Beyond Carbon -Emerging Markets for Ecosystem Services

Forest Trends/Katoomba/Swiss Re Conference

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# Advances in Measuring and Monitoring Carbon and other Ecosystem Services

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# Measuring and Monitoring

- For market confidence, need accurate and precise estimates of the "commodity"
  - Projects must make a difference
    - Baselines for all ecosystem services
  - Need minimum set of standards
  - Techniques must be cost efficient
  - Easily understandable and transparent
  - Verifiable

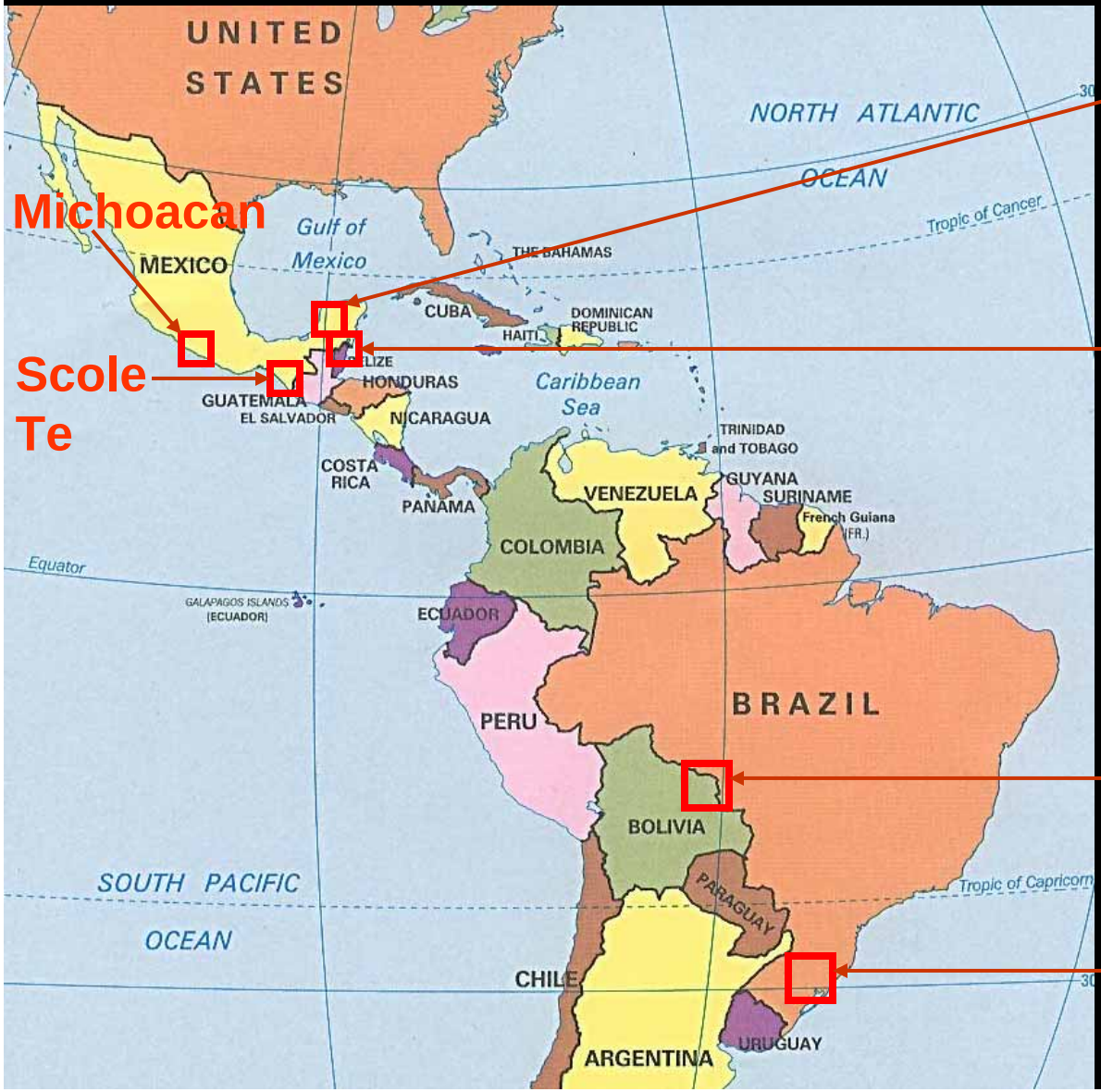
# Topics

- Approach for identifying where to locate projects and how to develop baselines
- Aerial digital imagery for measuring carbon
- Aerial digital imagery for change detection and monitoring of carbon and other ecosystem services

# Baselines

- A baseline has two components:
  - a projection of changes in land use through time
  - the corresponding changes in carbon stocks
- These two components can be treated separately

