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Kyoto and Carbon Science Team

Proposal for Phase 2 Participation

by

Josef Kellndorfer
The Woods Hole Research Center

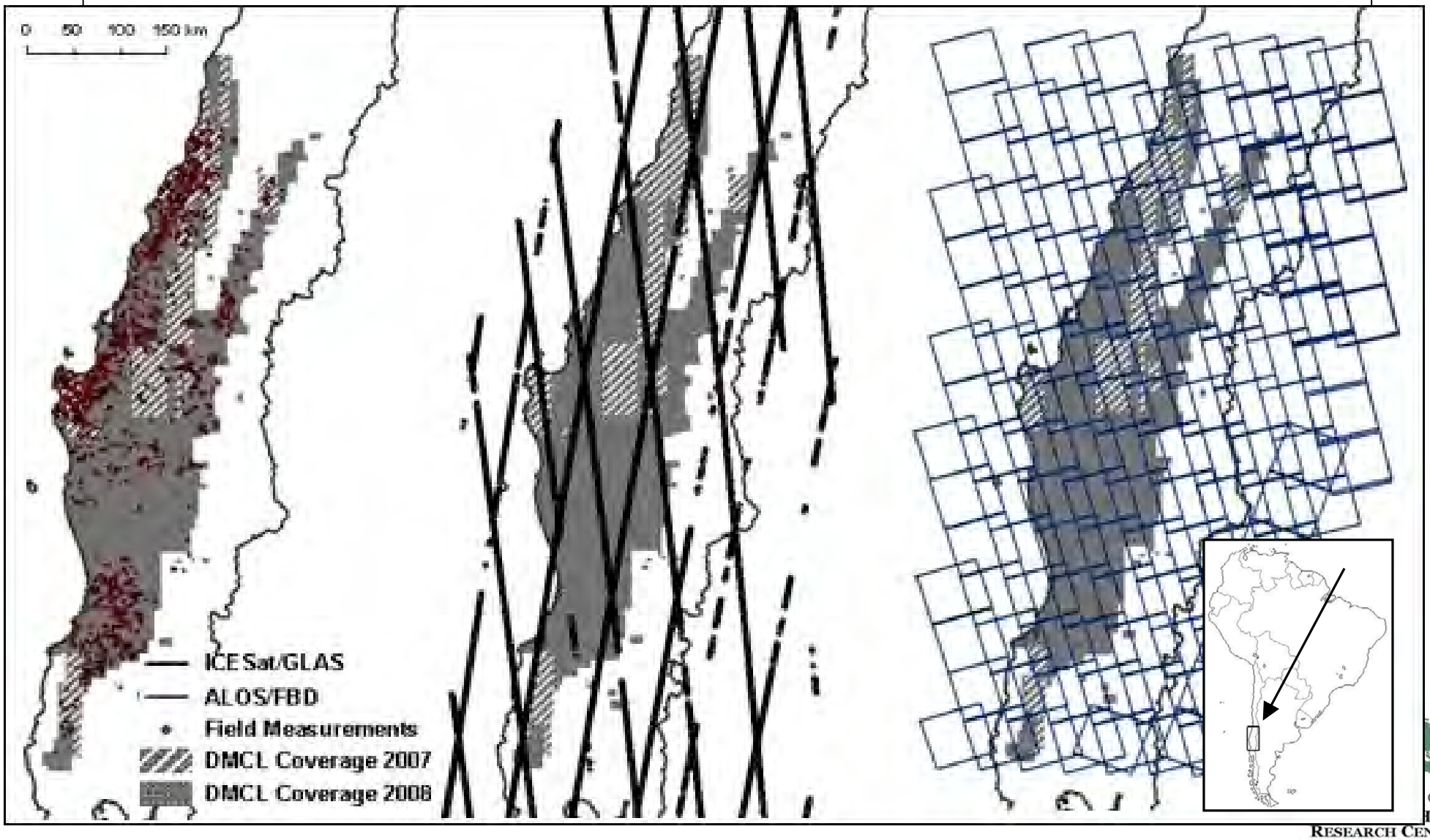
Three Funded Projects at WHRC involving ALOS Data

- NASA Terrestrial Ecology Program:
  - Ecosystem Structure Measurements From DESDynI: Studies Of Technological Options And Data Fusion Using Icesat/Glas, Airborne Lidar And ALOS/PALSAR Datasets Over Central Chile
- NASA/USDA Carbon Cycle Science Program:
  - Towards Spatially Explicit Quantification of Carbon Flux (2000-2007) in Northeastern U.S. Forests Linking Remote Sensing with Forest Inventory Data
- Moore/Google/Packard Foundations:
  - Pan-tropical Mapping of Forest Cover and Associated Carbon Stocks:Studies in Support of the UNFCCC REDD Process

NASA Funded Project under Terrestrial Ecology Program:

- **Ecosystem Structure Measurements from DESDynI: Studies of technological options and data fusion using IceSAT/GLAS, Airborne Lidar and ALOS/PALSAR data sets over Central Chile**
- **Project Time Frame: 5/2008 - 4/2010**
- **Team:**
  - **WHRC**
  - **Digimapas, Chile**
  - **Arauco Chile**

Studies on Lidar/Radar Fusion in Chile



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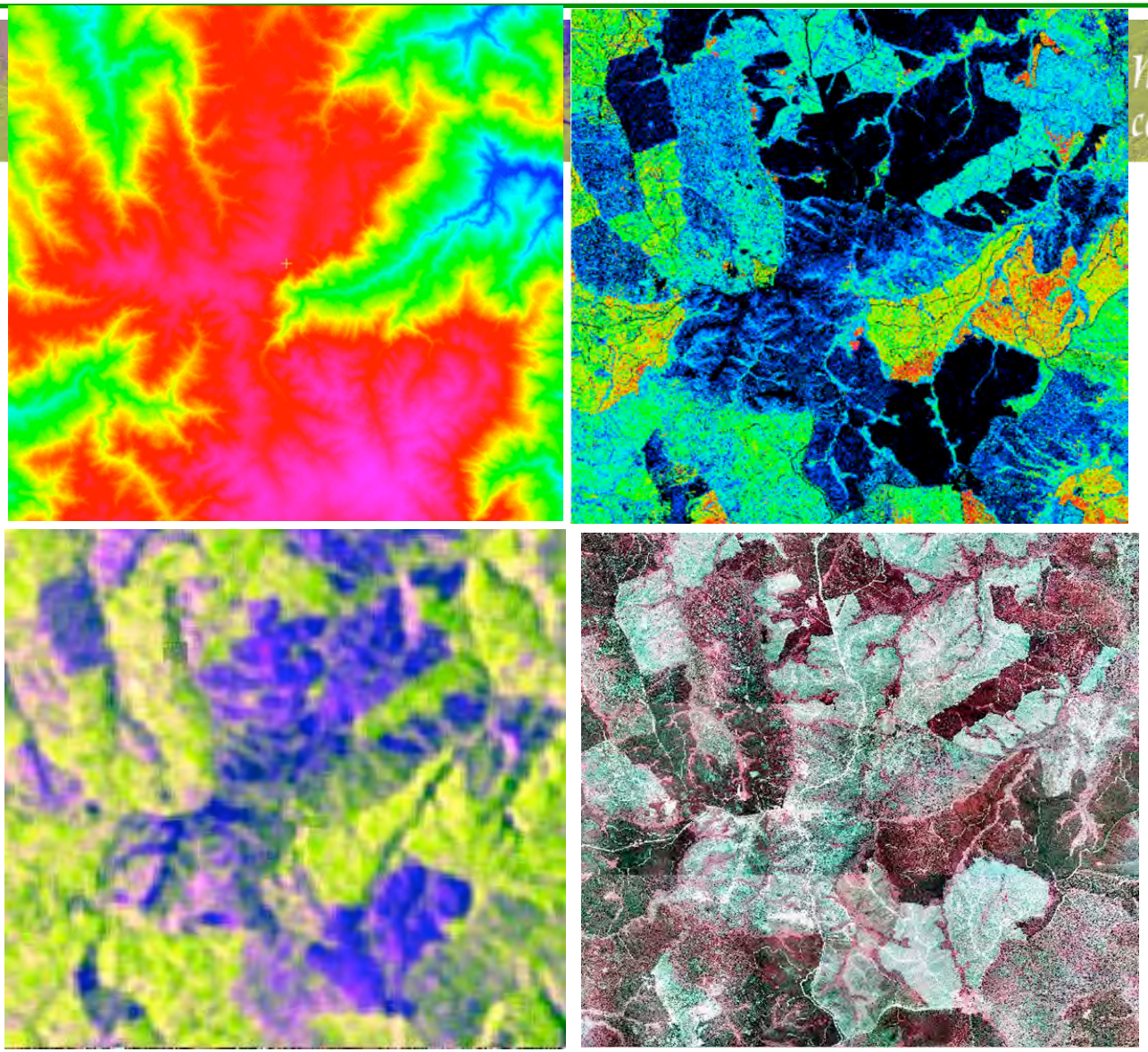


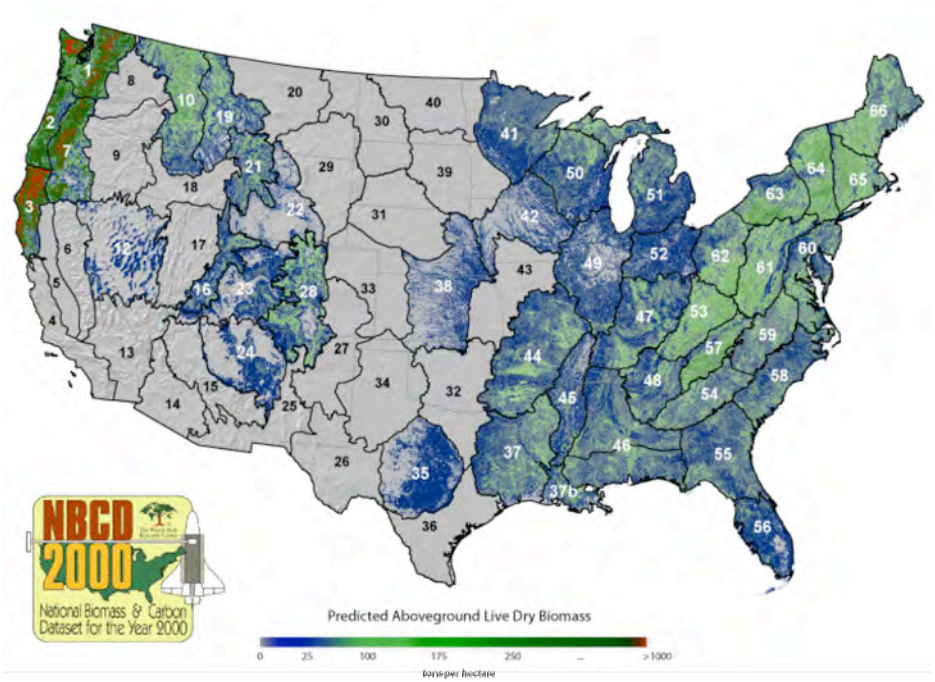
Example of a 6 x 6 km^2 region mapped by the DMCL small footprint lidar sensor and color infrared digital camera processed to 1 m resolution. Top left: Digital Terrain model (DTM); top right: Canopy height model (DSM-DTM); bottom left ALOS/PALSAR L-band hh/hv color composite; bottom right: False color infrared digital orthophoto.

