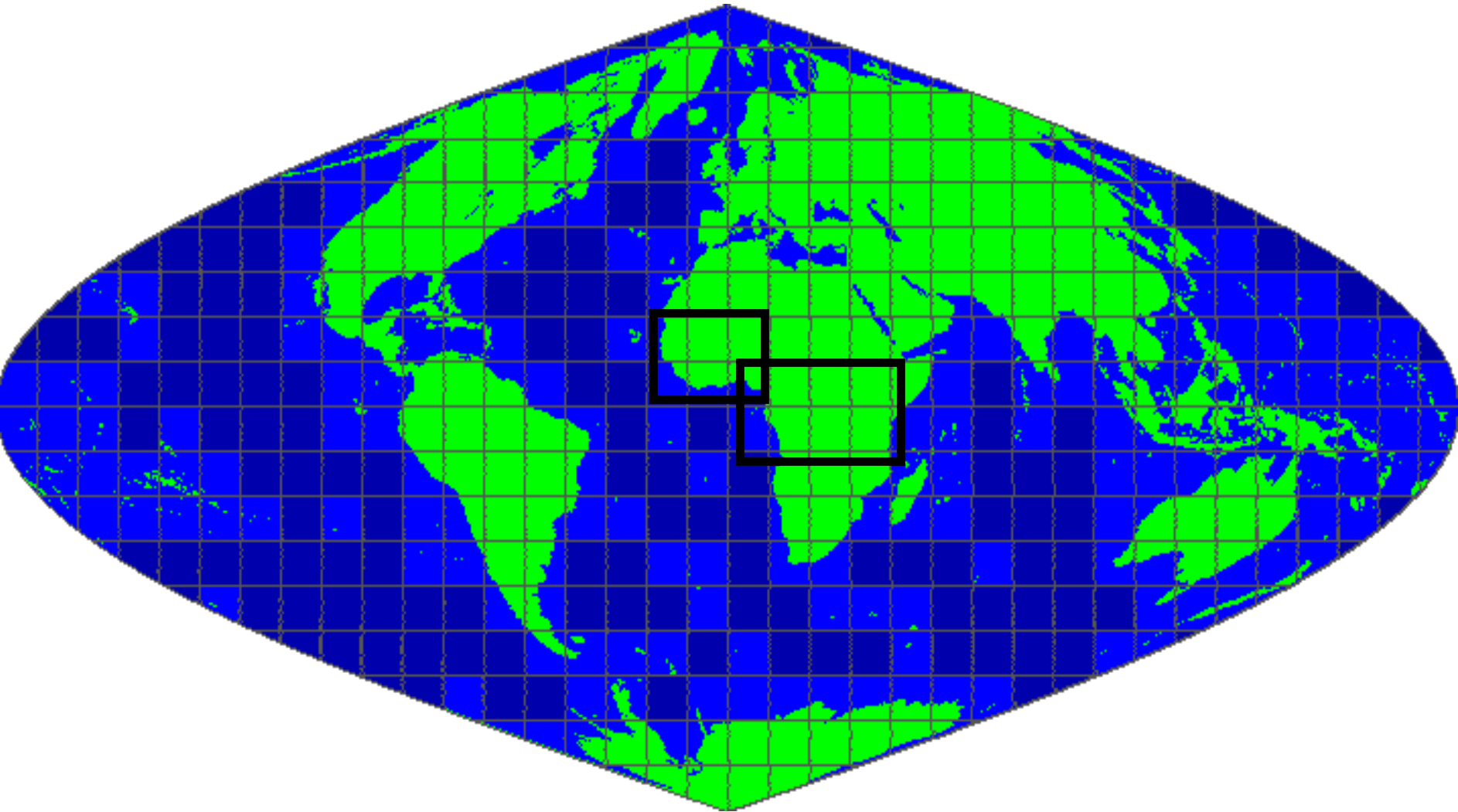
In: Croplands
Pasture
Shifting Cultivation (fallow)
1 forest
2 forest
Other ecosystems

Carbon

Annual change
in Carbon = Annual Flux

In: Croplands
Pasture
Shifting Cultivation (fallow)
1 forest
2 forest
Other ecosystems

Study area for Biomass mapping (~11 MODIS tiles)