# Location of project areas




Michoacan

Scole Te

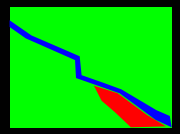
Calakmul, Mexico

Rio Bravo Conservation and Management Area, Belize

Noel Kempff Mercado National Park, Bolivia

Guaraquecaba, Brazil

# Spatial modeling approach (GEOMOD)



Agriculture
Forest
River

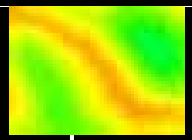
Time 1

Factor 4
Factor 3
Factor 2
Factor 1

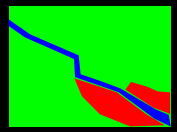
Maps of potential "drivers" of land-use change

Calibration Procedure

PLUC map

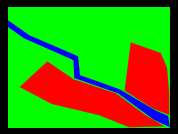


Time 2



Validation Procedure

Extrapolation Procedure



Predicted time 2

Kappa statistic

# Baselines—way forward

- Develop spatially explicit baselines to incorporate factors that influence the way people use the land and other conservation and development goals
- Develop baseline at regional scales before start of project
- Recognize that baseline projections beyond a 10-year period are not likely to be realistic—rates of land-use change are subject to many factors which are difficult to predict over the long term

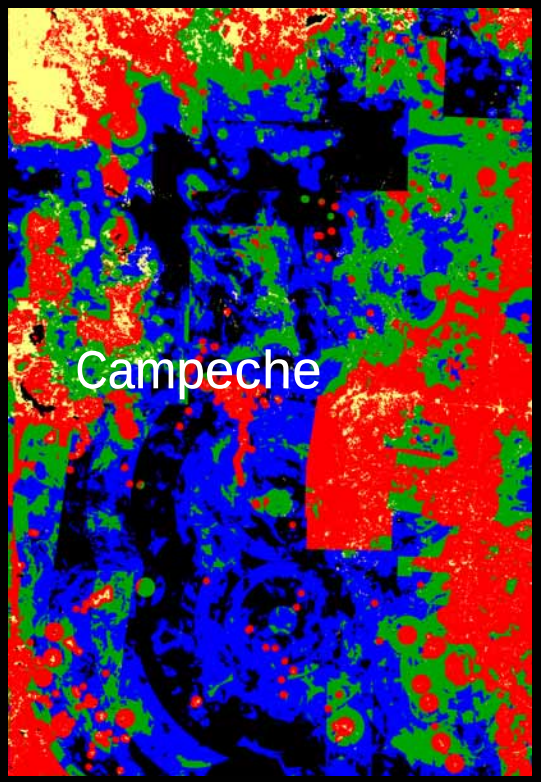
# Implementation of spatial approach for baseline setting:

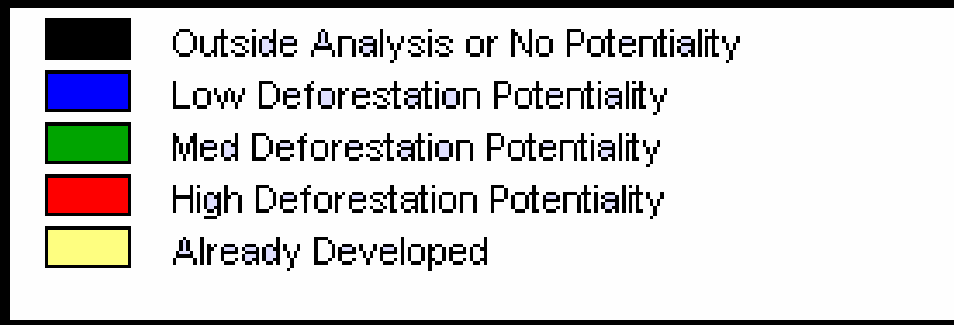
- A three-step approach:
  1. Use spatial model to develop the "potential land-use change map" rescaled to three levels of potentiality for change—high, medium, and low