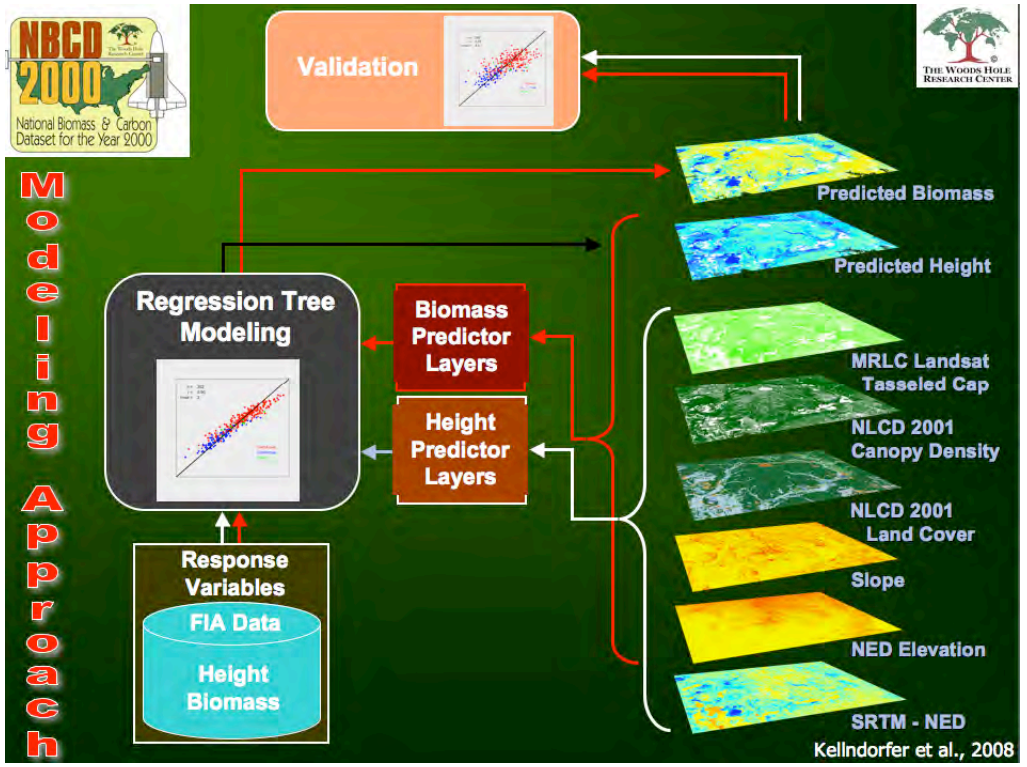
NASA/USDA Funded Project under Carbon Cycle Science:

- **Towards Spatially Explicit Quantification of Carbon Flux (2000-2007) in Northeastern U.S. Forests Linking Remote Sensing with Forest Inventory Data**
- **Project Time Frame: 5/2008 - 4/2011**
- **Team: WHRC, USDA Forest Service**

- Four specific objectives are proposed to achieve this goal:
  - (1) Generate an ALOS/PALSAR mosaic for the RGGI region for the year 2007.
  - (2) Use FIA data together with the ALOS/PALSAR mosaic for forest cover classification at three levels.
  - (3) Use FIA data together with the ALOS/PALSAR mosaic to estimate vegetation height and aboveground live dry biomass and generate the RGGI Biomass and Carbon Dataset 2007 (RBCD2007).
  - (4) Quantify spatially explicit changes in vegetation height, biomass and carbon stocks for the RGGI region by comparing the 2007 estimates (from 3) with the NBCD2000 baseline.

NBCD Status 11/2008





http:/whrc.org/nbcd

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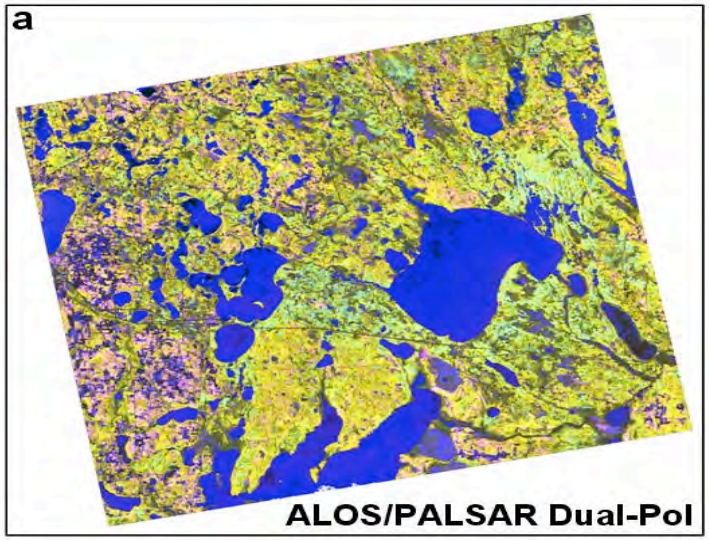
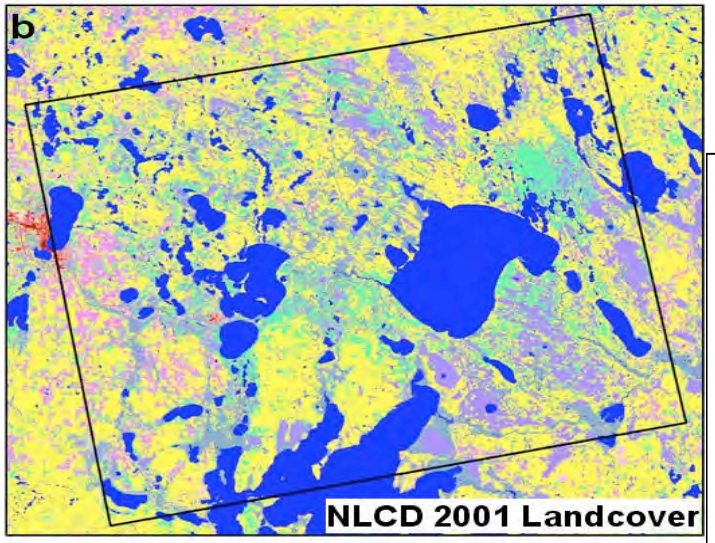
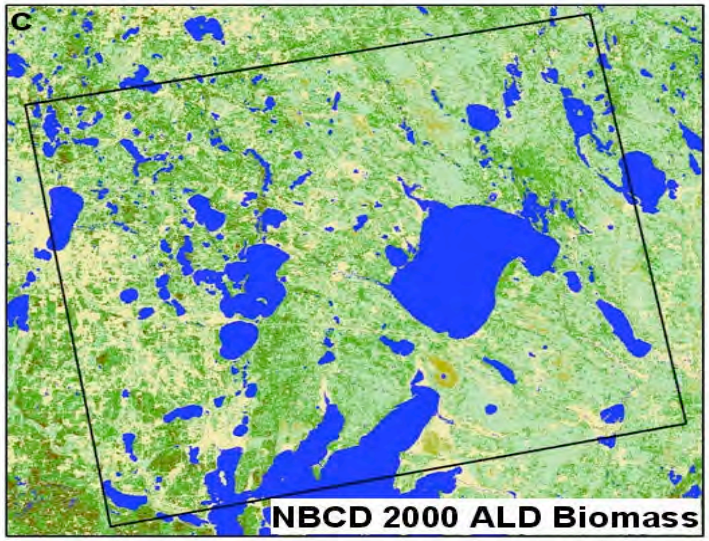
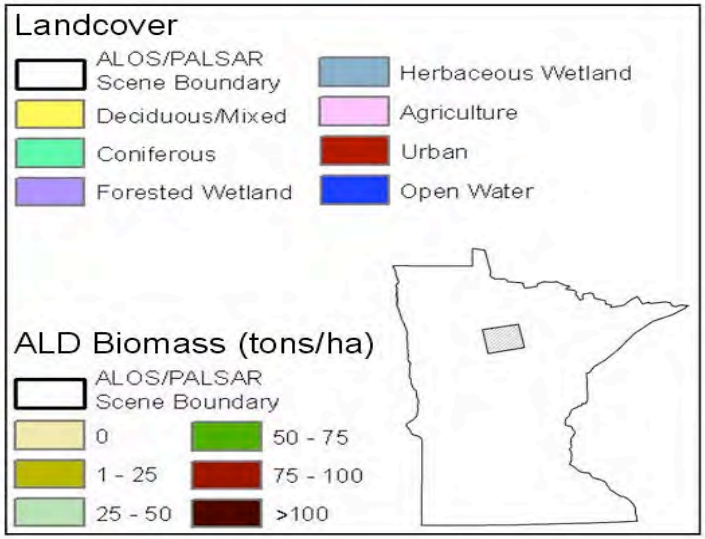
Spatially Explicit Carbon Flux in NE U.S. in Support of the Regional Greenhouse Gas Initiative









Example of input data for change detection (Proposal objective 2) and carbon flux calculation (Proposal objectives 3 and 4) from ALOS/PALSAR (a), NLCD 2001 landcover (b), and NBCD2000 biomass prediction (c).

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Moore/Google/Packard Funded Project: Pan-tropical Mapping of Forest Cover and Associated Carbon Stock

- Project Time Frame: 11/2008 - 10/2011
- Four specific objectives are proposed to achieve this goal:
  - (1) Generate an ALOS/PALSAR mosaic for the tropics for the year 2007.
  - (2) First Order Forest/Non-Forest Classification
  - (3) MODIS/Lidar based C stock mapping mid 2000
  - (4) Refinement of C Stock map through Optical/radar fusion
  - (5) Capacity Building on new Data sets to support REDD process

Project Partners

- **Funding Support:**
  - GBMF
  - Google.org
  - Packard Foundation
  - NASA (Data)
  - Software : ITTVIS, ESRI, Definiens
- **Key project partners:**
  - JAXA, ASF/AADN
- **Other collaborating partners:**
  - SARMAP, FAO, INPE, Spot Image

- **Contribution to New GEO Task on Forest Carbon Tracking**

GROUP ON EARTH OBSERVATIONS

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Target Area

- **Baseline: 2007 Dual-pol Data, Gaps filled with 2008 Data (15,000 Frames)**
- **Yellow: First target area currently ordered, 5,500 Frames**
- **Green: Remaining data, 9,500 Frames**