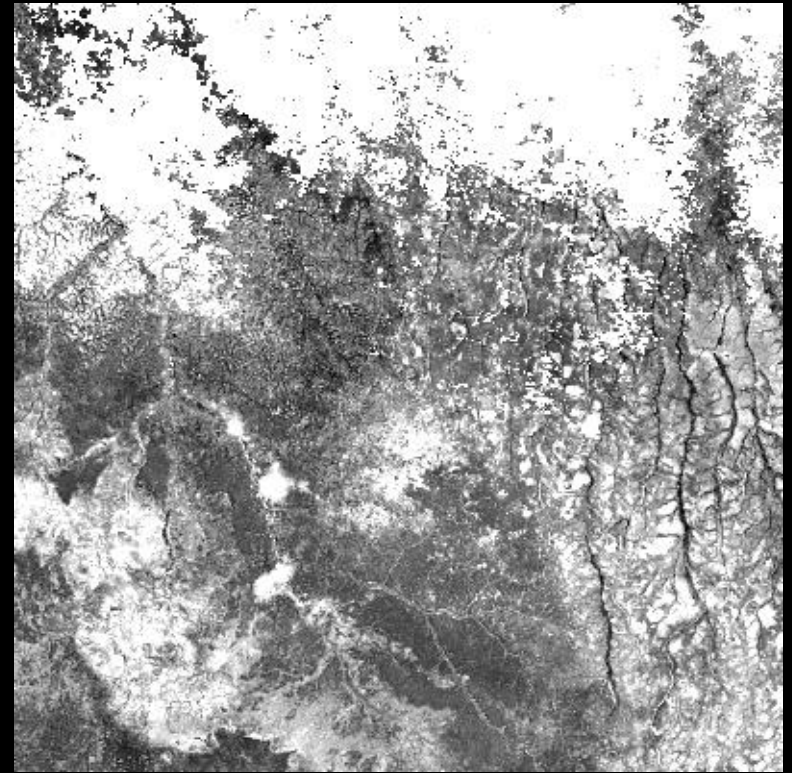
MODIS Data Quality Screening

NBAR COMPOSITE h19v09 (Red Band)



4 months 2000-2001
(4 images)

Clouds- stripping



4 months (2000-2001)

4 months (2001-2002)

(8 Images)

Field biomass estimates

Forest inventories:

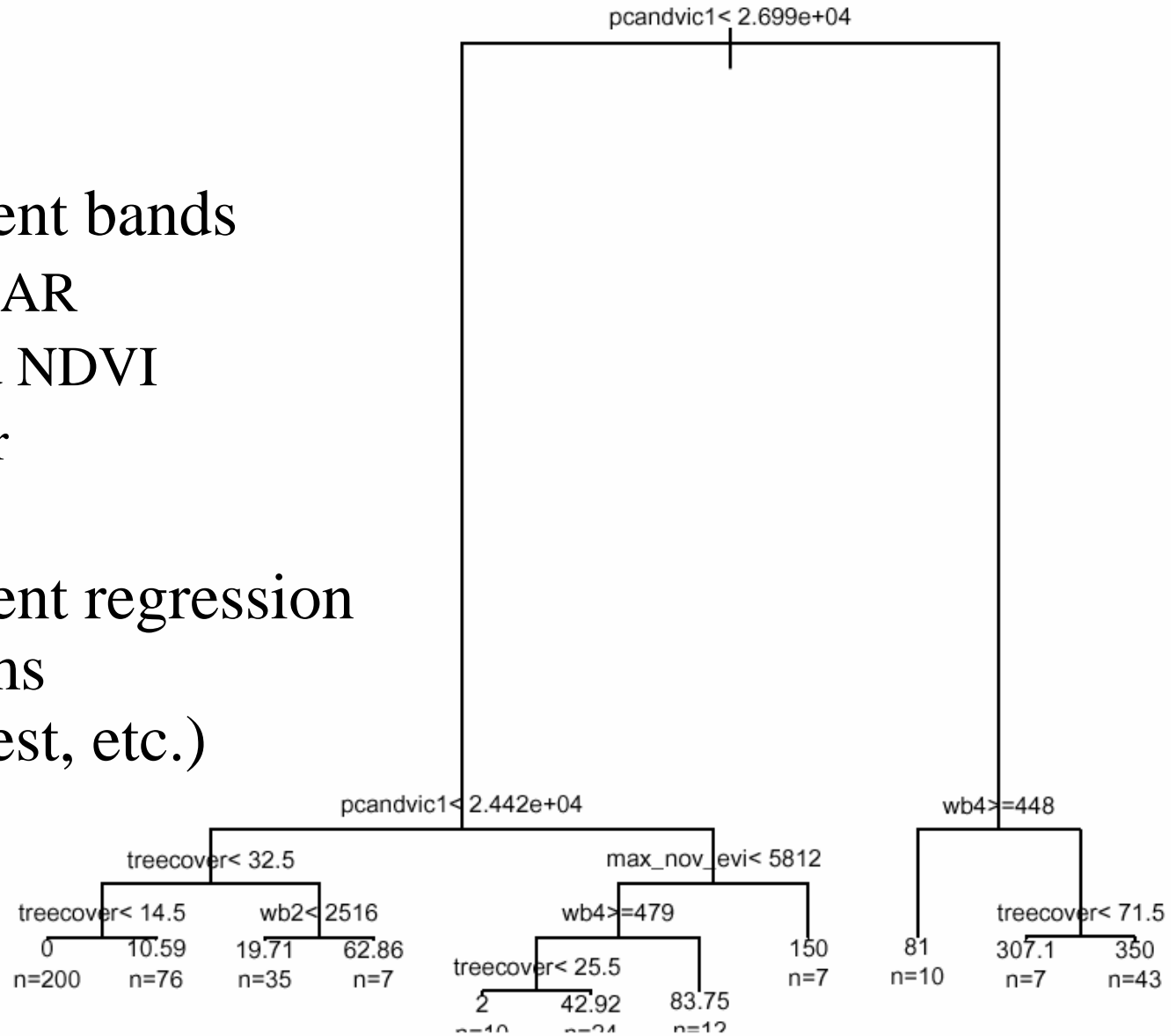
- Cameroon, Congo, Mal

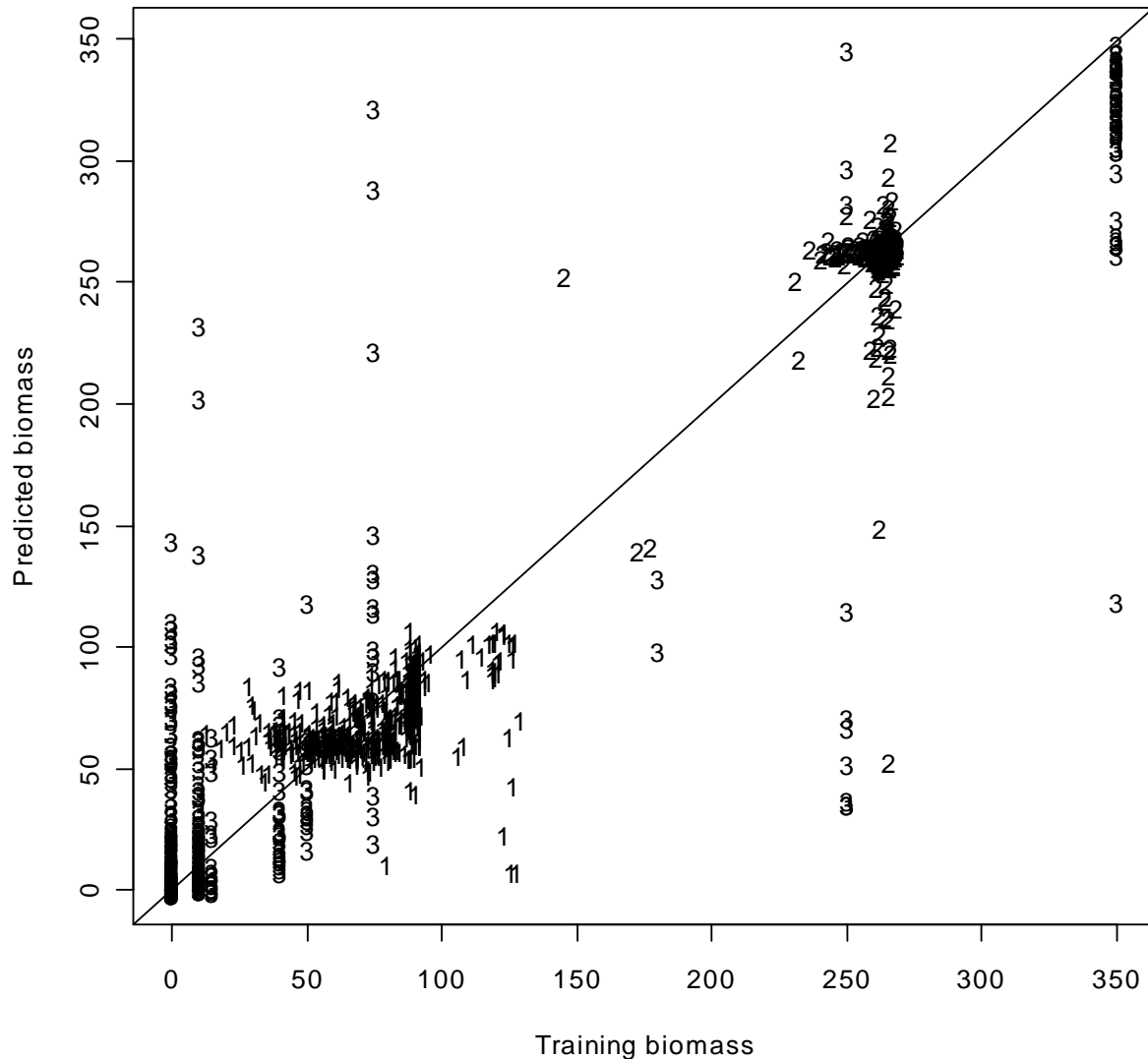
National Biomass surveys

- Uganda



- Decision tree classification methodology
- Tested different bands
 - 7 Bands NBAR
 - 7 Bands and NDVI
 - % tree cover
- Tested different regression tree algorithms (RandomForest, etc.)