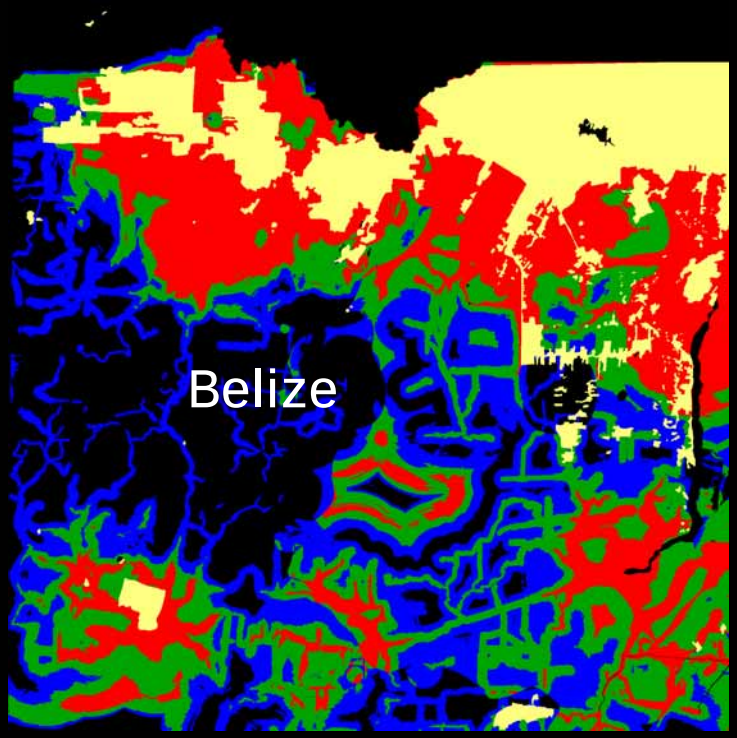
  2. Project land-use change over a 10-year period based on either
     - Simple projection of past rates (past 5-10 year) determined from remote sensing, or…
     - A simple model of human population and deforestation

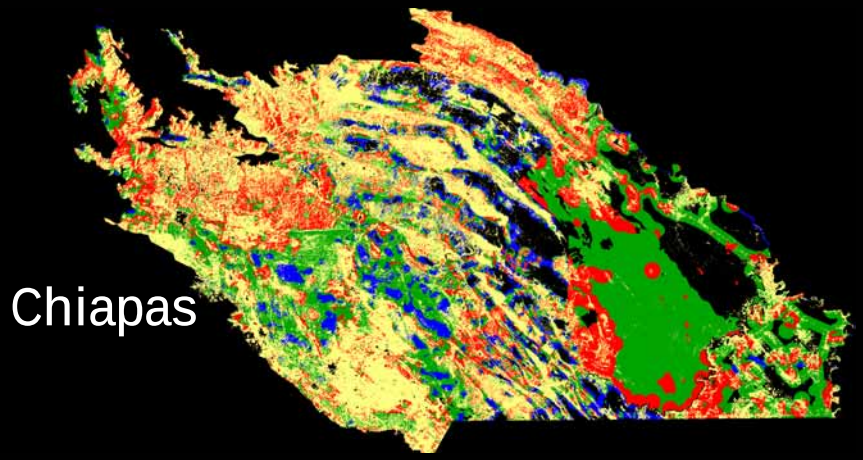
     (http://www.winrock.org/what/ecosystem_pubs.cfm)