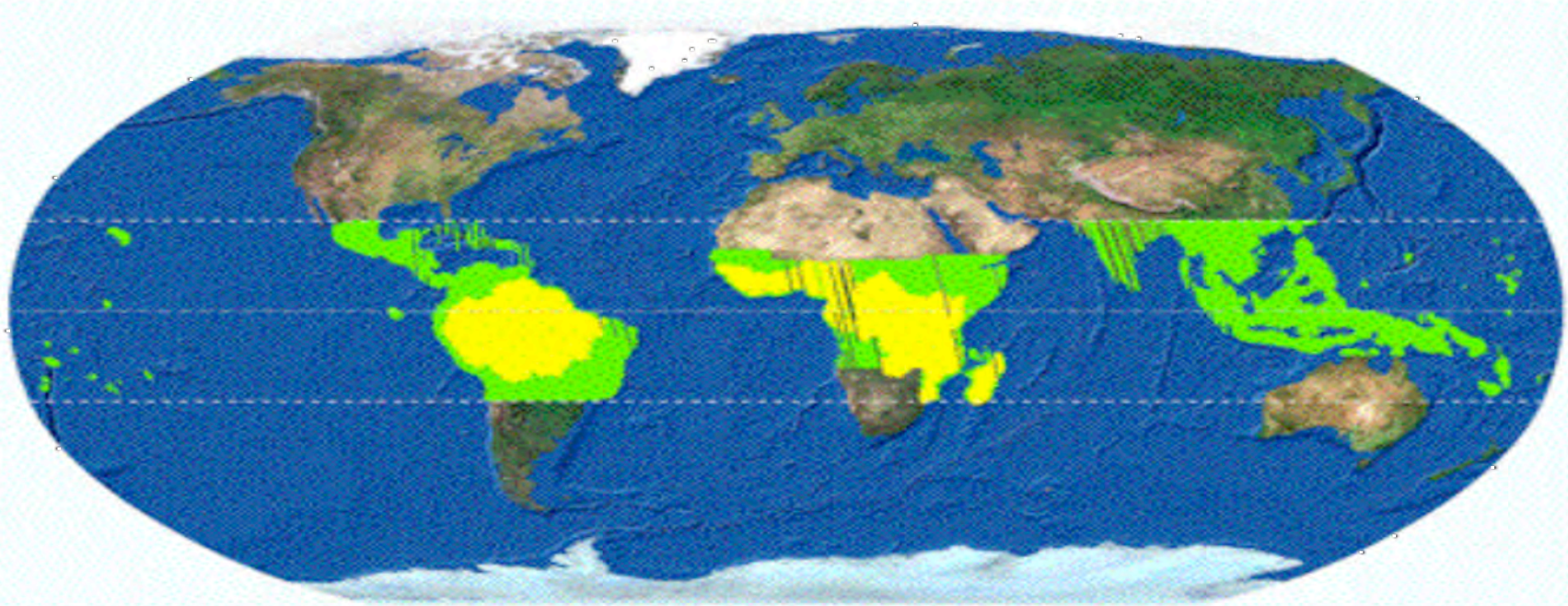
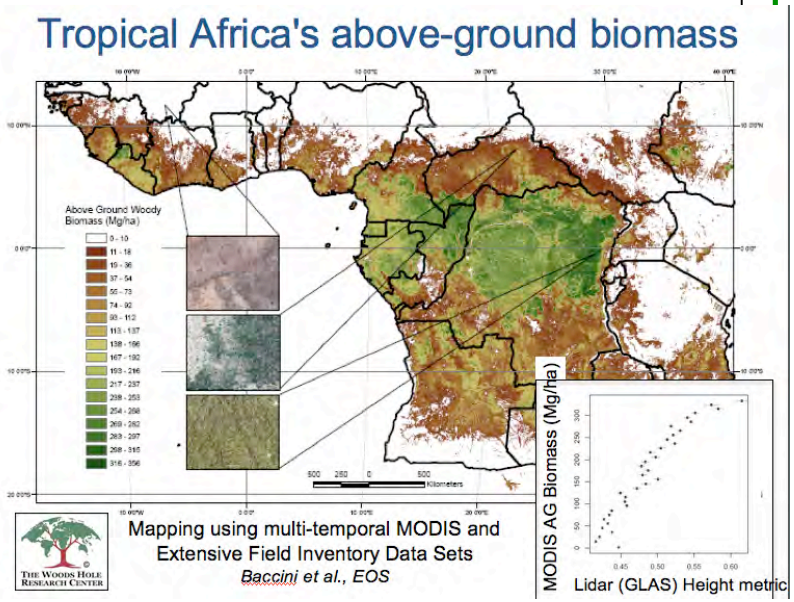


Figure 3: Pan-tropical coverage (green) of ALOS dual-polarimetric scenes. Regions shown in yellow represent scenes already requested by WHRC from the Alaska Satellite Facility (ASF).

Pan-Tropical Data Set

- SAR Component:
- Value Added product
  - Fully orthorectified (SRTM for terrain correction) and radiometrically calibrated mosaic data
  - Full SAR resolution, ca. 12.5 m (to allow for deriving adaptive MMUs)
- User friendly web delivery (Geotiff format), total delivered volume 8 bit three channels is 1.5 TBytes
- Globally consistent processing parameters
- Baseline data set for future change monitoring
- First Order Tropical Forest Cover map for 2007

- OTHER Component: MODIS/Lidar
- Pan-tropical biomass map
  - Improve through optical/radar fusion



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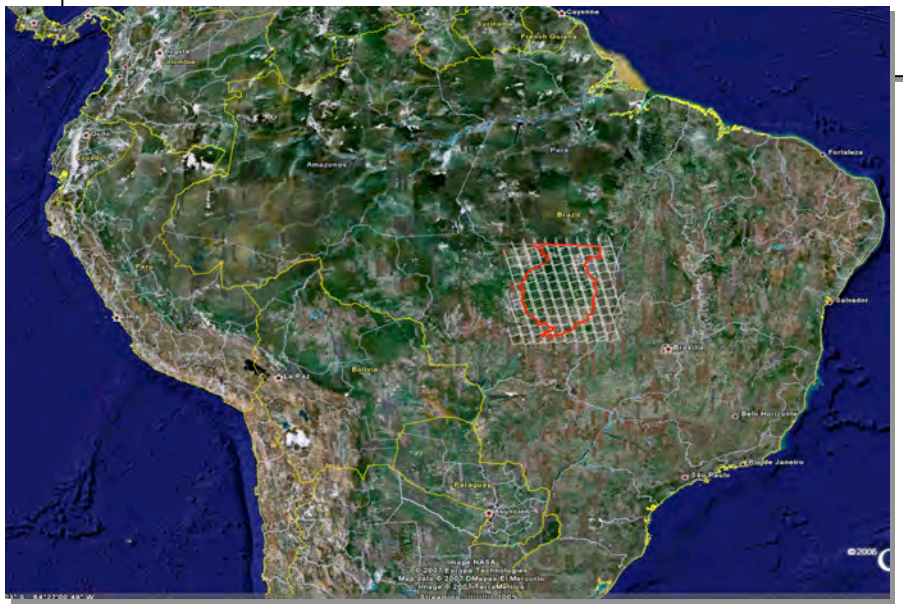
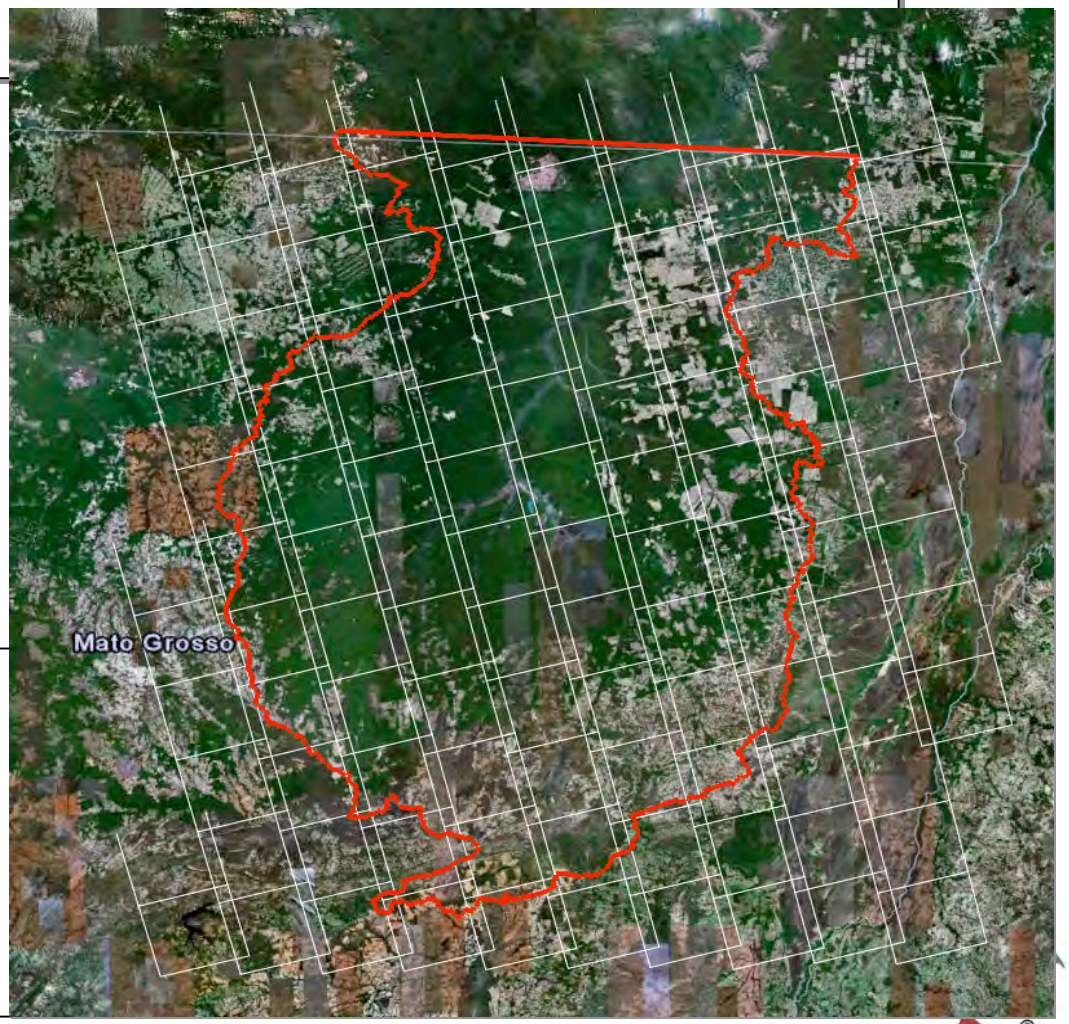
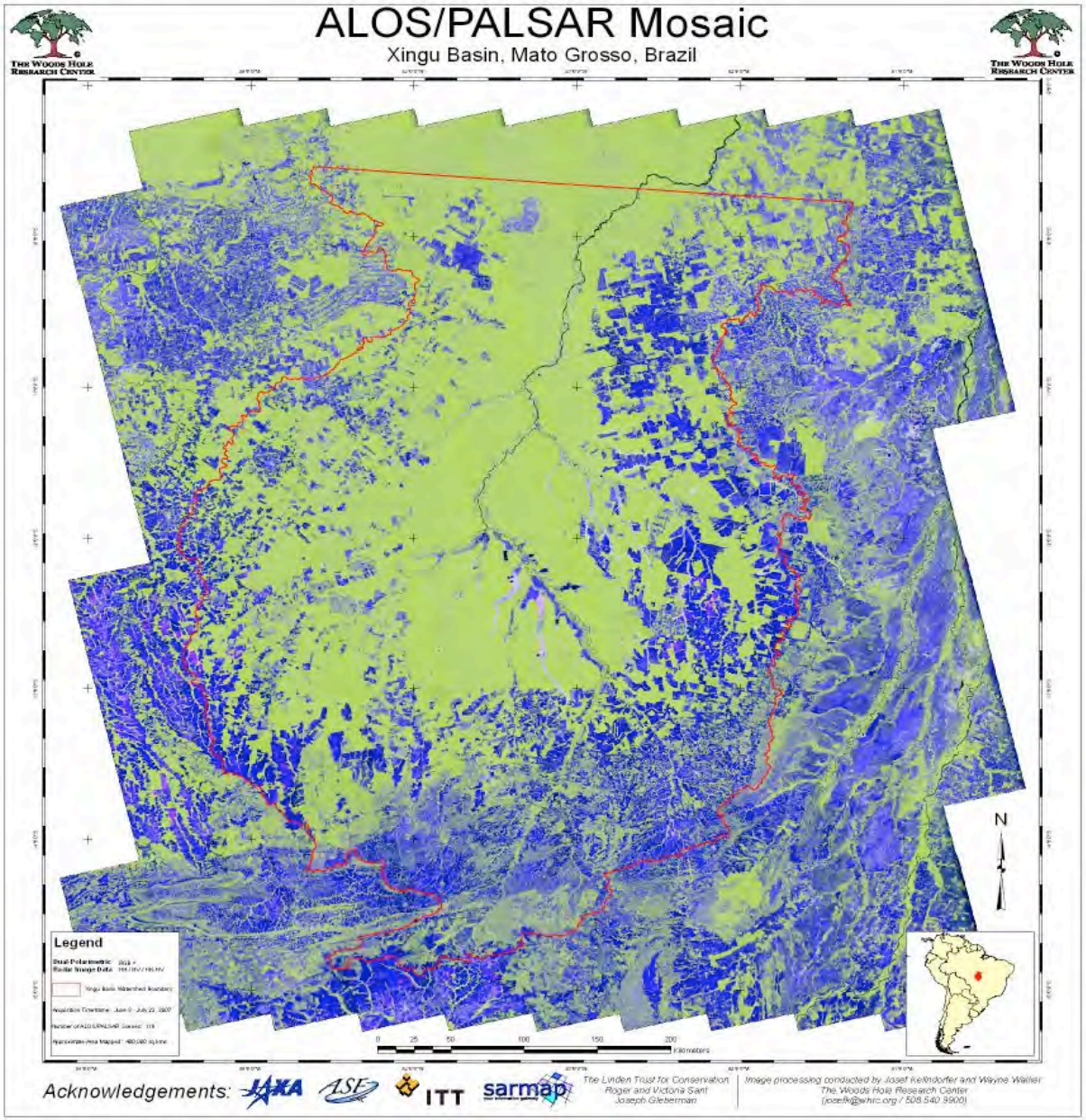
Pilot Study results:
Xingu Basin, Mato Grasso, Brazil