Results of the regression tree model based on MODIS NBAR surface refl. (using forest inventories + National biomass surveys)

1- Mali

2- Rep. of Congo

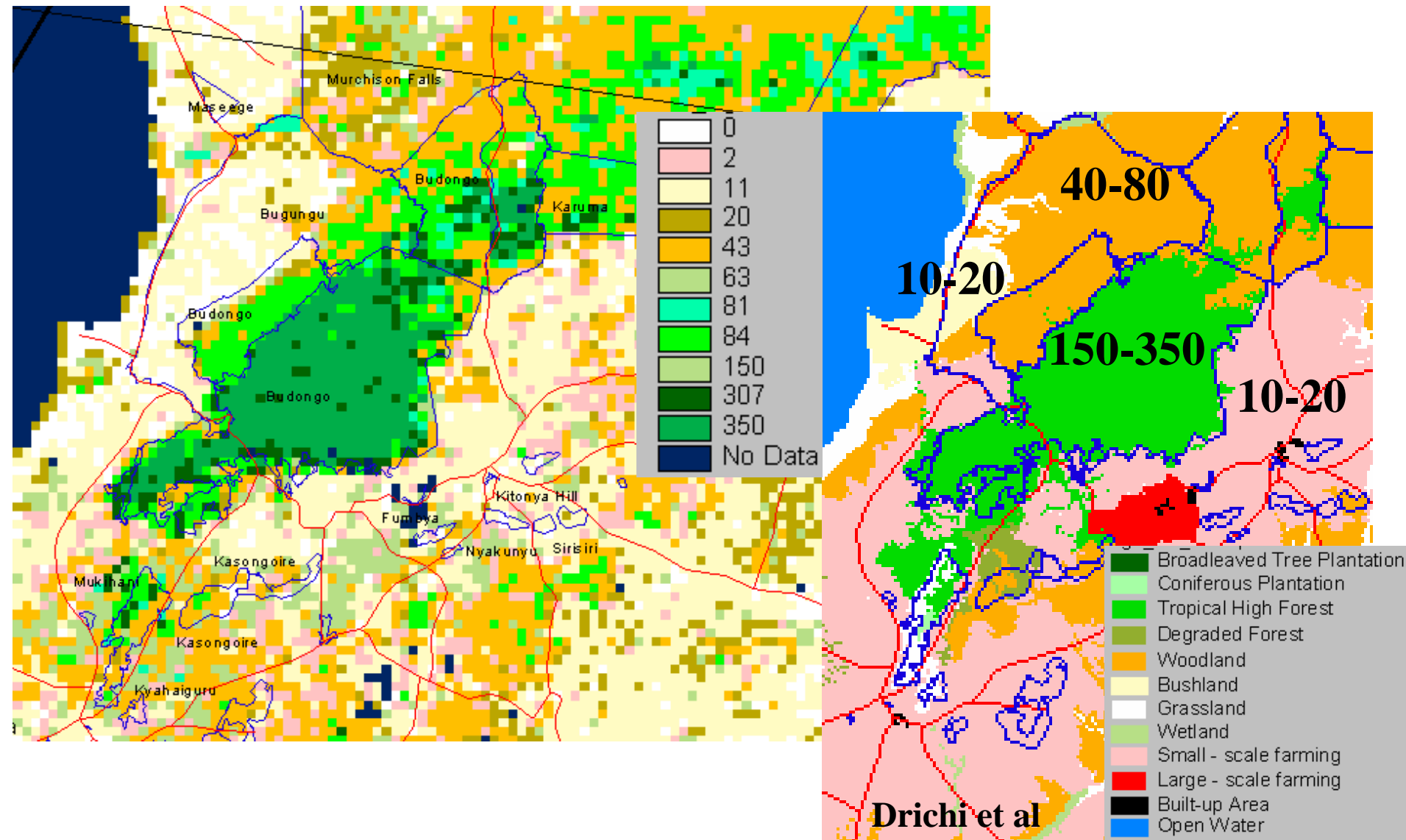
3- Uganda

The model explains 94% of the variance in above ground biomass with a root mean square error (RMSE) of 27 Tons/ha (0-350T/ha)

Budongo Forest Reserve Biomass (T/ha)

This project: MODIS 2003

National Forest Service, Uganda



Next Steps

- Validation of Uganda biomass map
 - In Collaboration with the National Forest Authority
- Compile cloud free MODIS NBAR mosaics for the entire study area
- Publish the Biomass map for the Central Africa region
- Establish historical rates of deforestation
- Collaboration with the European AfricaCarbon initiative with the Overseas Agronomic Institute (IAO) of Florence



Thanks