# Example of a rescaled PLUC map



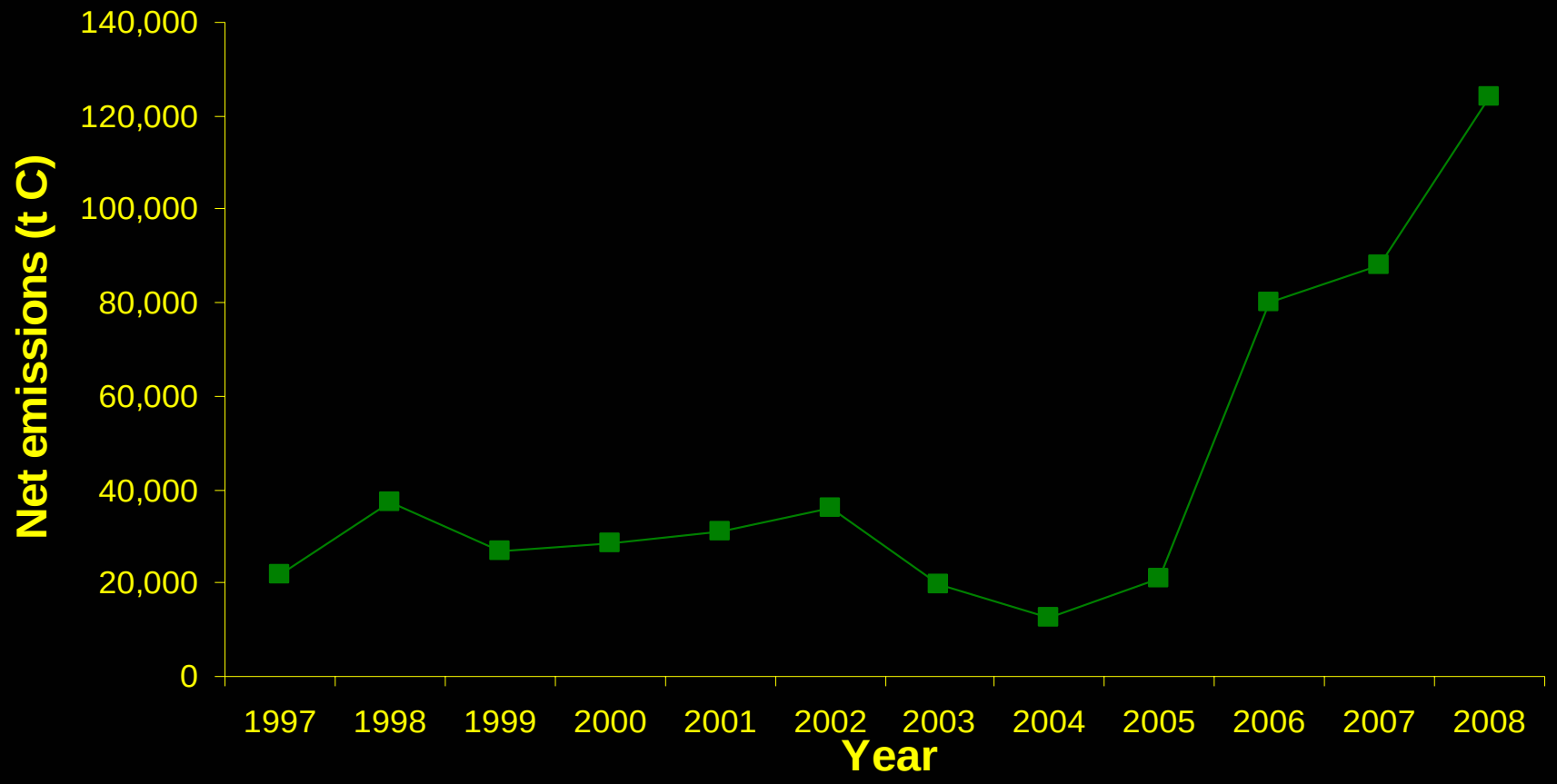



# Implementation of spatial approach for baseline setting:

3. Convert the PLUC map to a carbon baseline at the potential project site
   - Identify project area and measure its carbon using standard approaches
     (e.g., http://www.winrock.org/what/ecosystem_pubs.cfm)
- Re-assess potentiality for land-use change and rates of change on a 10 yr cycles for updated baselines

# Carbon baseline for Noel Kempff project, Bolivia

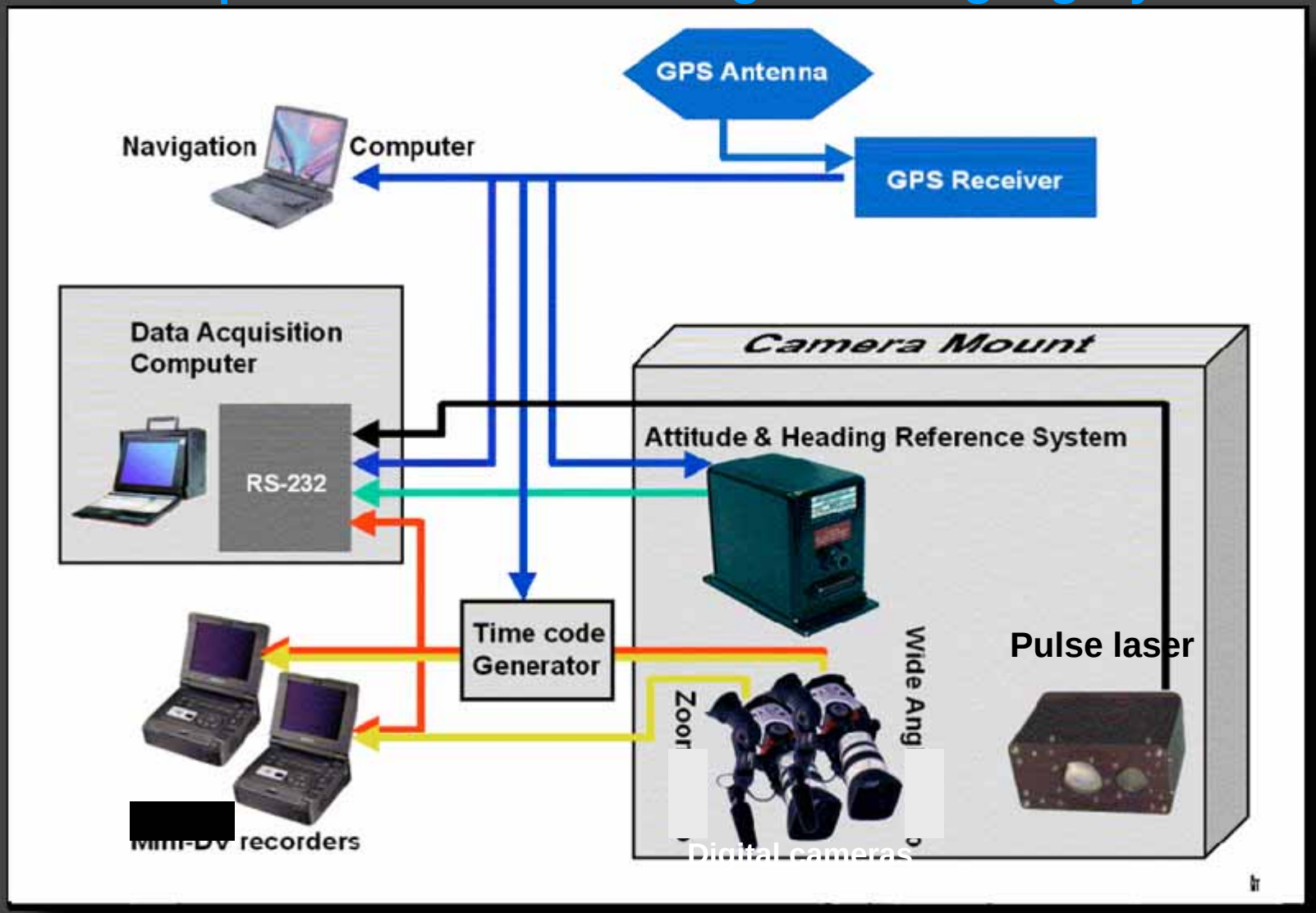
Combine the projected rate of change with the project specific carbon stocks to generate a carbon baseline