ALOS/PALSAR Dual-Pol Mosaic





- Acquisition Time Frame: June 6th to July 22nd 2007
- 116 Scenes Selected



ALOS/
PALSAR
2007
Radar Image Mosaic of the Xingu Watershed

Data Acquistion:
6/8-7/22 2007

Number of Scenes: 116

Resolution: 25 m

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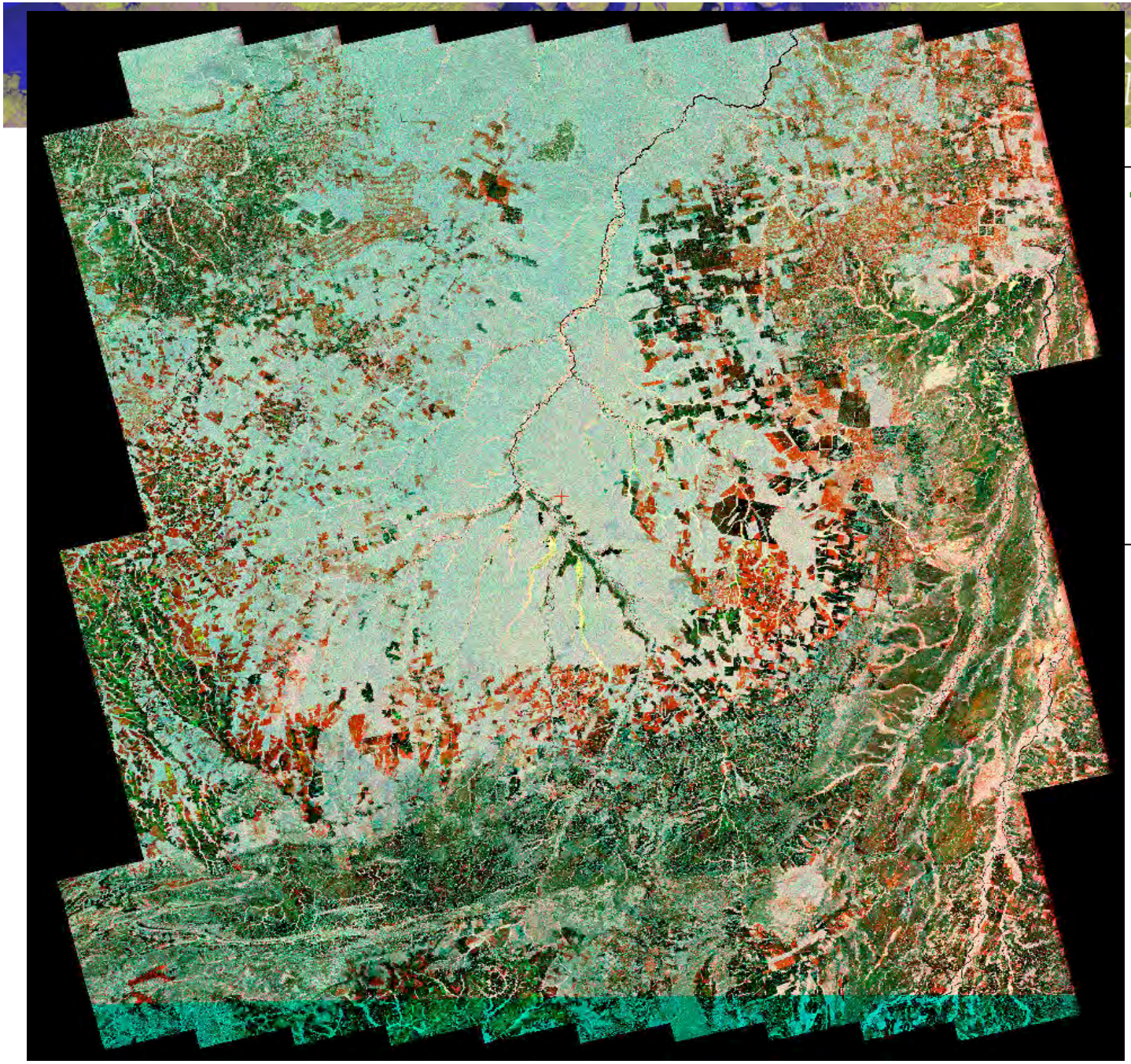

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11 Year Change between JERS-1 and ALOS

Red JERS-1 LHH
Green ALOS LHH
Blue ALOS LHV

Deforested Areas between 1996 and 2007 appear in red

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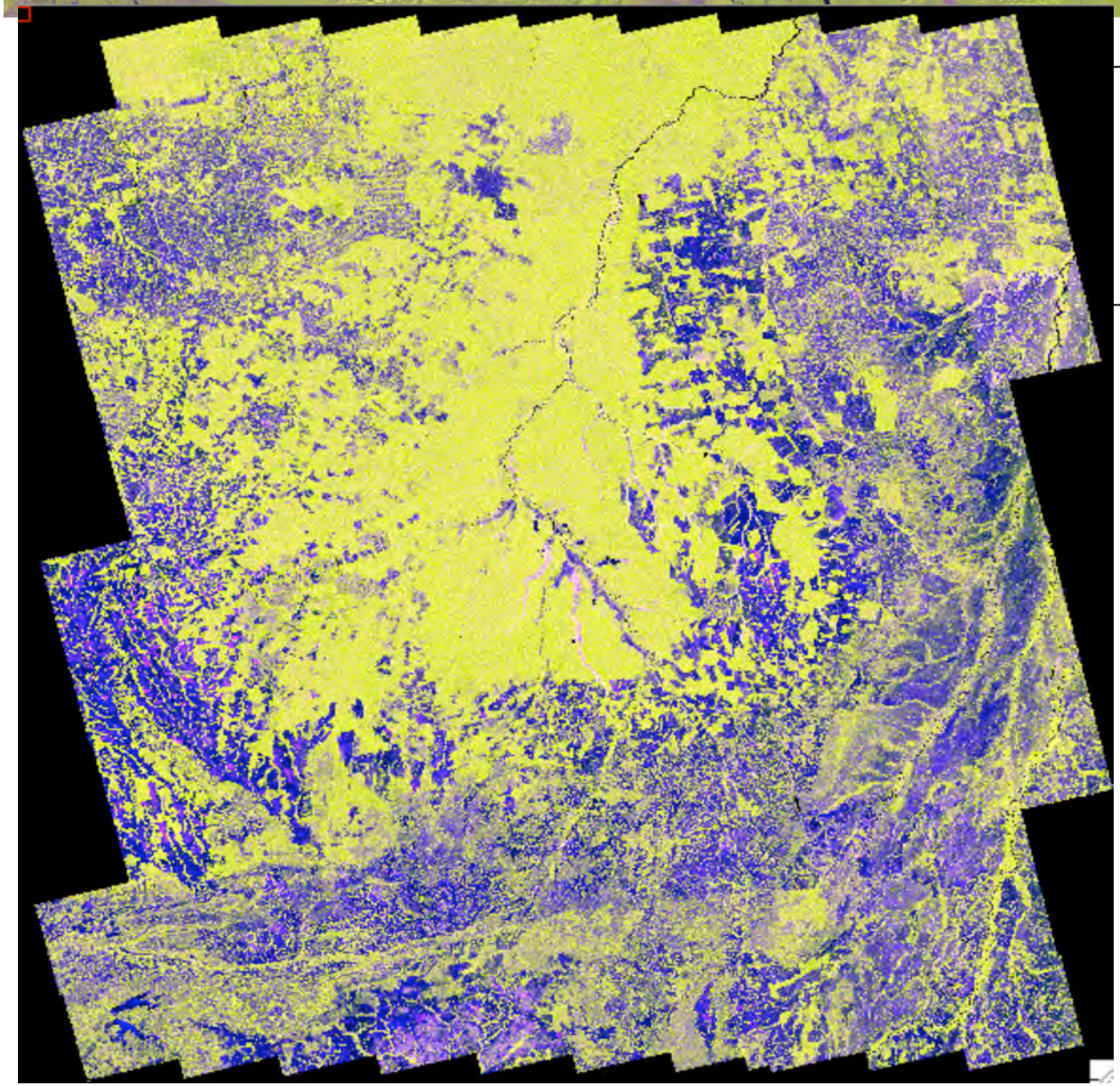

Xingu 2008

Band Combination:

Red LHH
Green LHV
Blue LHH/HV Ratio

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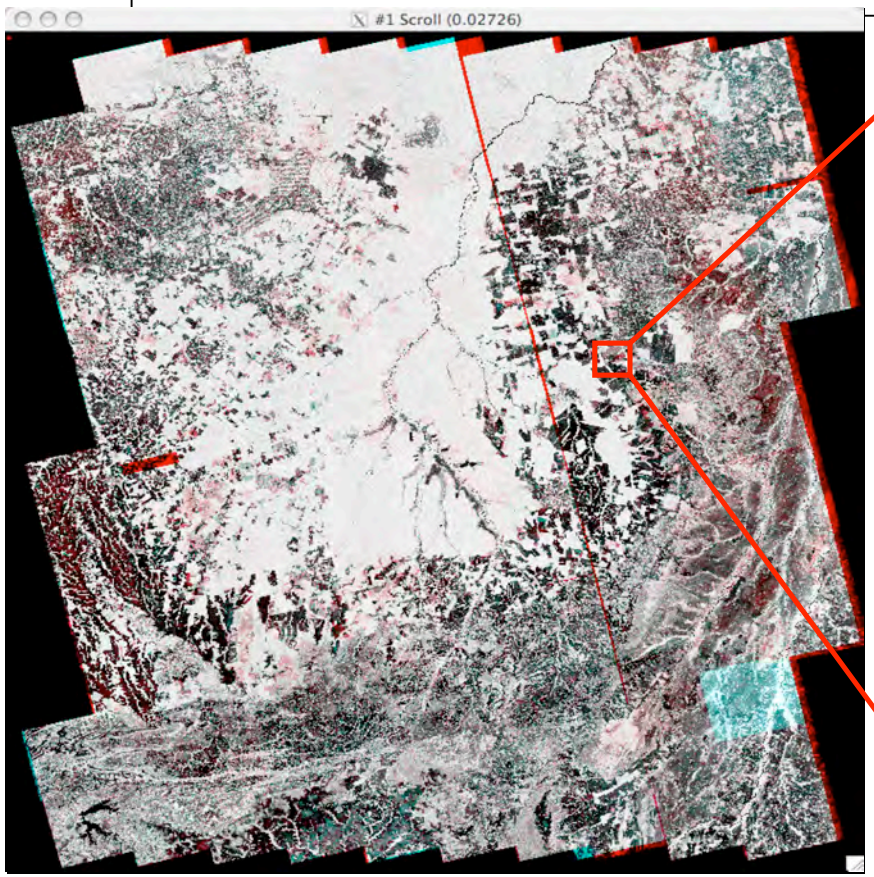
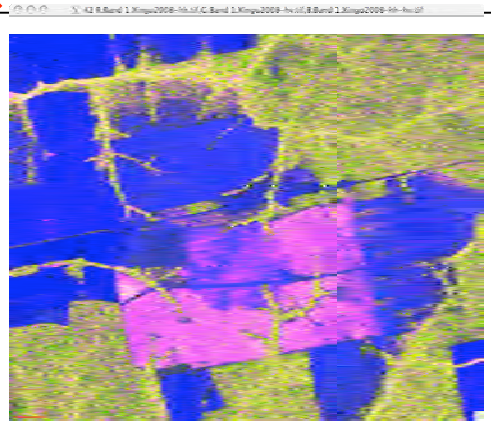
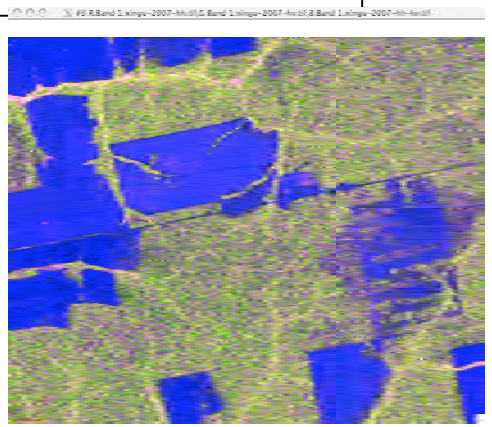
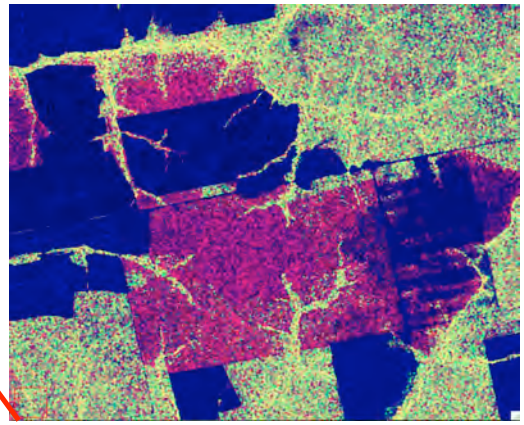
Xingu One Year Change: Deforestation

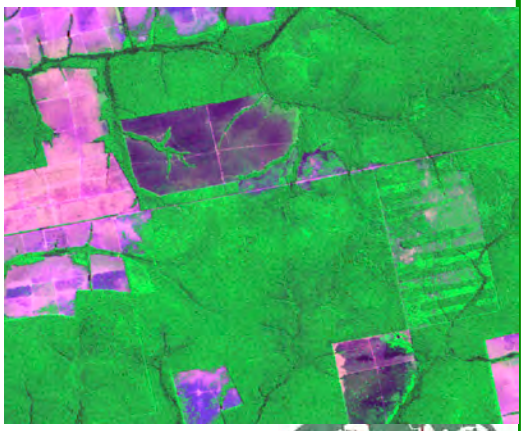
2008 2007











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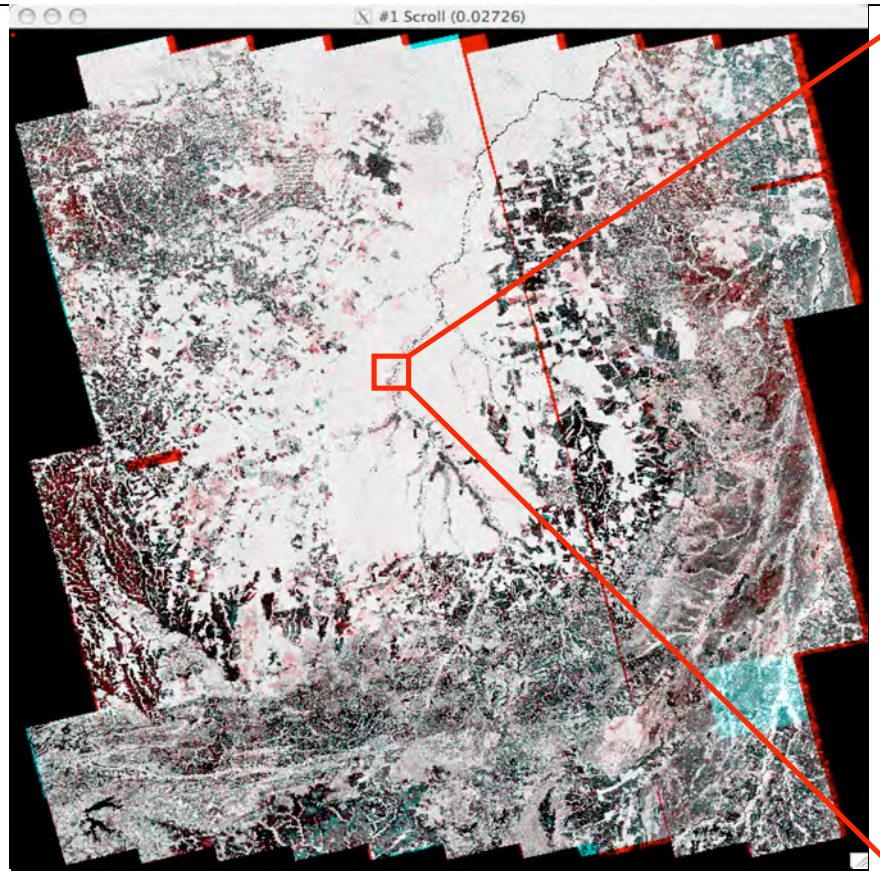
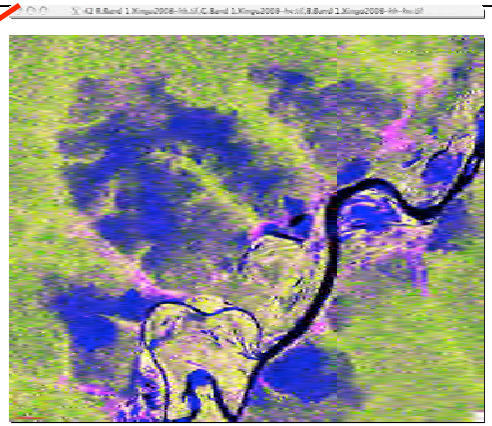
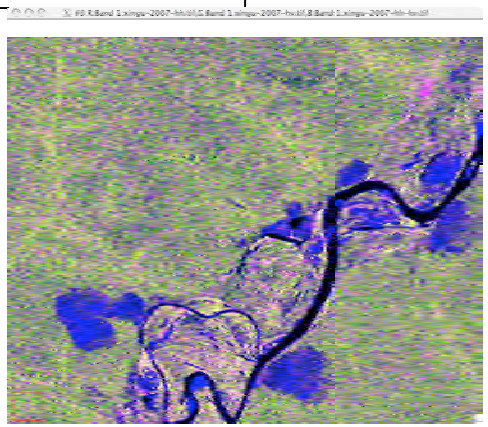
Xingu One Year Change: Fire Scars

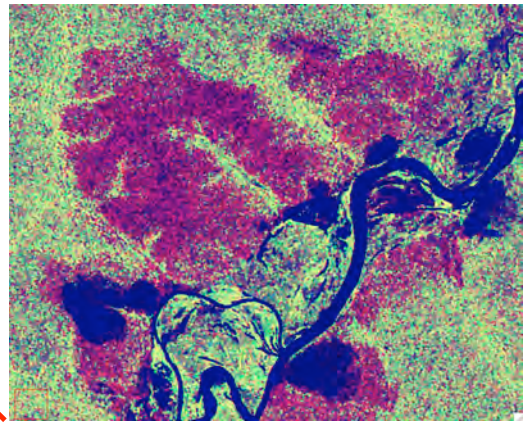
2008

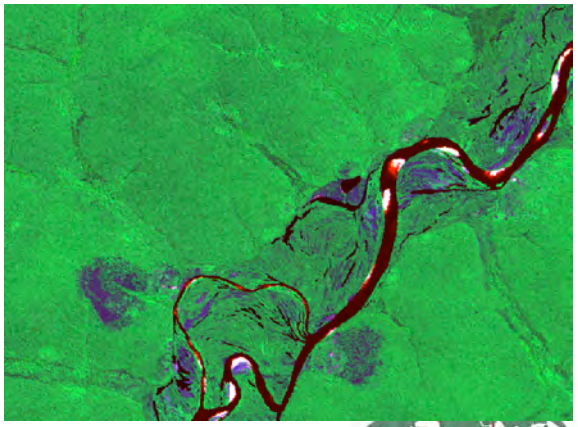
2007











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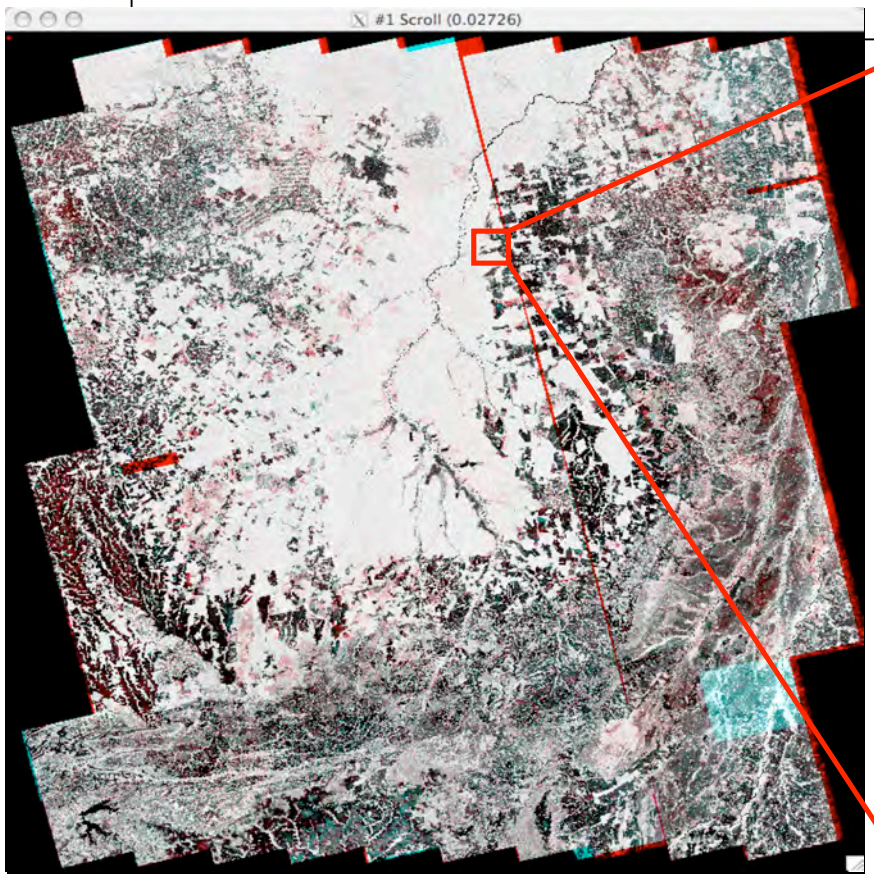
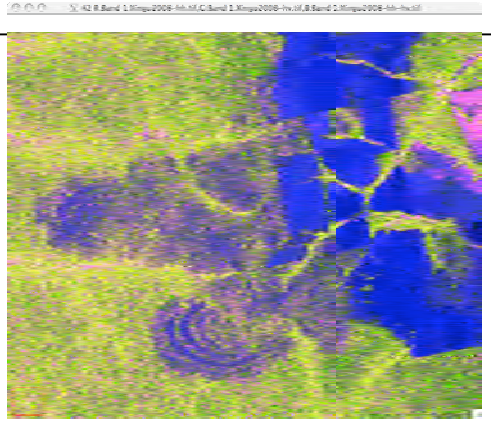
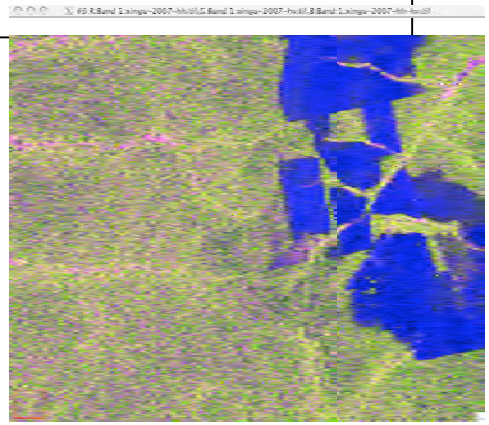
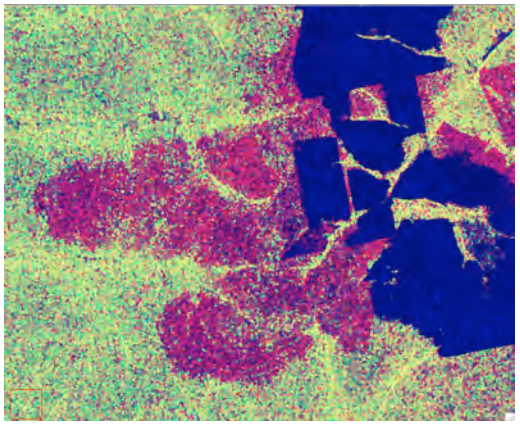
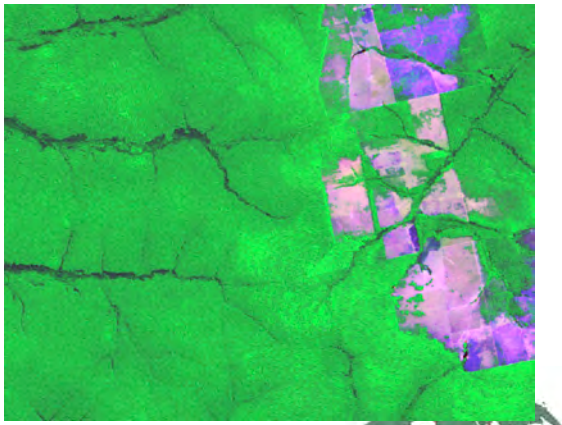
Xingu 4 - Fire Scars + Deforestation











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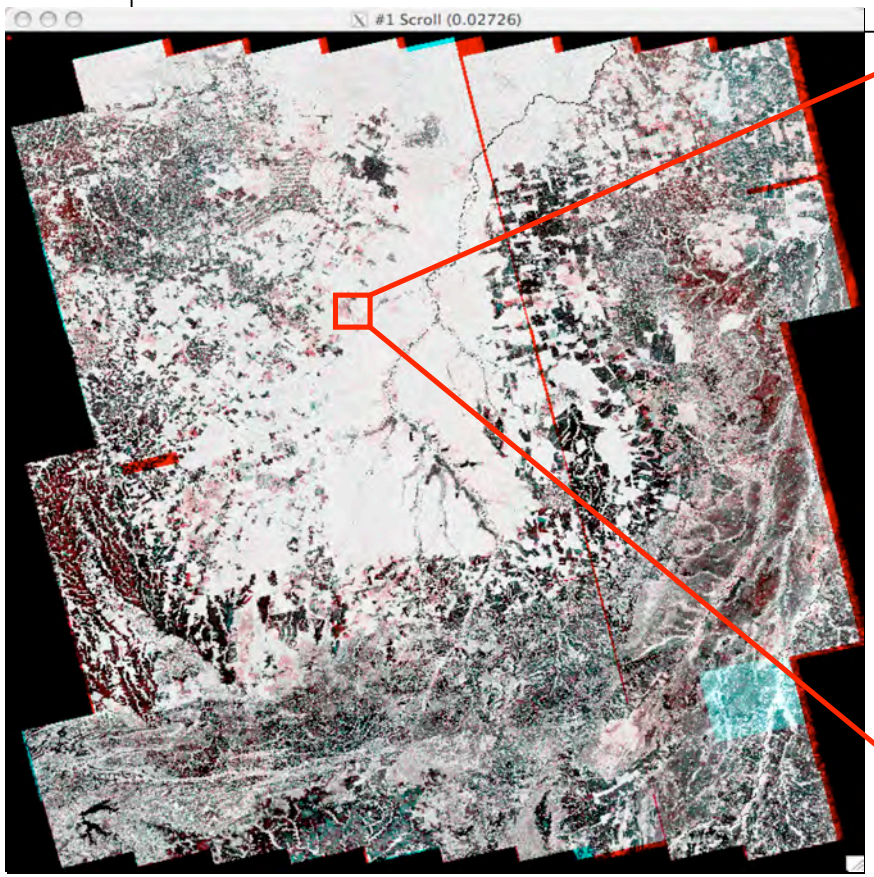
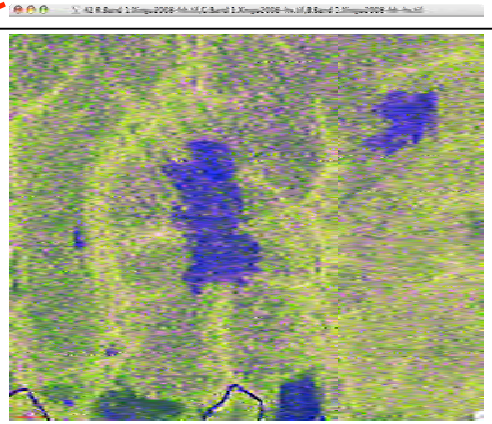
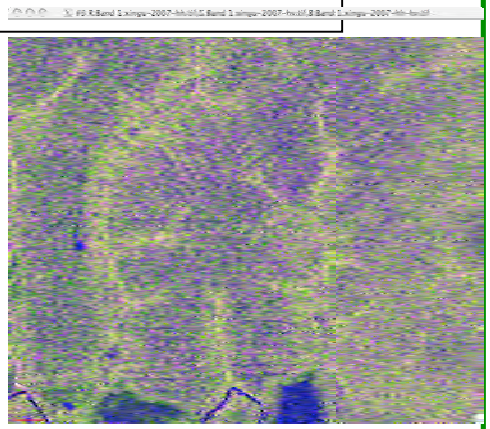
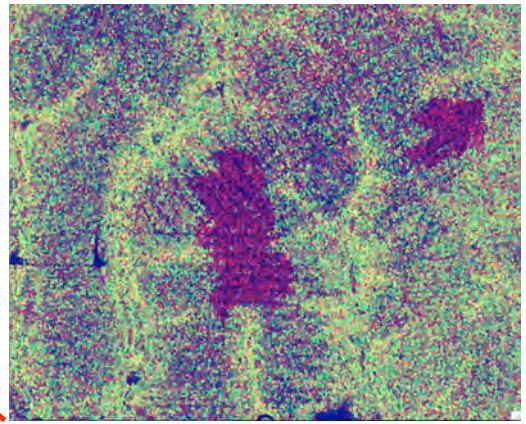
Xingu 1- Continued Degradation