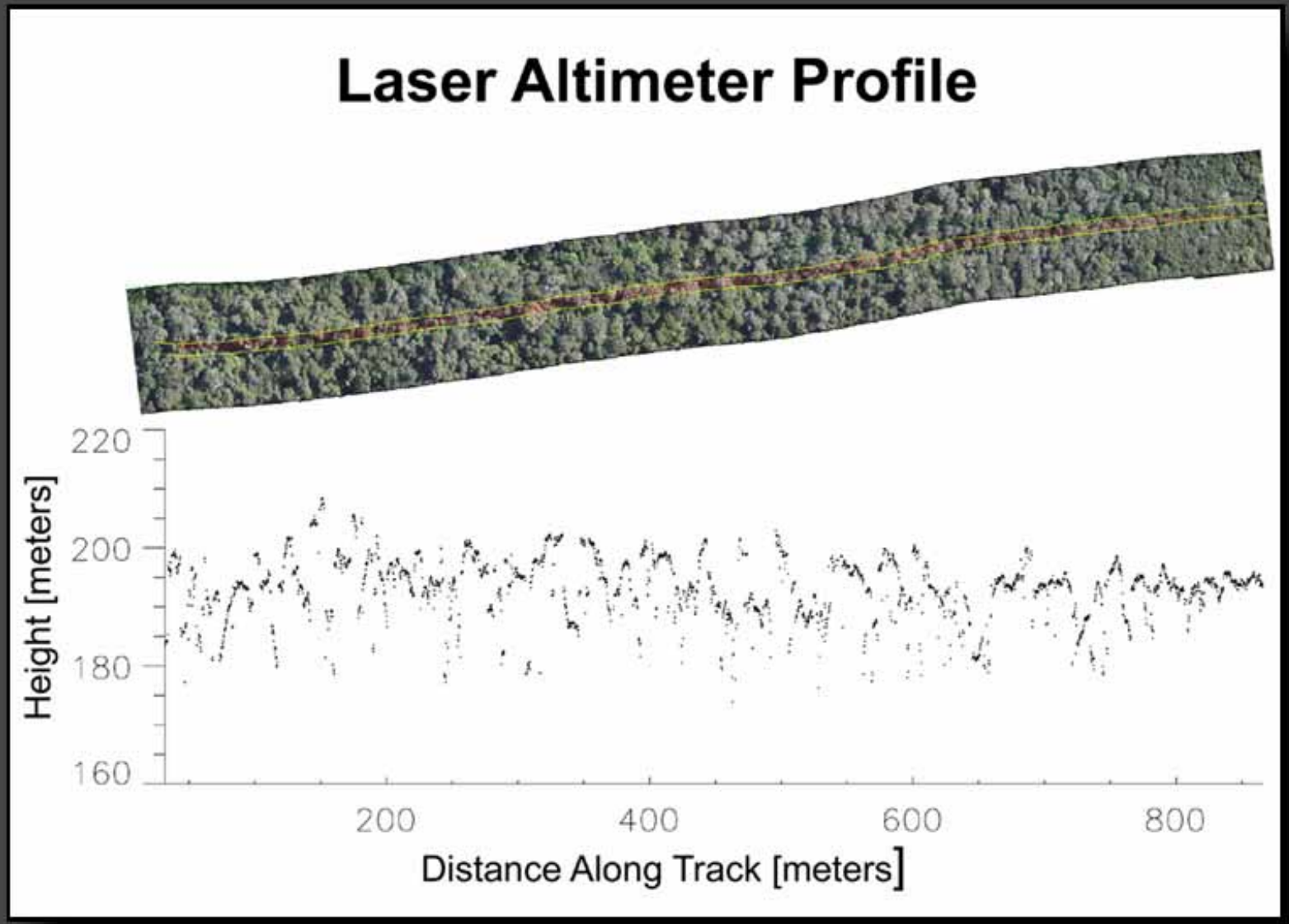
# Multispectral 3D aerial digital imagery system