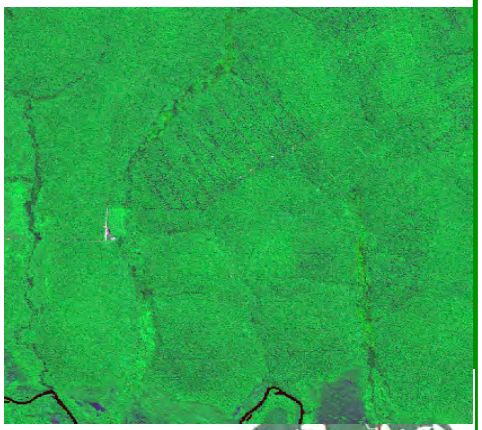
2008 2007











Need best resolution data for this detection

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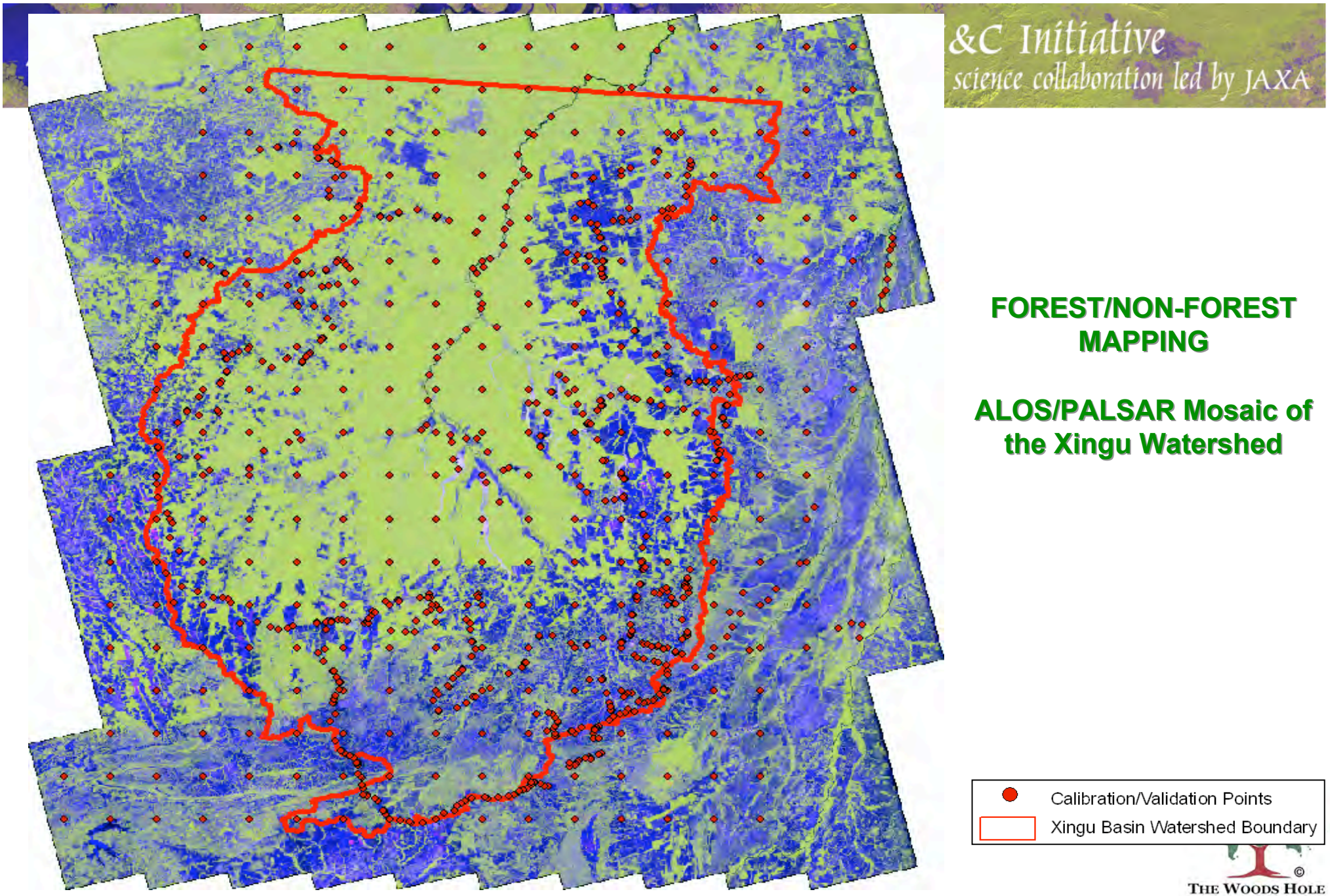
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FOREST/NON-FOREST MAPPING
ALOS/PALSAR Mosaic of the Xingu Watershed
Calibration/Validation Points
Xingu Basin Watershed Boundary
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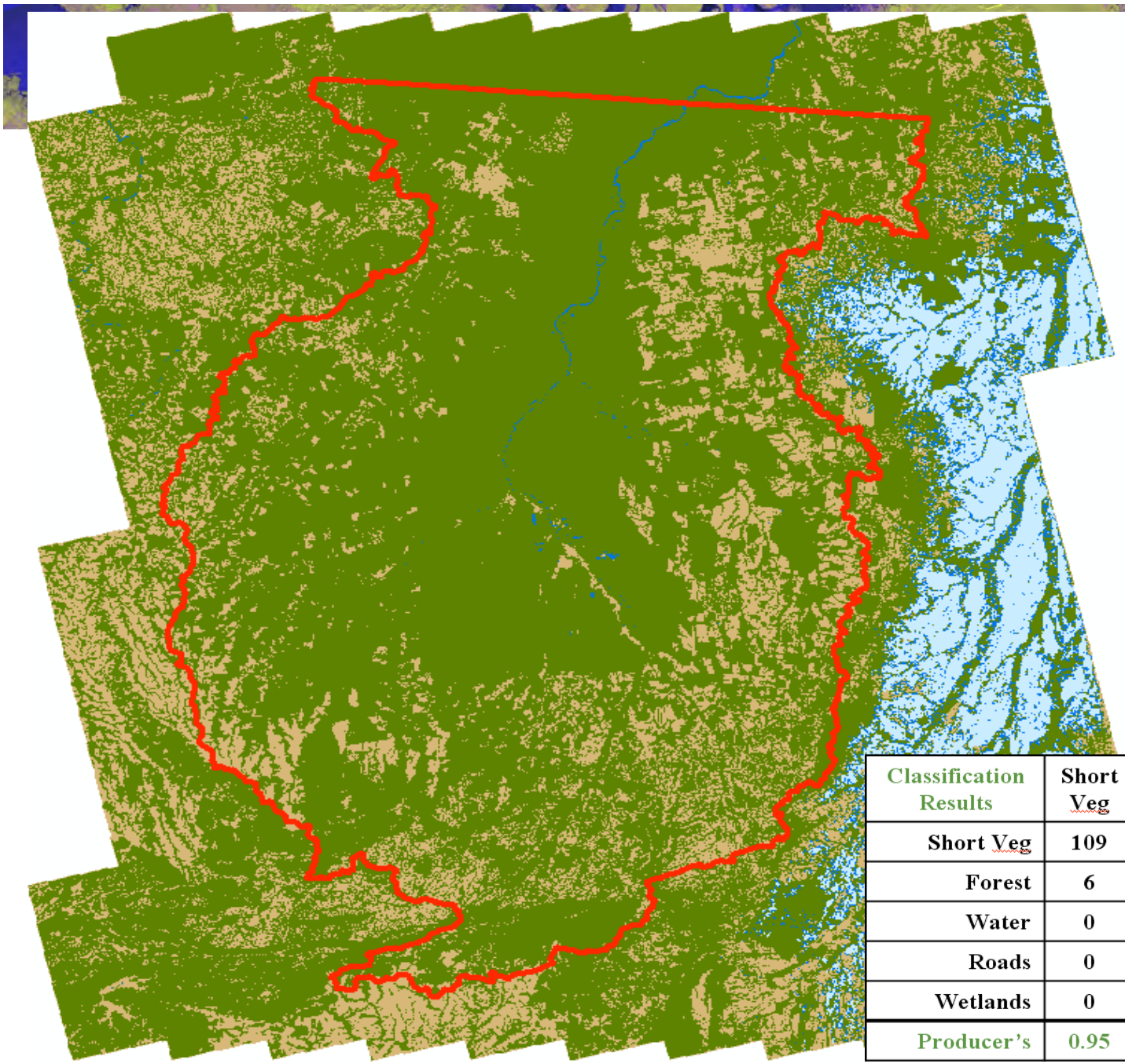

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ALOS/PALSAR Classification of the Xingu Watershed

- Xingu Basin Watershed Boundary
- Agriculture
- Roads
- Forest
- Rivers/Lakes
- Non-forested Wetlands

Classification Results	Short Veg	Forest	Water	Roads	Wet-lands	User's
Short Veg	109	18	0	2	0	0.85
Forest	6	109	0	0	1	0.94
Water	0	0	11	0	0	1.00
Roads	0	0	0	3	0	1.00
Wetlands	0	0	0	0	7	1.00
Producer's	0.95	0.86	1.00	0.60	0.88	0.90

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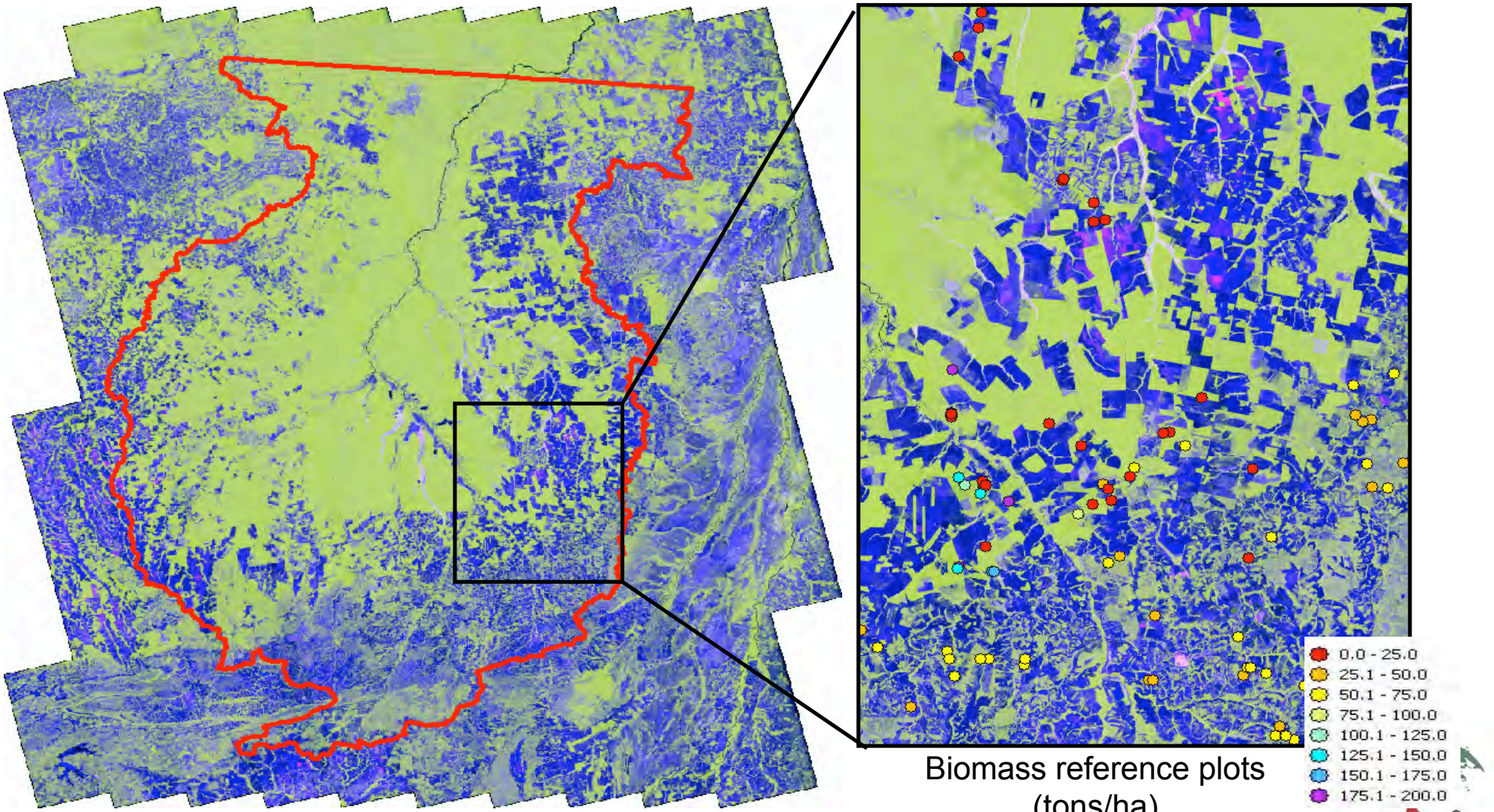
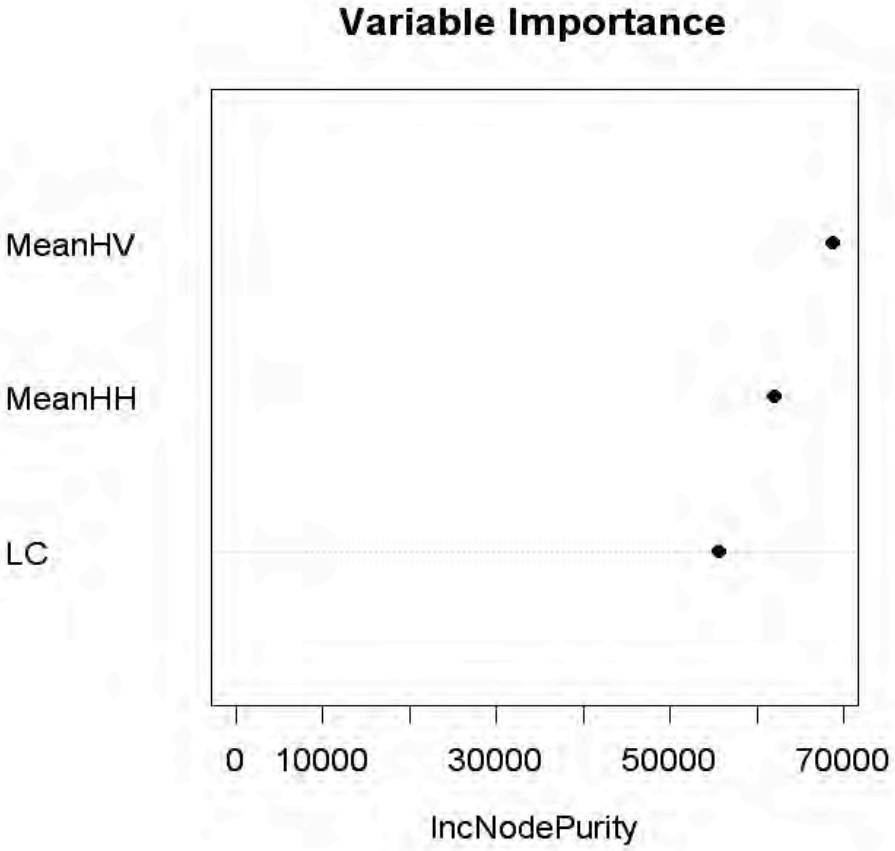
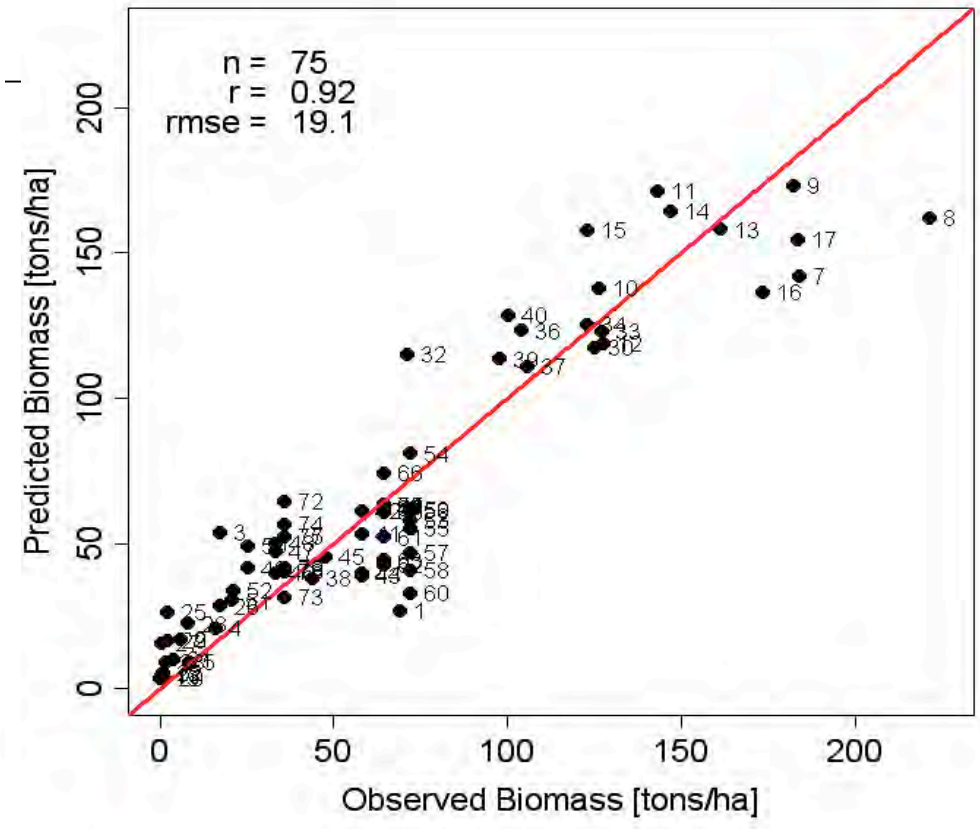
Advancing Biomass Mapping