- Measuring and monitoring carbon
- Monitoring other ecosystem services

# Multispectral 3D aerial digital imaging system




- Fits in a portable camera pod
- Will fit into commercial airline luggage
- Attaches to any Cessna in about an hour




The laser accurately measures a profile of crown height along each strip

# Noel Kempff Mercado National Park, Bolivia

This 3D approach provides new methods for studying and mapping forest canopies and individual trees

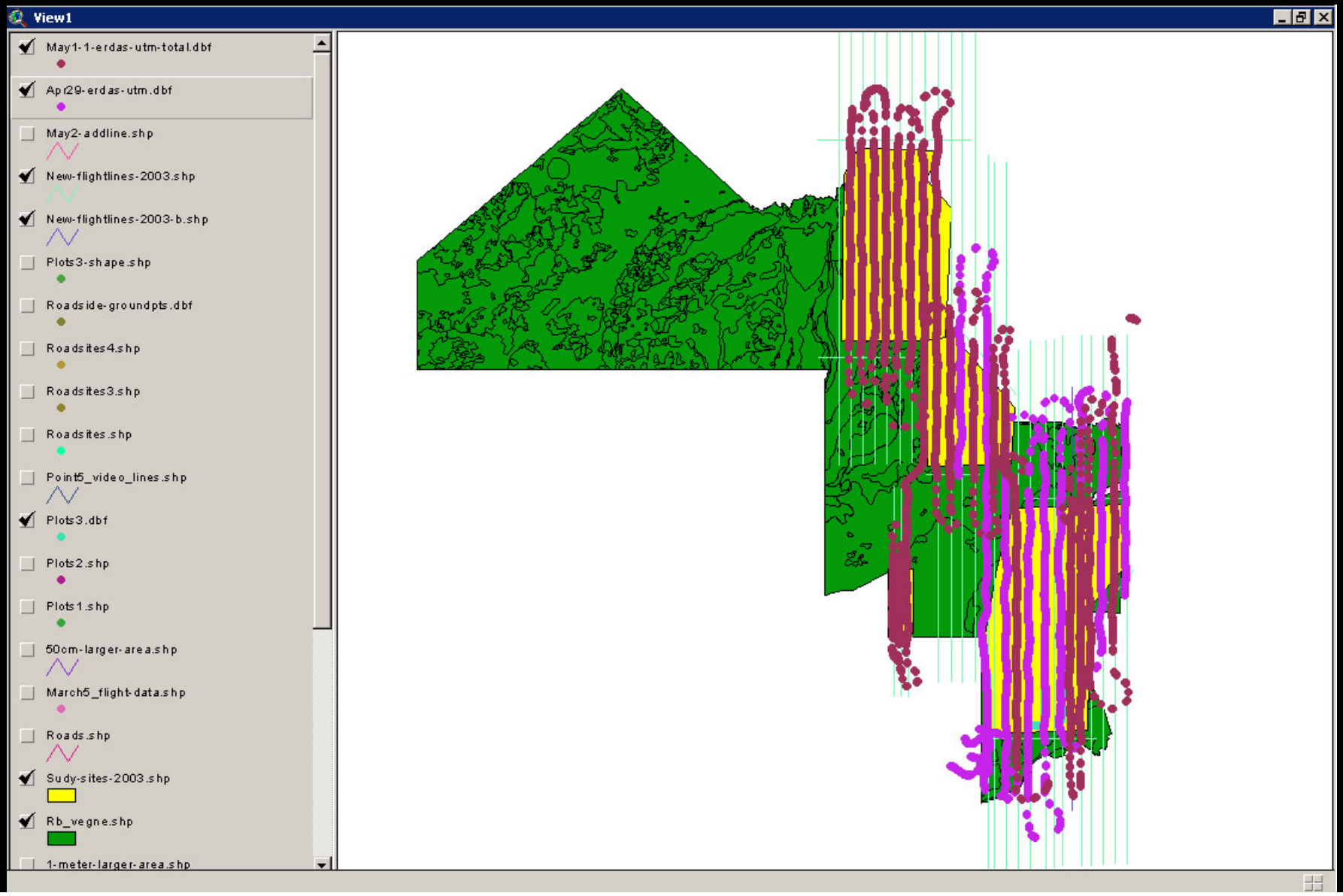
# Noel Kempff Mercado National Park, Bolivia

- These can be re-flown to monitor change in the forest on an individual tree level.
- Produces a virtual forest for later analyses

# Application of M3DADI to measure carbon in forests

- Two steps involved:
  - Collect and analyze digital imagery of ecosystem
  - Collect and analyze ground data to use in combination with imagery

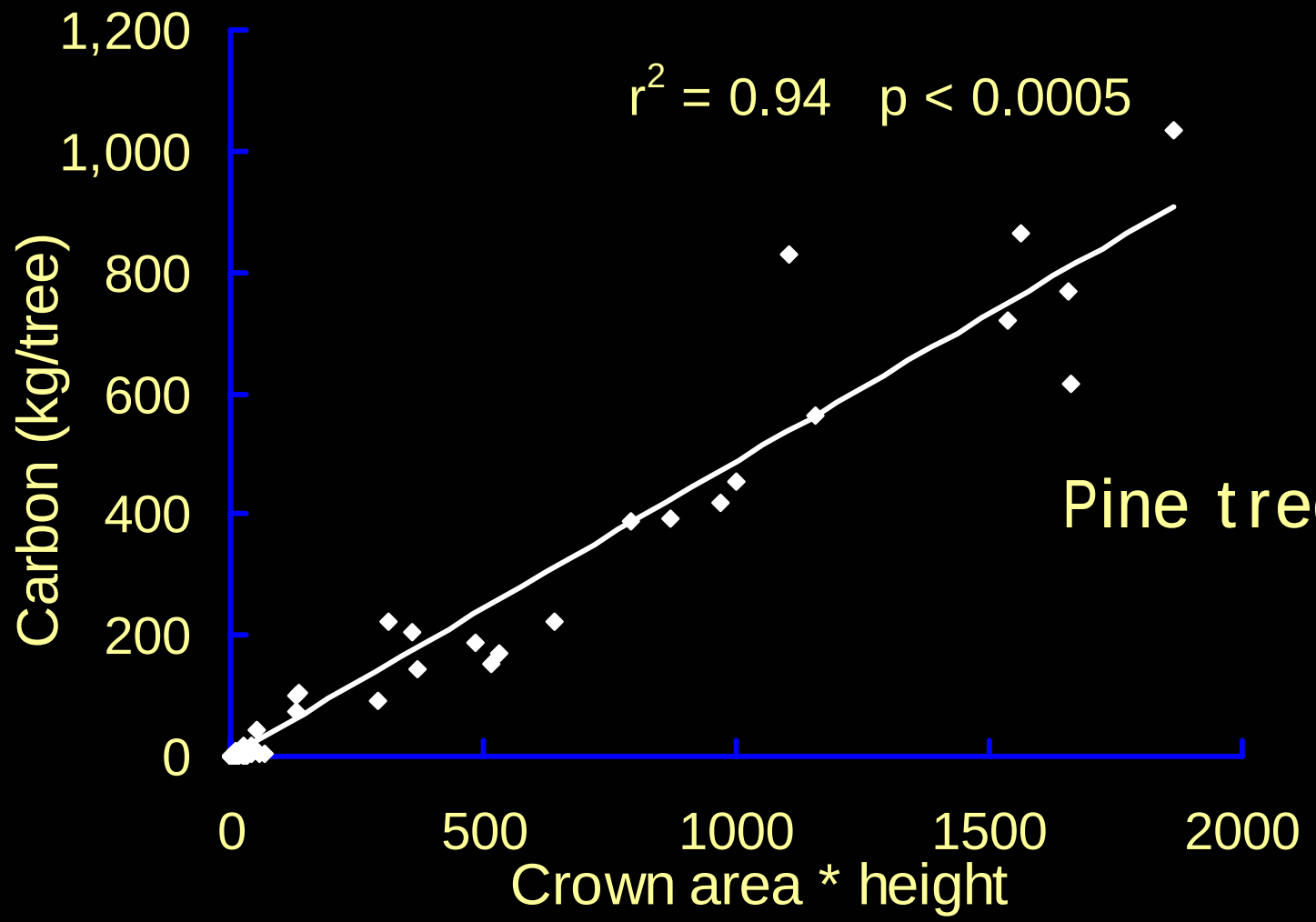
# Flight paths for collecting M3DADI of the pine savanna in Belize



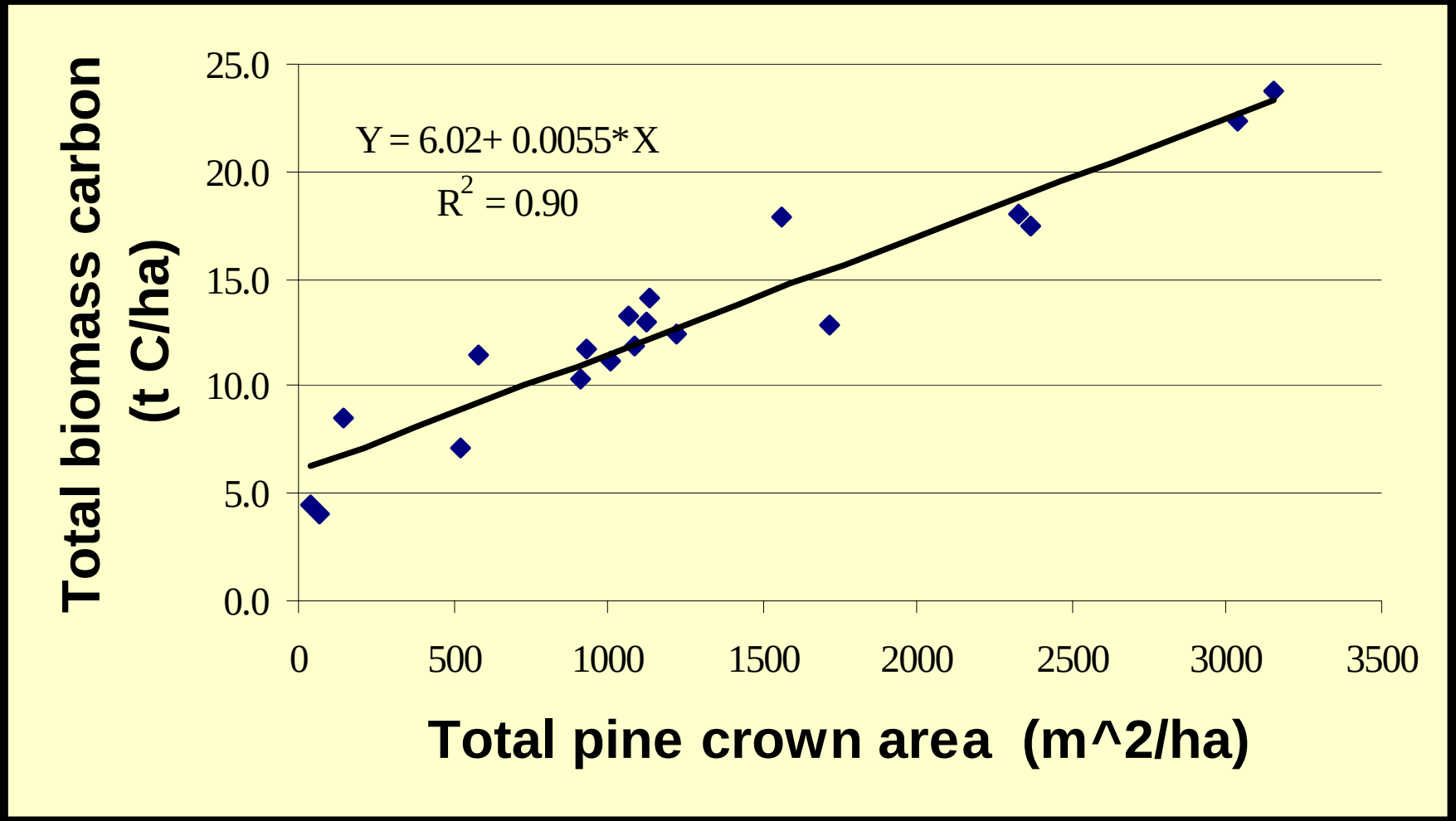
# From M3DADI the following data are measured (in Stereo Analyst)

- Trees: crown areas and tree heights, by pines and broadleaf
- Shrubs: crown area and height class for all species combined
- Palmettos:
  - Thickets– aerial extent and average height class
  - Clumps (associated with pine woodlands)—crown area and height class
- Grasses: aerial extent by sparse and dense classes

# Models of biomass carbon and measures of crown area and height by plant types based on field data



# Total biomass carbon is a function of pine tree crown area



# Change Detection and Monitoring

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