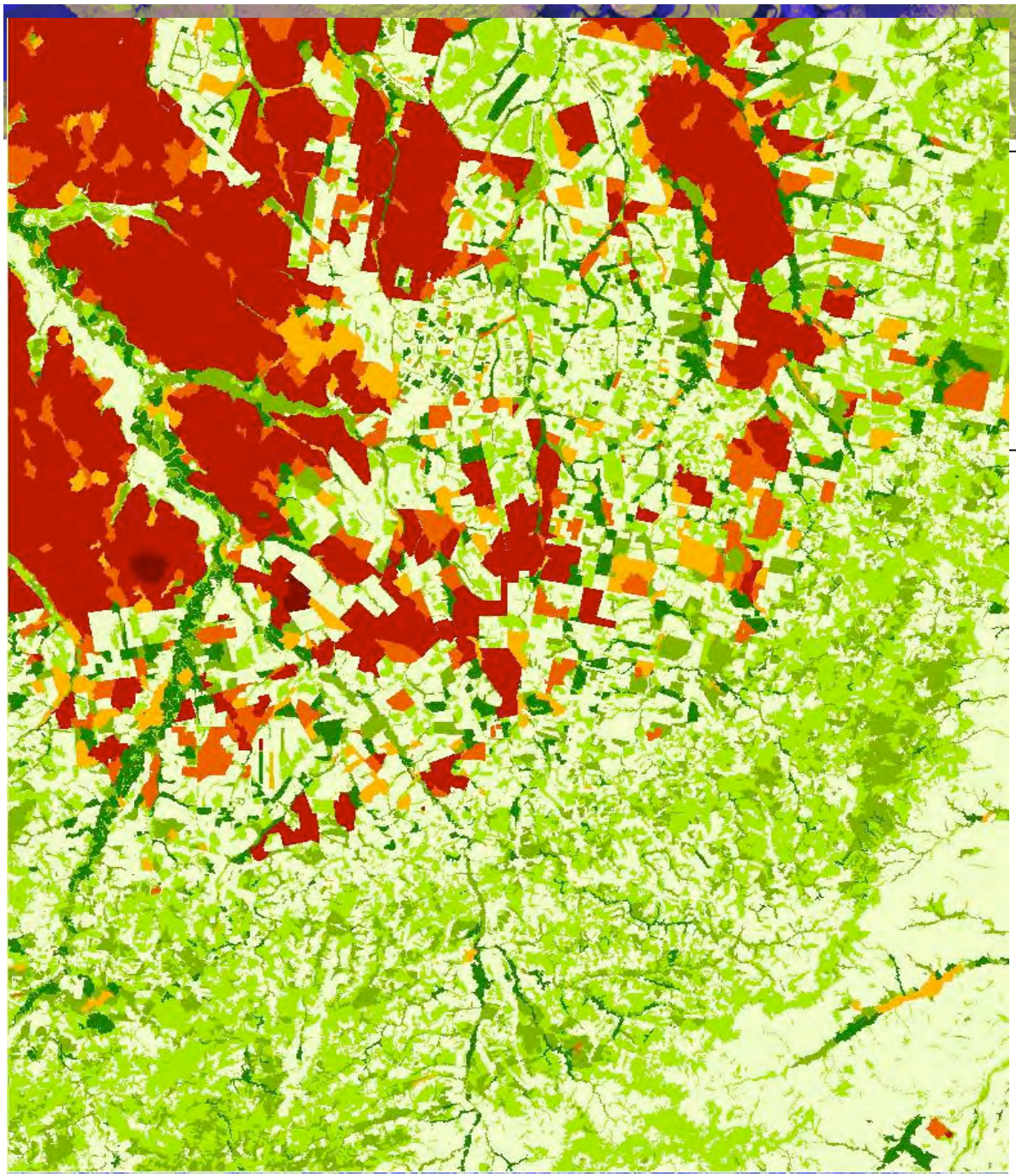
Biomass reference plots (tons/ha)

Dual-Pol + Land Cover Model





Landcover Data derived from Landsat ETM Classification



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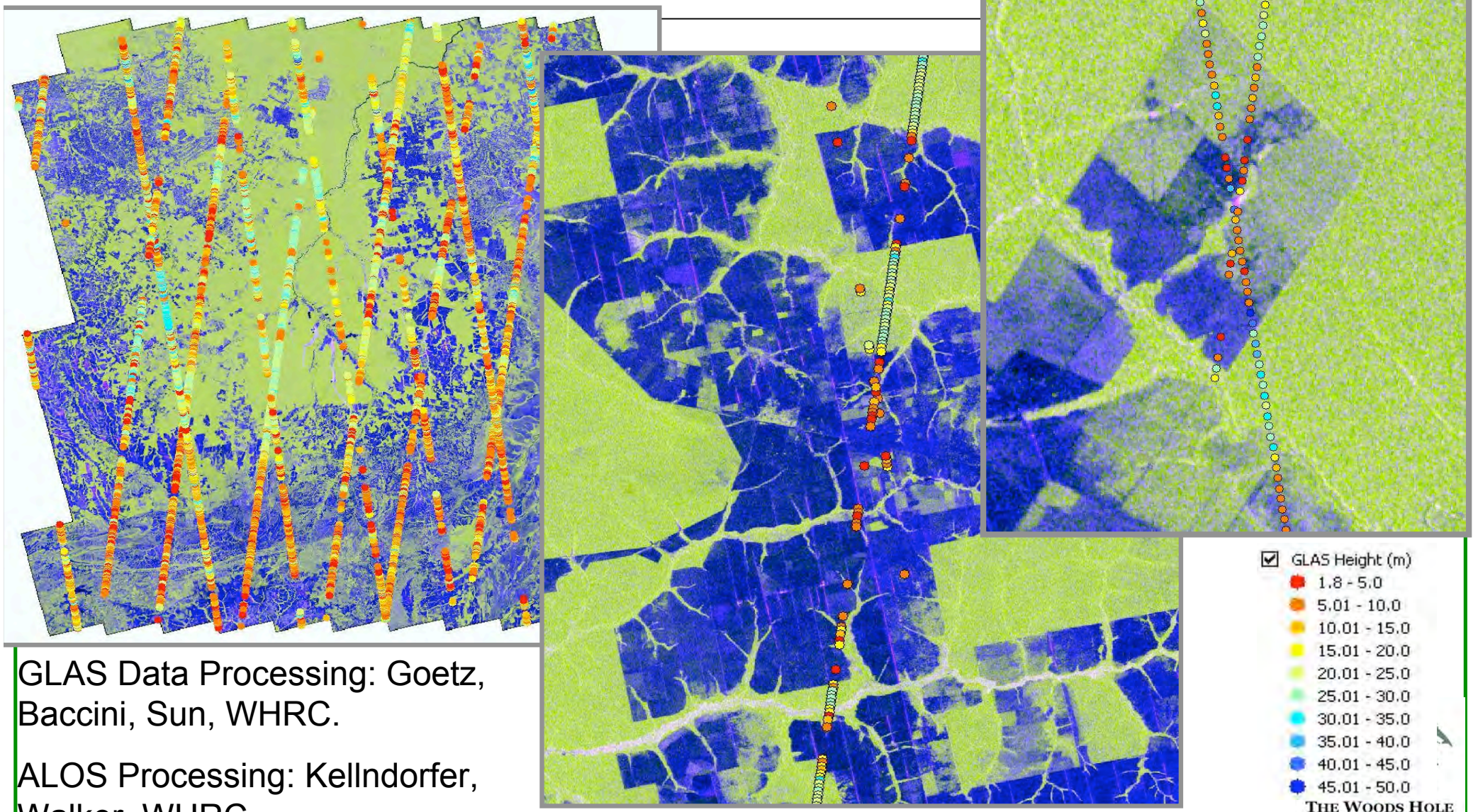
Biomass Map 2007

- **SE Xingu Watershed, Mato Grosso, Brazil**

Aboveground Biomass (tons/ha)

- 0 - 25
- 25 - 50
- 50 - 75
- 75 - 100
- 100 - 125
- 125 - 150
- 150 - 175
- 175 - 200+

Lidar/Radar Synergy for Biomass Mapping



GLAS Data Processing: Goetz, Baccini, Sun, WHRC.

ALOS Processing: Kellndorfer, Walker, WHRC.

Involvement with K&C

- **Further scientific studies on best data use for all projects, predominately Pan-Tropical Mapping Project**
- **Collaboration with team members on cal/val for 2007 data set**
  - **Data at full resolution will be made available to the team, have some flexibility to prioritize processing certain areas**
- **Data Needs:**
  - **Full resolution SLC, and AVNIR data , 50 scene/year pool**
    - **Goal: Explore value of coherance and SAR/Optical Fusion in case studies**
  - **ScanSAR Data for exploiting multi-temporal signal for better forest classification and biomass assessment (slant range)**
    - **Focus areas: UN-REDD Countries, Uganda, Xingu**
  - **25 m (or better) mosaic fully calibrated data ?????**
  - **Full resolution (SLC) JERS-1 Data for selected pilot sites**
- **Coordination with REDD Activities**
- **Coordination with GEO Task on Forest Carbon Tracking**

Special Mission in the Next two years: