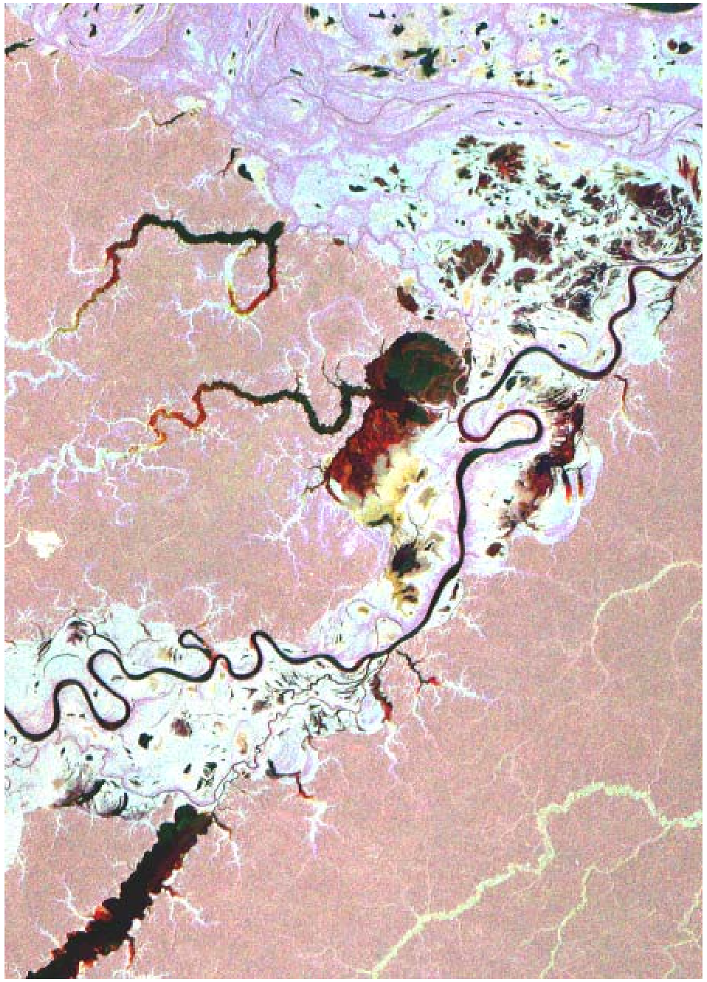
ALOS Kyoto & Carbon Initiative
Amazon Wetlands Products



Laura Hess

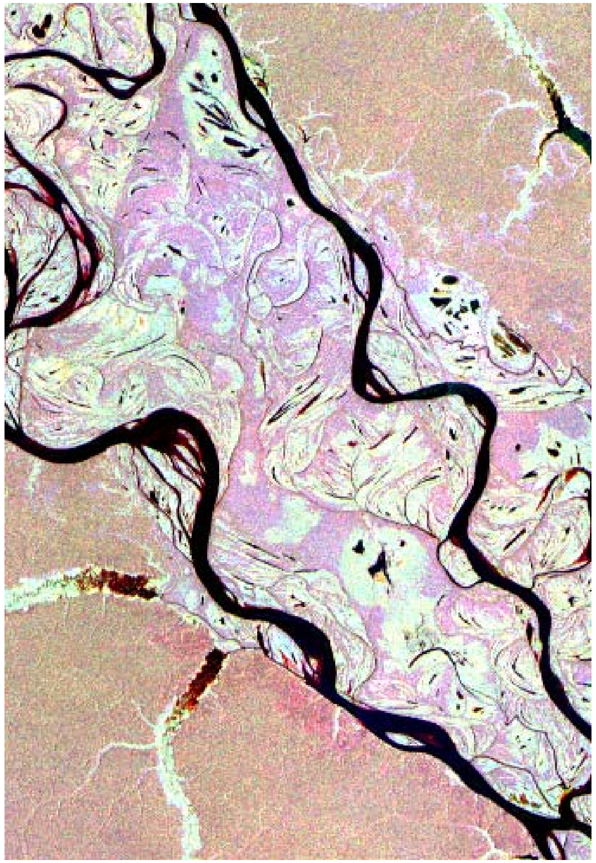
University of California, Santa Barbara

Evlyn Novo, Adriana Affonso, Eduardo Arraut

Inst. Nacional de Pesquisas Espaciais (INPE)

Laurent Durieux

Inst. de Recherche pour le Développement (IRD)



SCIENCE GOALS:

-Estimate seasonal rates of CH_4 emissions and CO_2 evasion

-Estimate surface water component of Amazon hydrologic cycle

- Characterize and preserve the biodiversity of Amazonian wetlands

PHASE I -> PHASE 2:

-Mapping wetland extent, vegetation, and seasonal inundation for central Amazon region

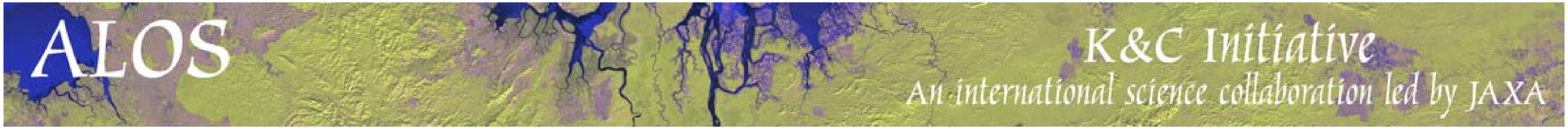
- Improving classification algorithms for FB and ScanSAR datasets

- Merging with optical mapping of water properties

-Moving from prototype to regional scales

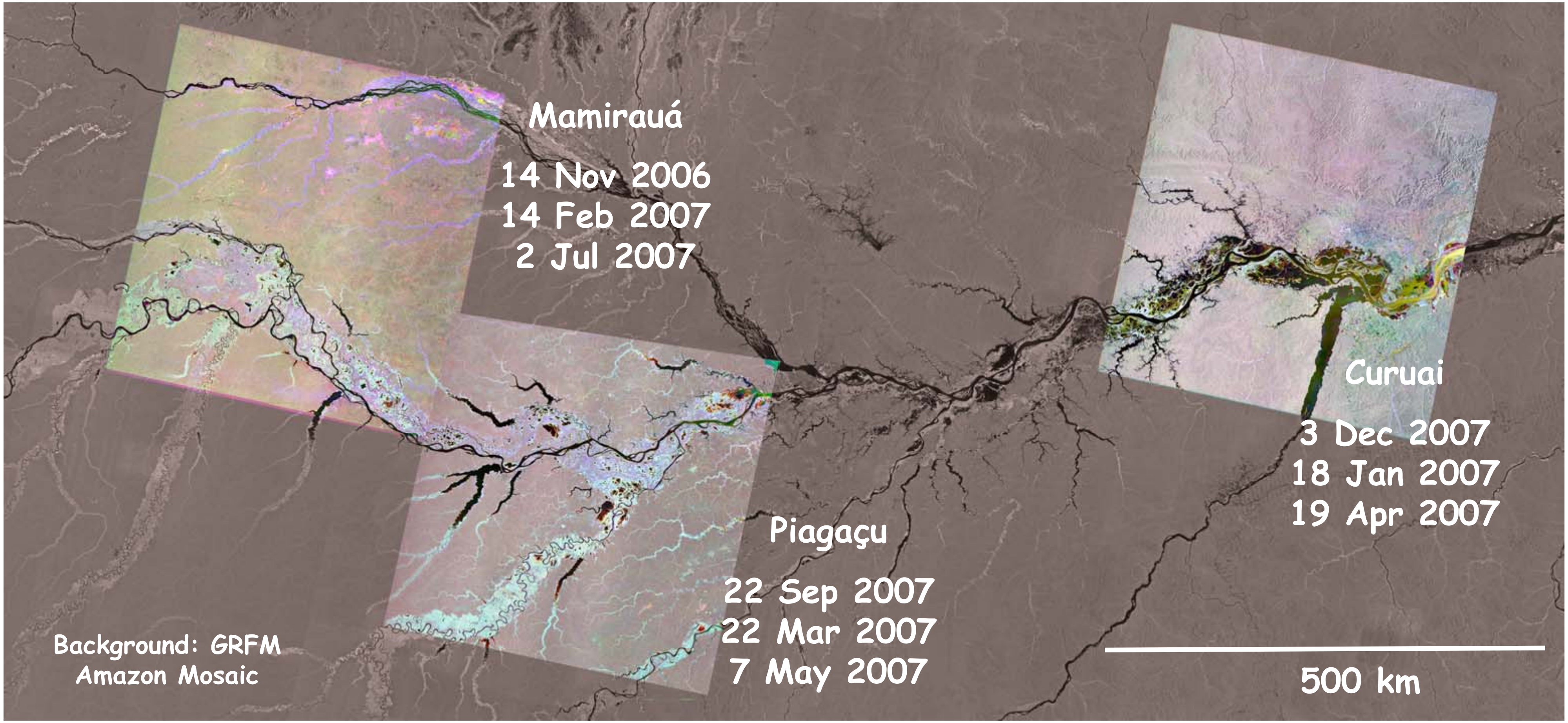
- Validation campaign planning

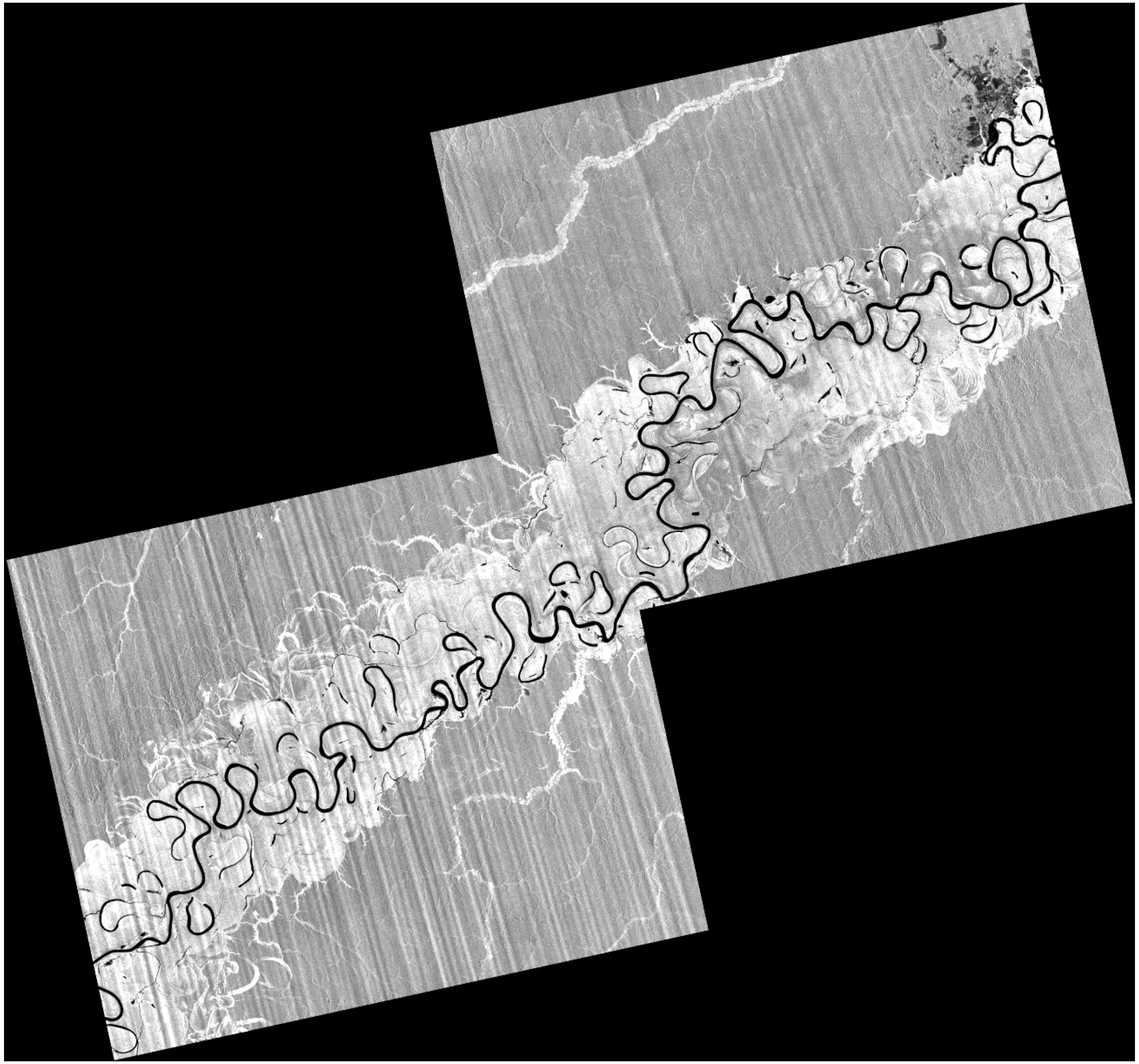
Scale/Goals	Site/Region	PALSAR datasets	PALSAR Source
I. Site-based: Support of reserves and individual projects; Algorithm development	Mamirauá, Piagaçu, Curuai, Juruá	Scenes; Fine-Beam (25 m); ScanSAR (100 m)	JAXA AUIG
II. Várzea-wide: Support of GEOMA and others; regional modeling	66W,1S - 52W,5S	Mosaicked strips: FB 50 m & ScanSAR 100 m; SRTM-coreg	ALOS K&C via JPL
III. Sub-continental: Biogeochemical and hydrologic modeling; Ramsar inventory	ALOS Fine-Beam Polygons G1,G2	Mosaicked strips: FB 50 m & ScanSAR 100 m; SRTM-coreg	ALOS K&C via JPL



CENTRAL AMAZON PROTOTYPE REGIONS

ALOS ScanSAR composites for focus areas





Data Quality Issues

Juruá site:

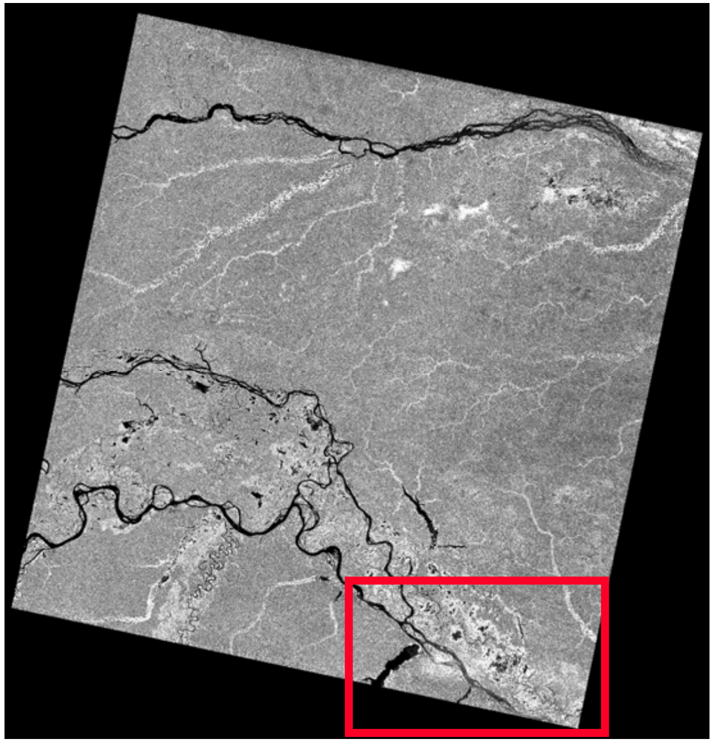
FBS

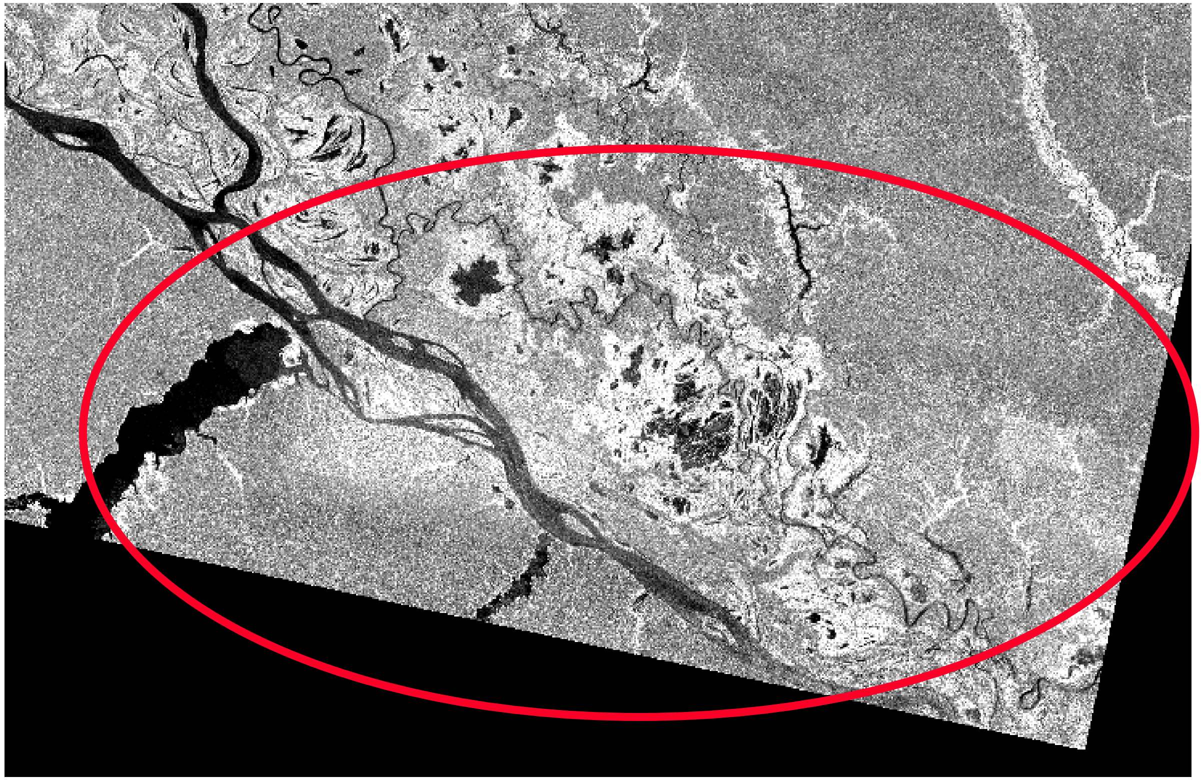
9 March 2008

26 March 2008

Data Quality Issues:

ScanSAR, 17 Feb 2008





Algorithm refinement: Fine-Beam

- improved training data set and class statistical analysis

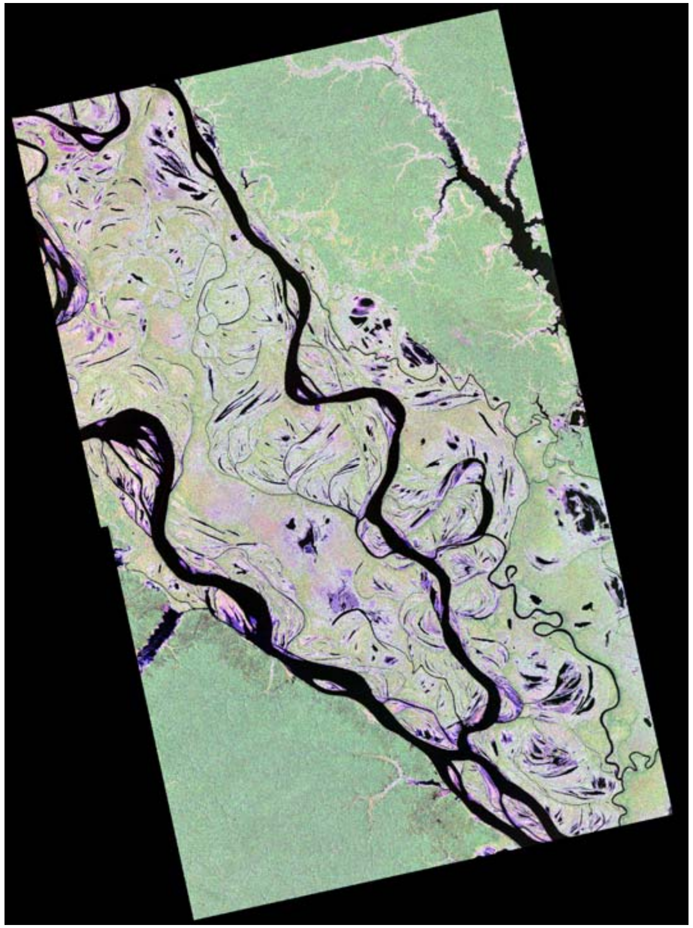
- segmentation parameter refinement

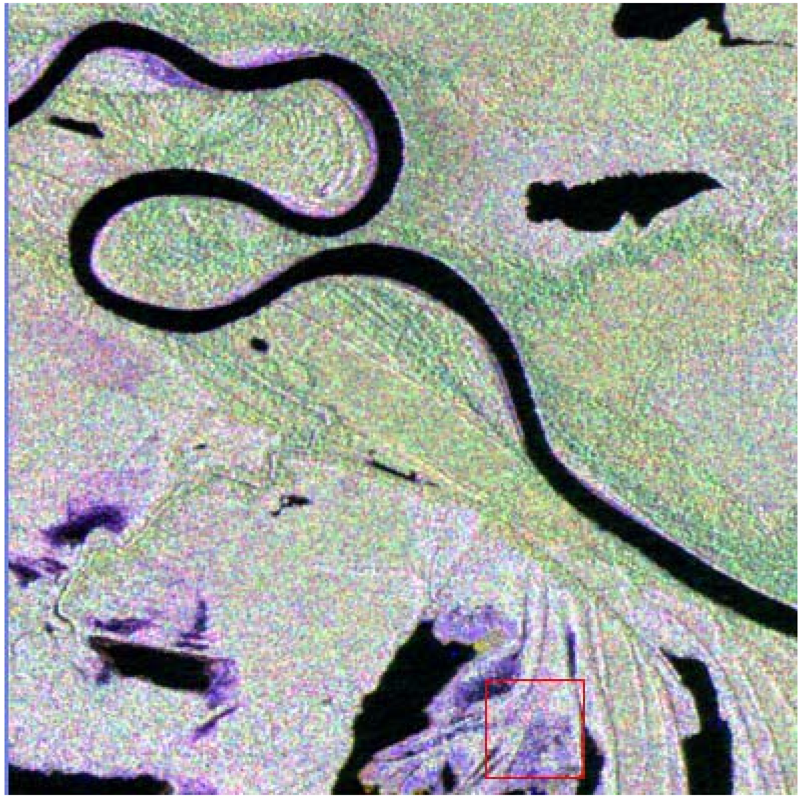
- use of polygon morphology as classification feature for narrow channels

- merging with optical analysis of water properties (A. Affonso, E. Novo)

FBD: June 14 2007, July 30 2007

FBS: Oct 30 2007

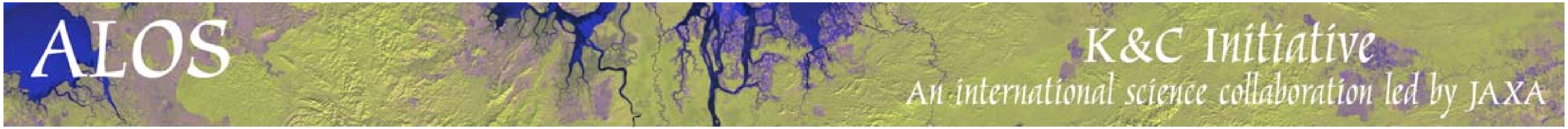


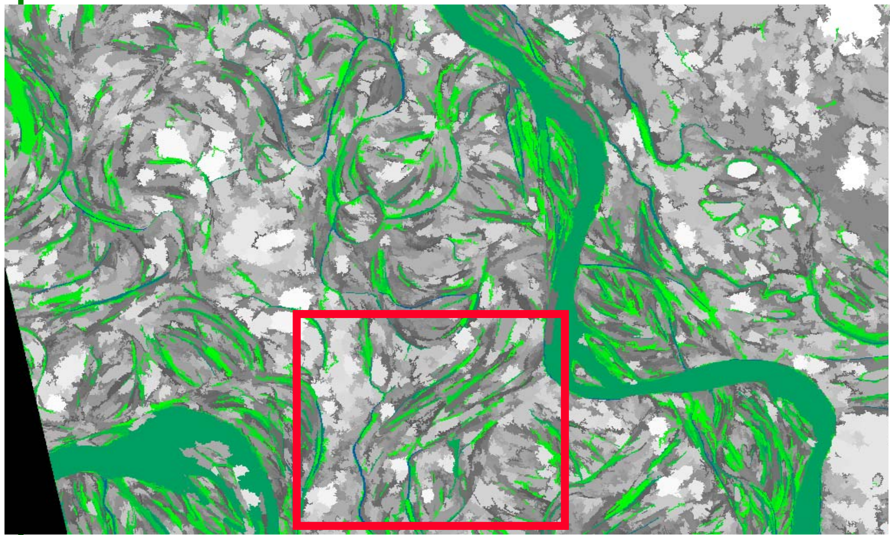


RGB = June HH, June HV, July HH

- Automatica
  - Segmentation
    - 80 [shape:0.7 compct.:0.8] creating 'Level 80-21211'
    - at Level 80-21211: spectral difference 80
  - Classfication
    - Tall&Woody - 0to3 Flooded
      - with HV-Jun-HV-Jul < 0 at Level 80-21211: HV-Jun<HV-Jul
      - with HV-Jun-HV-Jul >= 0 at Level 80-21211: HV-Jun>HV-Jul
      - HV-Jun<HV-Jul with Mean HV-Jun >= 1950 at Level 80-21211: HV-Jun<HV-Jul& Tall Woody
      - HV-Jun>HV-Jul with Mean HV-Jul >= 1950 at Level 80-21211: HV-Jun>HV-Jul& Tall Woody
      - G-Tall Woody at Level 80-21211: Flooded 0 date, Flooded 1 date, Flooded 2 date, Flooded 3 date
    - Water & Pasture
      - HV-Jun<HV-Jul, HV-Jun>HV-Jul, unclassified with MAX: Thematic Layer 1 <= 2763 at Level 80-212
      - Water & Pasture at Level 80-21211: Pasture, Water 3 date
    - Narrow Channels
      - at Level 80-21211: Narrow Channels
    - Short Woody & Macrophytes
      - HV-Jun<HV-Jul, HV-Jun>HV-Jul at Level 80-21211: Short Woody
      - HV-Jun<HV-Jul, HV-Jun>HV-Jul with Mean HV-Jun >= 1202 at Level 80-21211: macrophytes
      - HV-Jun<HV-Jul, HV-Jun>HV-Jul at Level 80-21211: Short Woody

Multiresolution Segmentation with weighted layers
HH – Jun = 2, HV – Jun = 1
HH – Jul = 2, HV – Jul = 1
HH – Oct = 1
Scale parameter = 80, Shape: 0.7, Compactness: 0.8





Density

The density an be expressed by the area covered by the image object divided by its radius. **Definiens Developer** uses the following imp r of pixels forming the image object and the radius is matrix.Use the density to describe the compactness compact form on a pixel raster is the square. The m e a square, the higher its density.

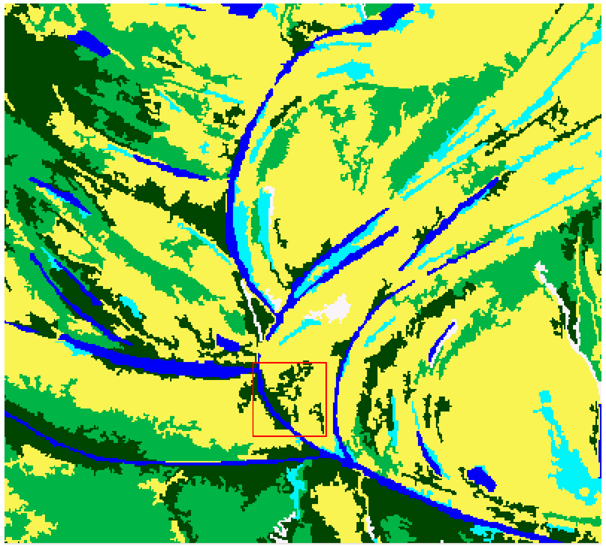
Expression:

$$\frac{\sqrt{\#P_v}}{1+\sqrt{VarX+VarY}}$$

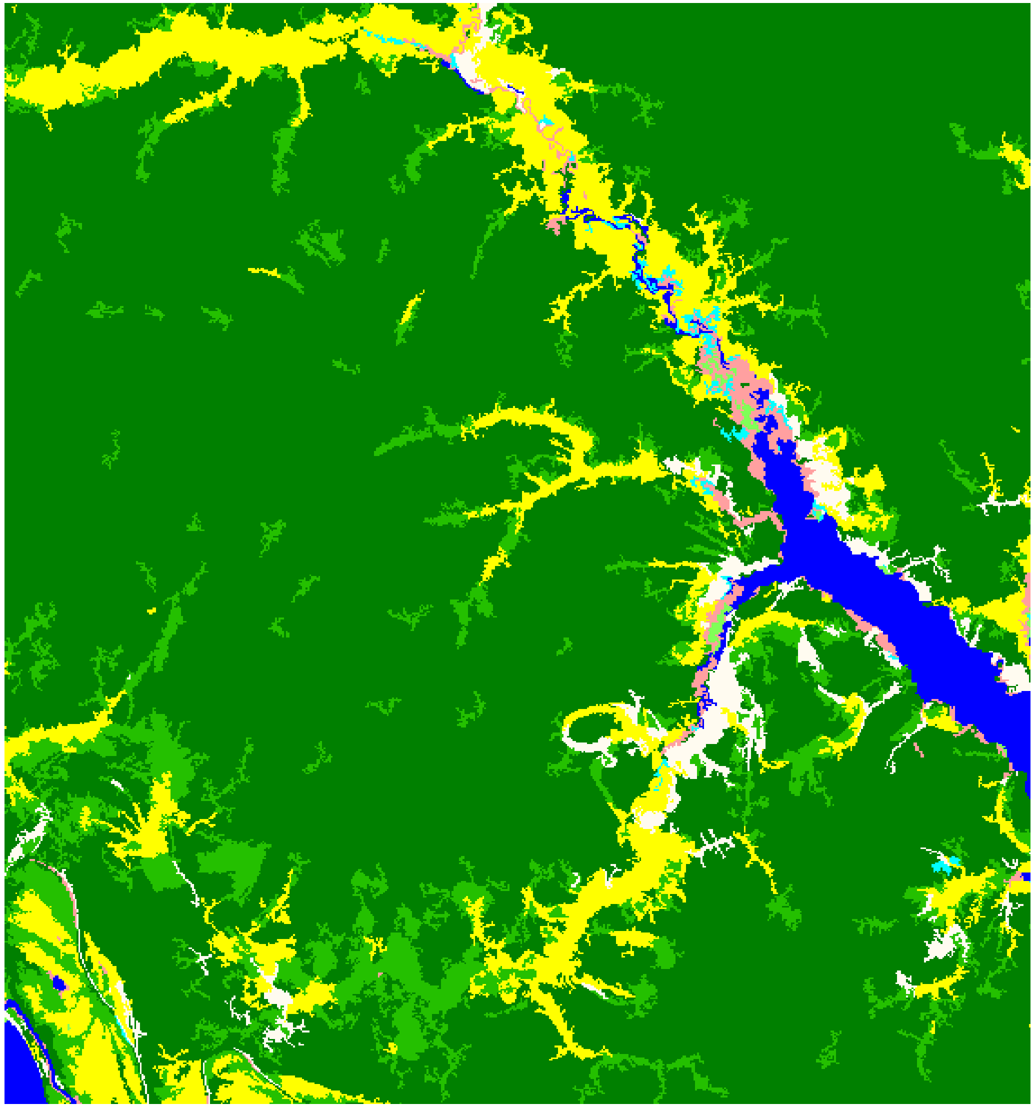
Parameters:

$\sqrt{\#P_v}$: diameter of a square object with $\#P_v$ pixels.

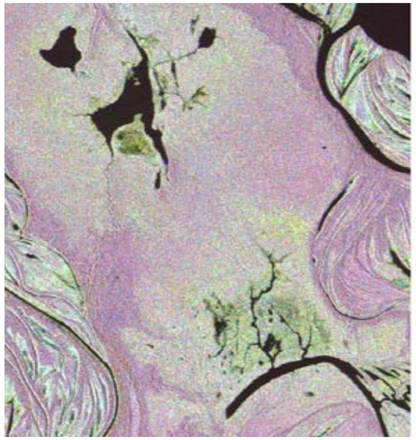
$\sqrt{VarX+VarY}$: diameter of the ellipse

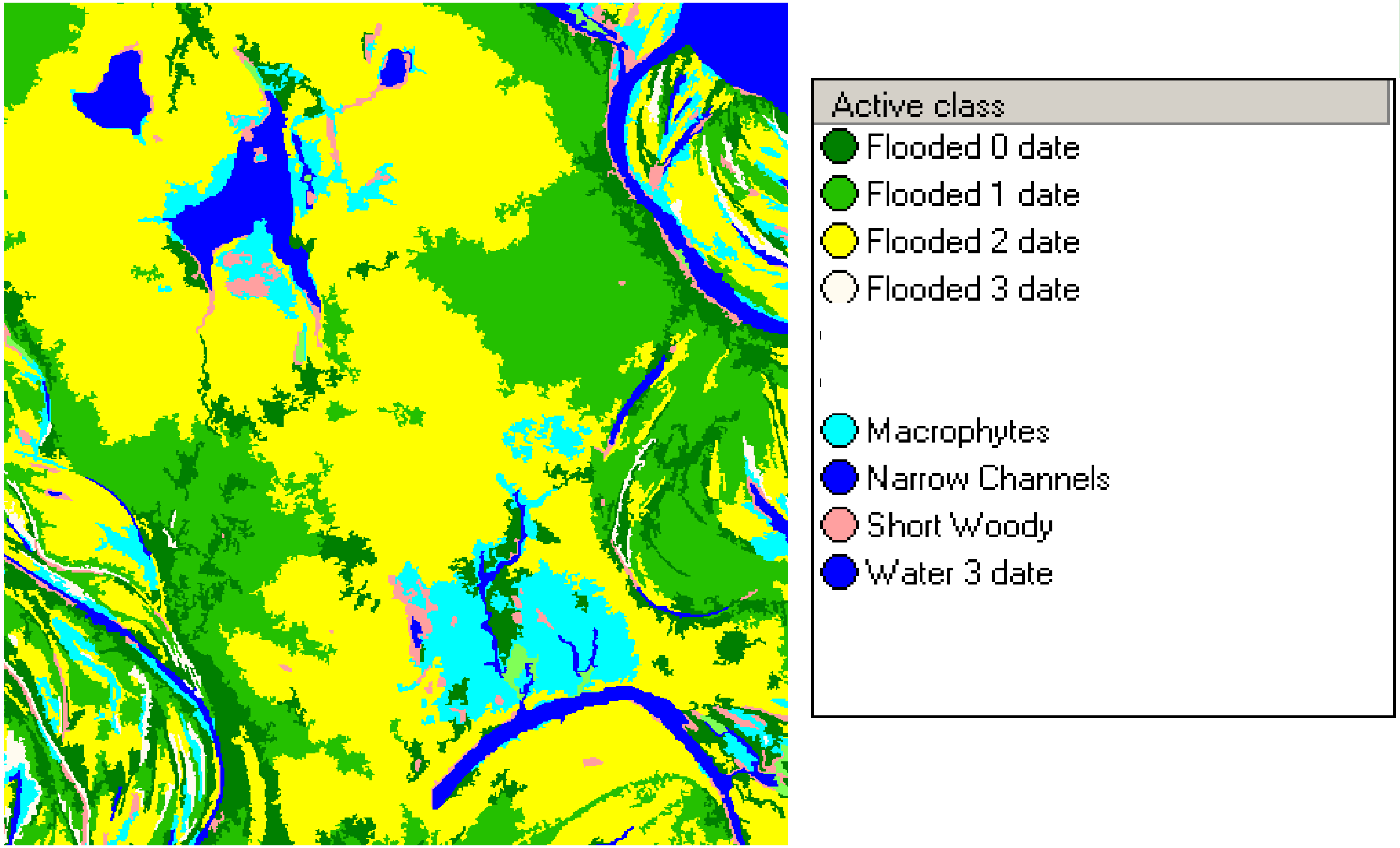


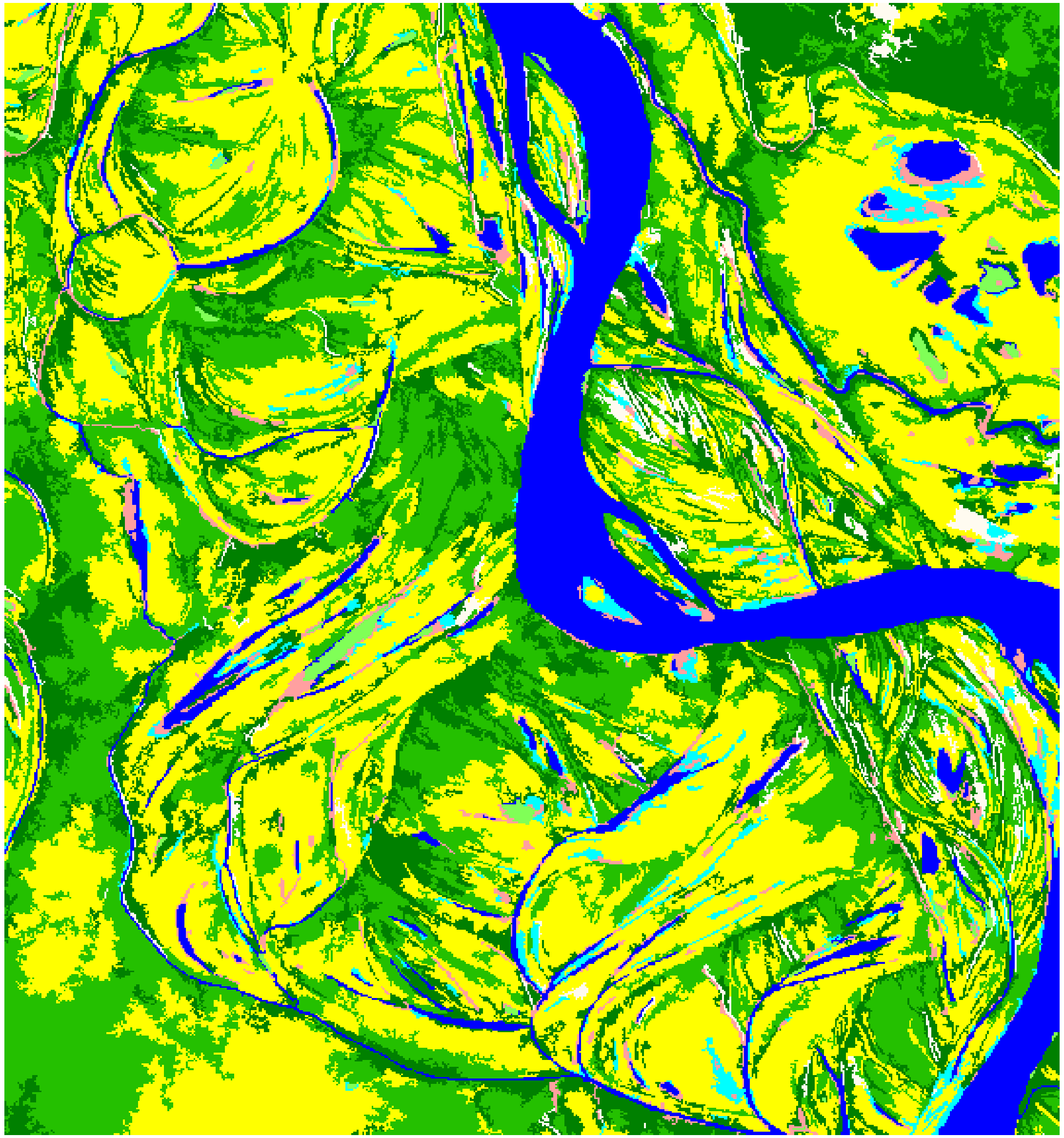
Narrow Channels defined by:
Density < 1.05
Mean HV-Jun < 1400



Active class
- Flooded 0 date
- Flooded 1 date
- Flooded 2 date
- Flooded 3 date
- Macrophytes
- Narrow Channels
- Short Woody
- Water 3 date




Active class
Flooded 0 date
Flooded 1 date
Flooded 2 date
Flooded 3 date
Macrophytes
Narrow Channels
Short Woody
Water 3 date

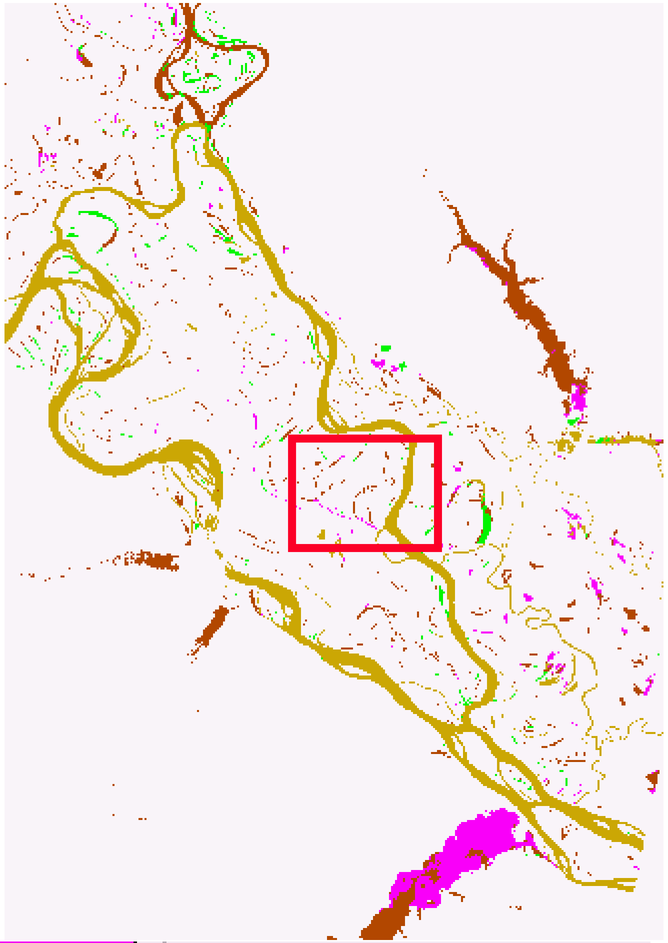


Active class

- Flooded 0 date
- Flooded 1 date
- Flooded 2 date
- Flooded 3 date
- Macrophytes
- Narrow Channels
- Short Woody
- Water 3 date

Classification of water types from Landsat TM

Adriana Affonso, INPE



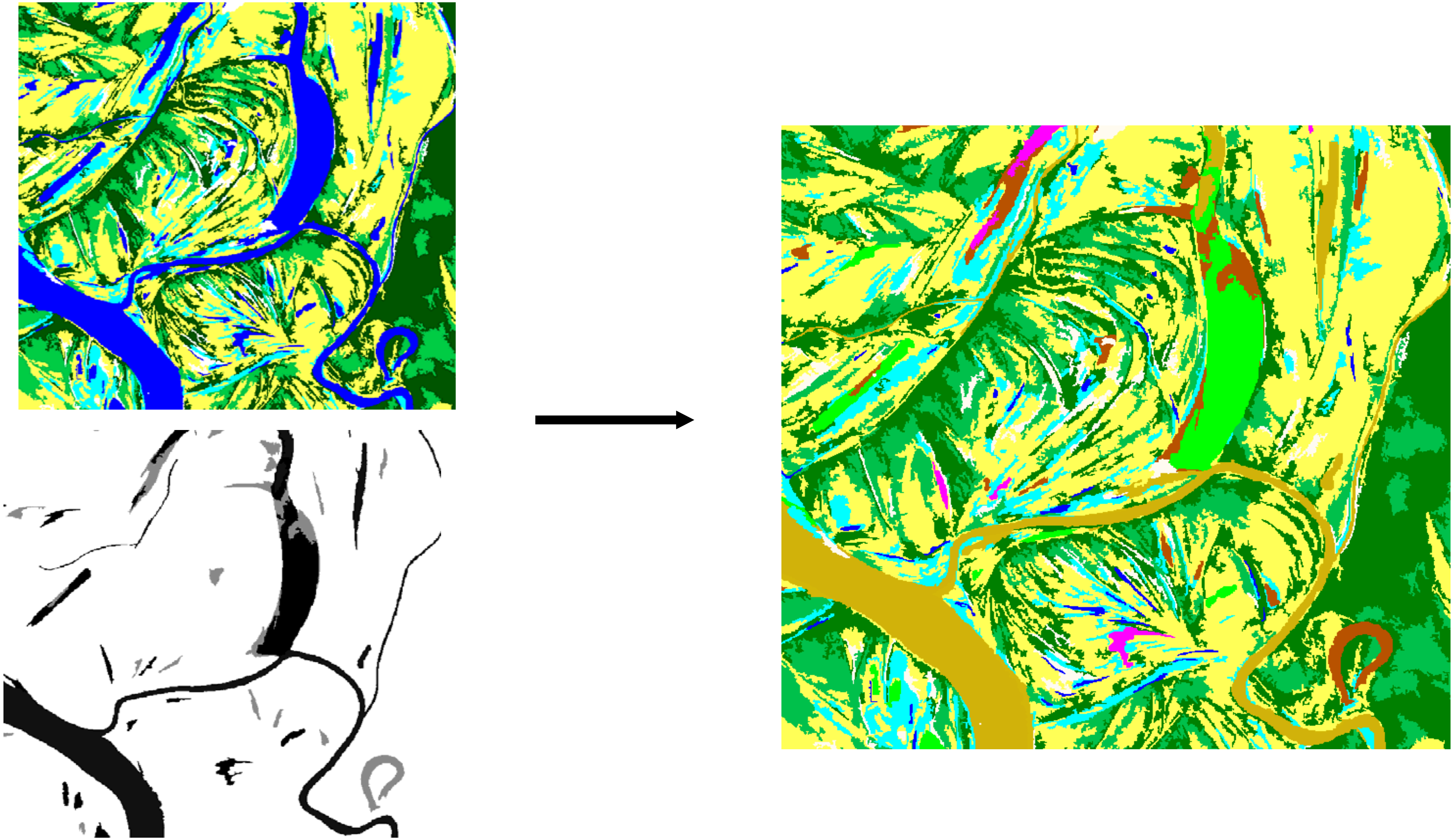
- branca-preta
- ricas-clorofila
- optpreta-quimbranca
- branca

Process Tree

- 1000 [shape:0.1 compct.:0.5] creating 'New Level'
- water at New Level: branca, branca-preta, optpreta-quimbranca, ricas-clorofila
- water at New Level: 40 [shape:0.1 compct.:0.5] creating 'Level wc'
- with Object ID: classif = 13 at New Level: water
- with Object ID: classif = 11 at New Level: water
- with Existence of super objects water (1) = 1 at Level wc: water
- water at Level wc: branca, branca-preta, optpreta-quimbranca, ricas-clorofila
- Border Water
  - water with Border to branca > 0 m at Level wc: border branca
  - water with Border to branca-preta > 0 m at Level wc: border branca-preta
  - water with Border to optpreta-quimbranca > 0 m at Level wc: Border optpreta-quimbranca
  - water with Border to ricas-clorofila > 0 m at Level wc: Border ricas-clorofila
- Classification
  - with Object ID: classif = 1 at Level wc: Woody Flooded 0 date
  - with Object ID: classif = 2 at Level wc: G-Tall Woody
  - with Object ID: classif = 7 at Level wc: Woody Flooded 1 date
  - with Object ID: classif = 8 at Level wc: Woody Flooded 2 date
  - with Object ID: classif = 9 at Level wc: Woody Flooded 3 date
  - with Object ID: classif = 12 at Level wc: Human disturbance
  - with Object ID: classif = 14 at Level wc: Short Woody
  - with Object ID: classif = 16 at Level wc: Macrophytes
  - with Object ID: classif = 18 at Level wc: Short Woody Flooded 2 date
  - with Object ID: classif = 19 at Level wc: Short Woody Flooded 3 date

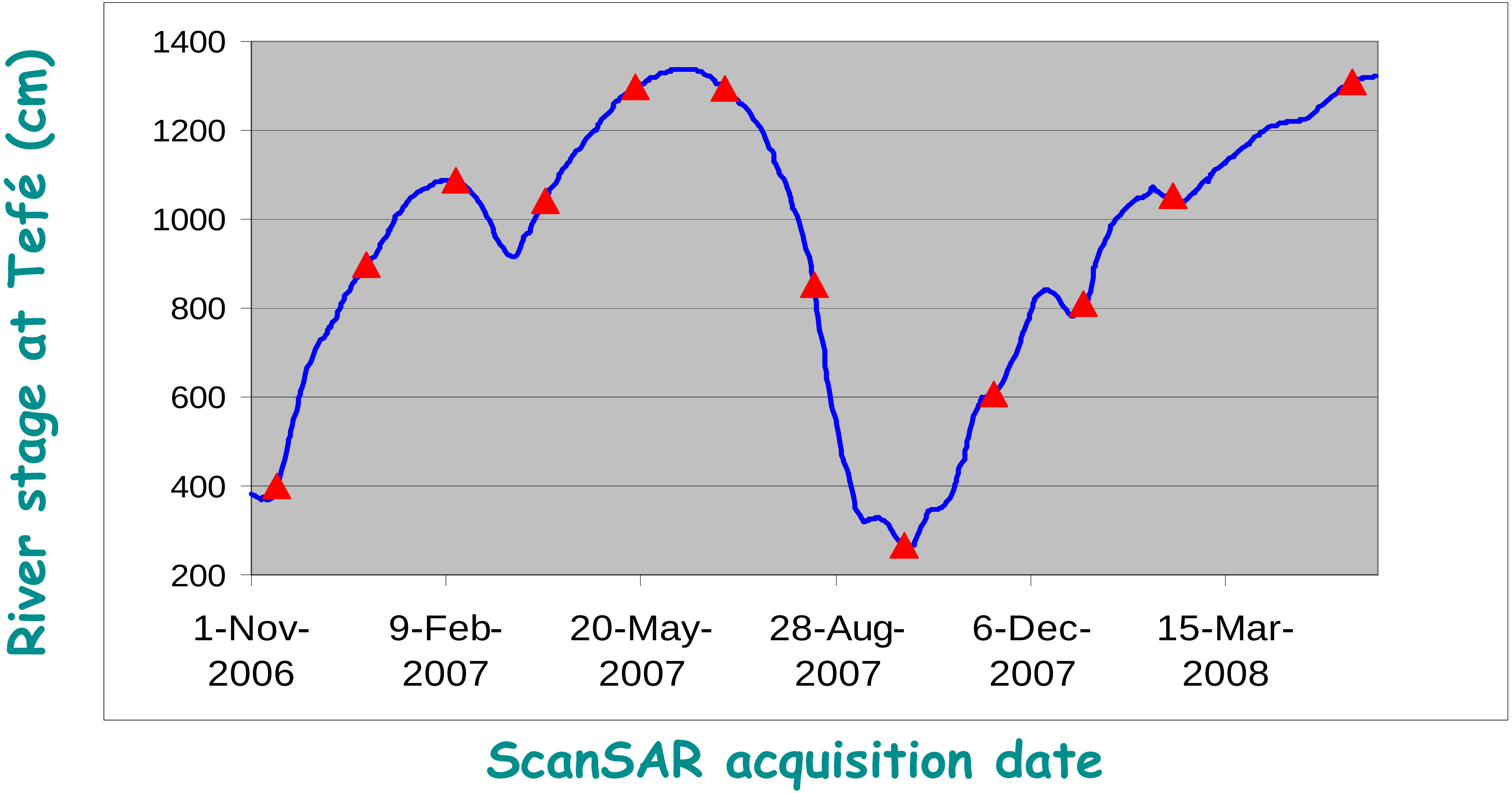
Merging SAR & Optical in Definiens

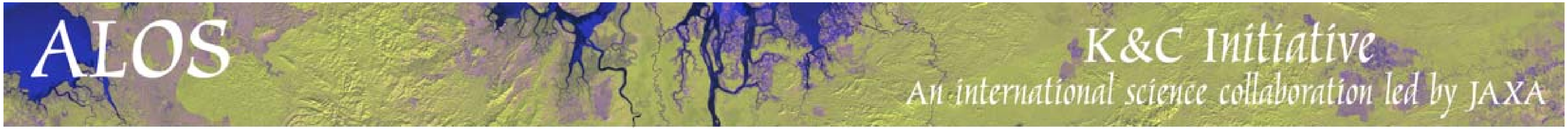
(for SAR-mapped permanent open water only)



	Class_Name	
	unclassified	Outside image boundary
	branca-preta	Water on 3 dates, classified or adjacent on TM: branca-preta
	water	Water on 3 dates, not classified on TM and not adjacent to classified
	ricas-clorofila	Water on 3 dates, classified or adjacent on TM: ricas-clorofila
	optpreta-quimbranca	Water on 3 dates,classified or adjacent on TM: optpreta-quimbranca
	branca	Water on 3 dates, classified or adjacent on TM: branca
	Woody Flooded 0 date	Woody not flooded: terra firme and highest restinga forest
	Woody Flooded 1 date	Woody flooded 2007-06-14: high-level várzea and igapó forest
	Woody Flooded 2 date	Woody flooded 2007-06-14, 2007-07-30: mid-level várzea and igapó forest
	Woody Flooded 3 date	Woody flooded 2007-06-14, 2007-07-30, 2007-10-30: low-level várzea and igapó forest
	Macrophytes	Seasonal or semi-permanent aquatic macrophytes*
	Short Woody Flooded 2 date	Short woody flooded 2007-06-14, 2007-07-30: mid-level várzea and igapó forest and shrub
	Short Woody Flooded 3 date	Short woody flooded 2007-06-14, 2007-07-30, 2007-10-30: mid-level várzea and igapó shrub
		*includes open woodland (open tree with macrophyte understory)

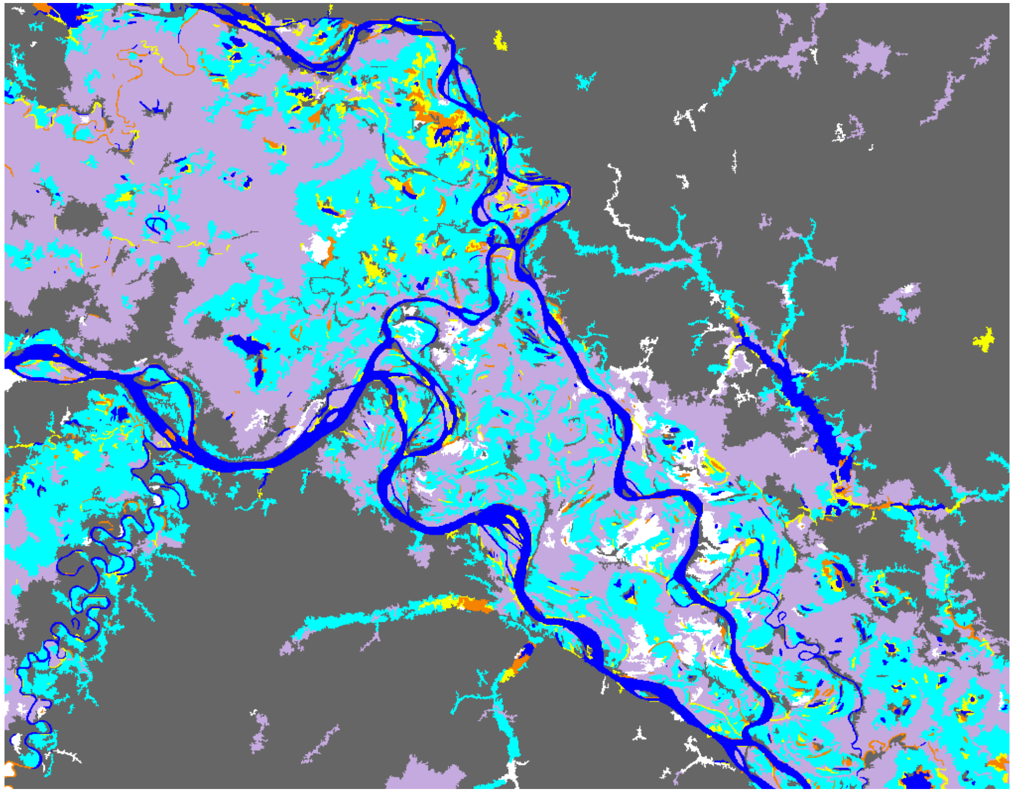
ALOS ScanSAR acquisition dates relative to Amazon River stage at Tefé



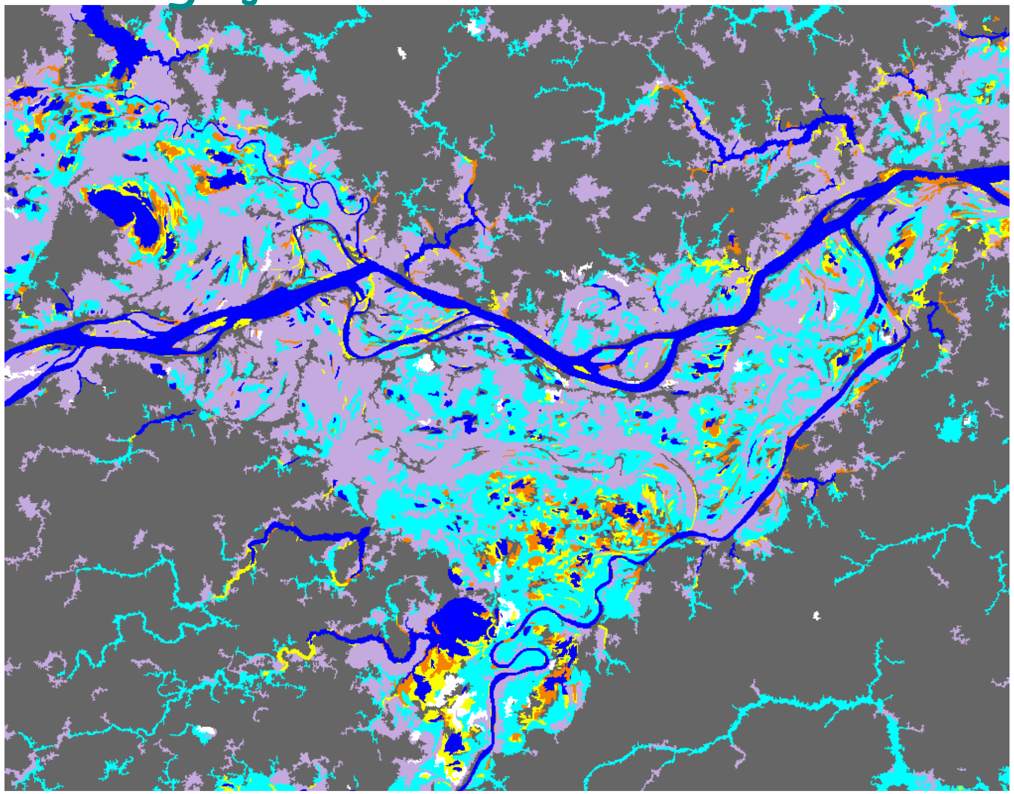


Classified ScanSAR (5 dates)

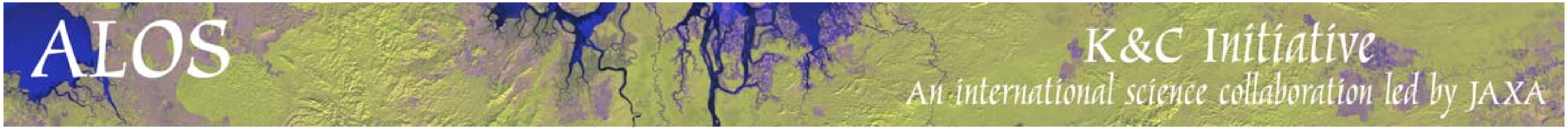
Mamirauá

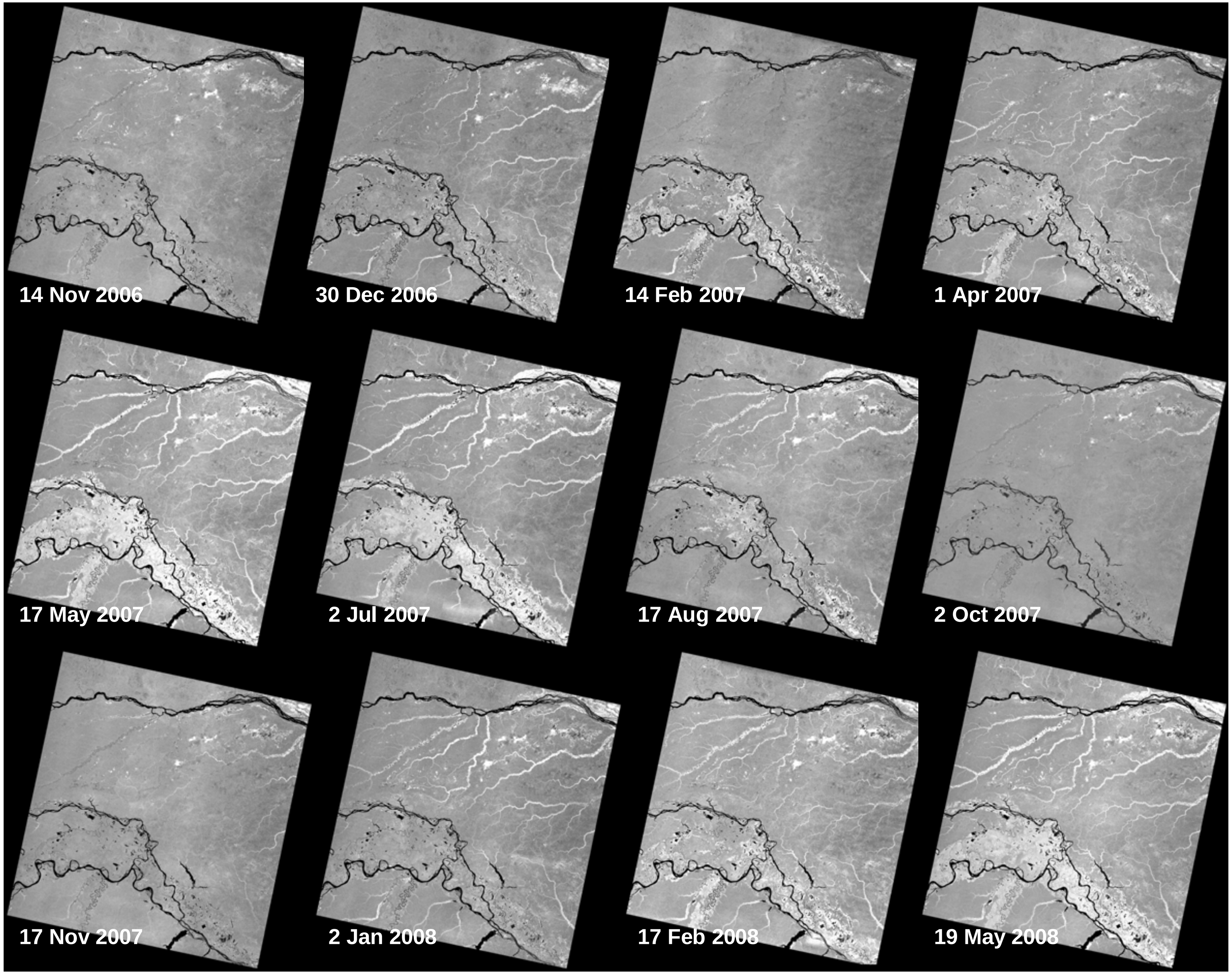


Piagaçu-Purus



- Open water
- Aquatic macrophyte
- Shrub
- Non-wetland
- Forest, flooded 1-2 m/a
- Forest, flooded 3-6 m/a
- Forest, flooded > 6 m/a

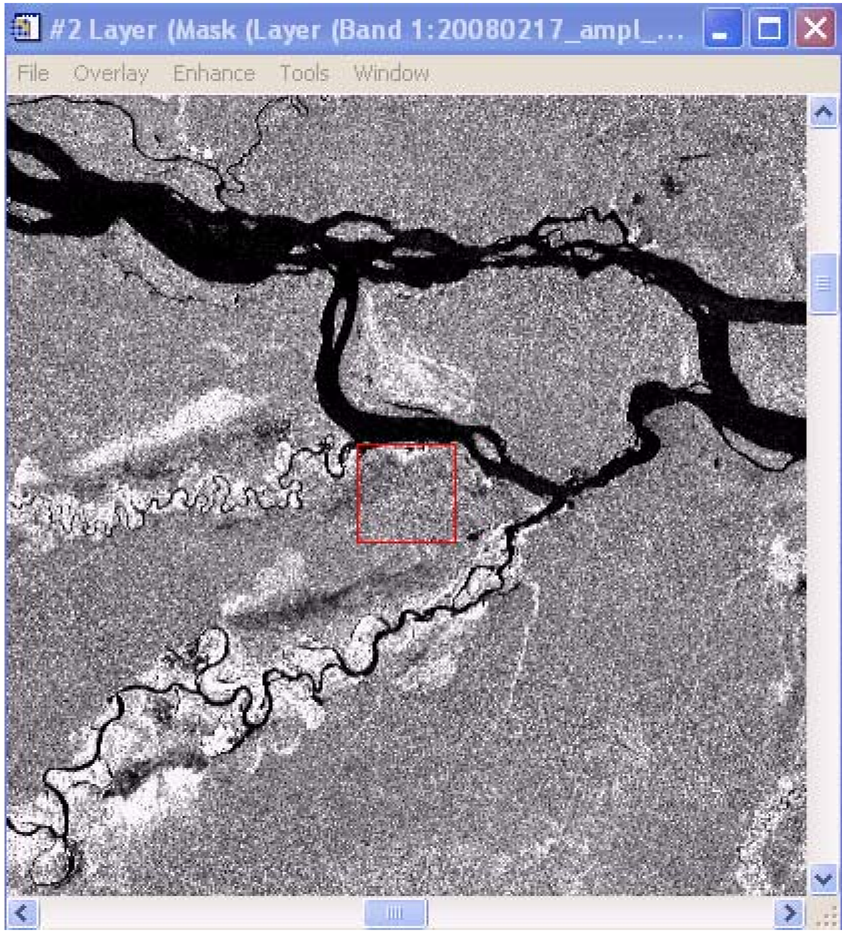




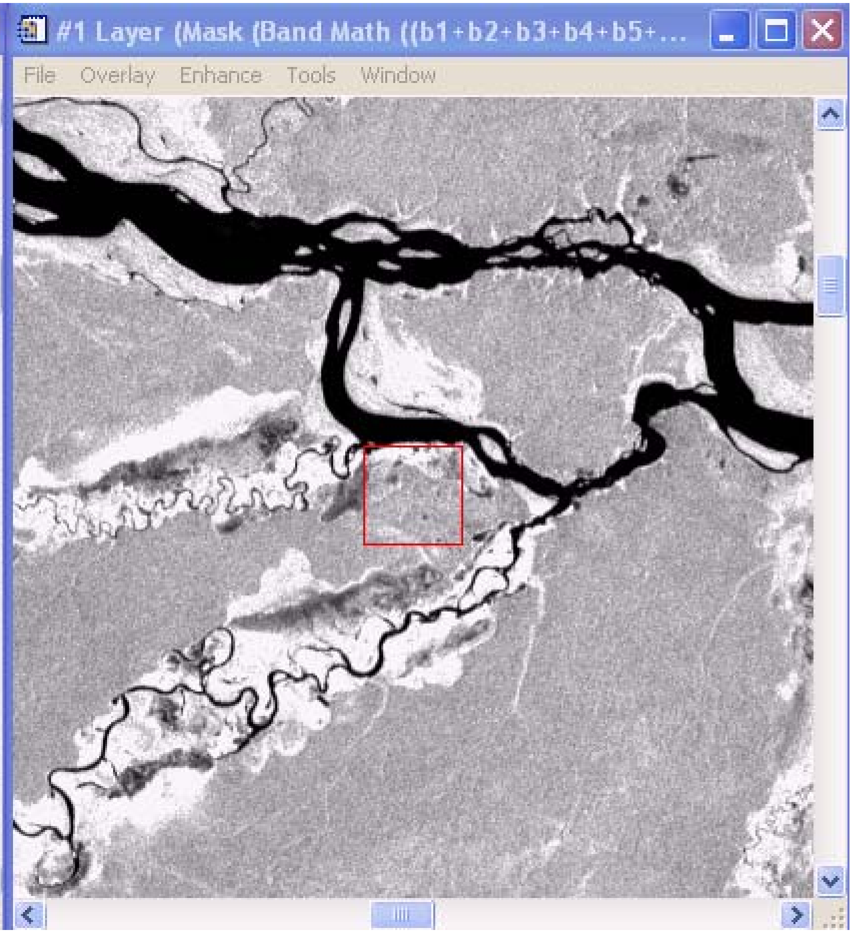
ScanSAR Time Series

Amazon, Japurá, and Negro Rivers

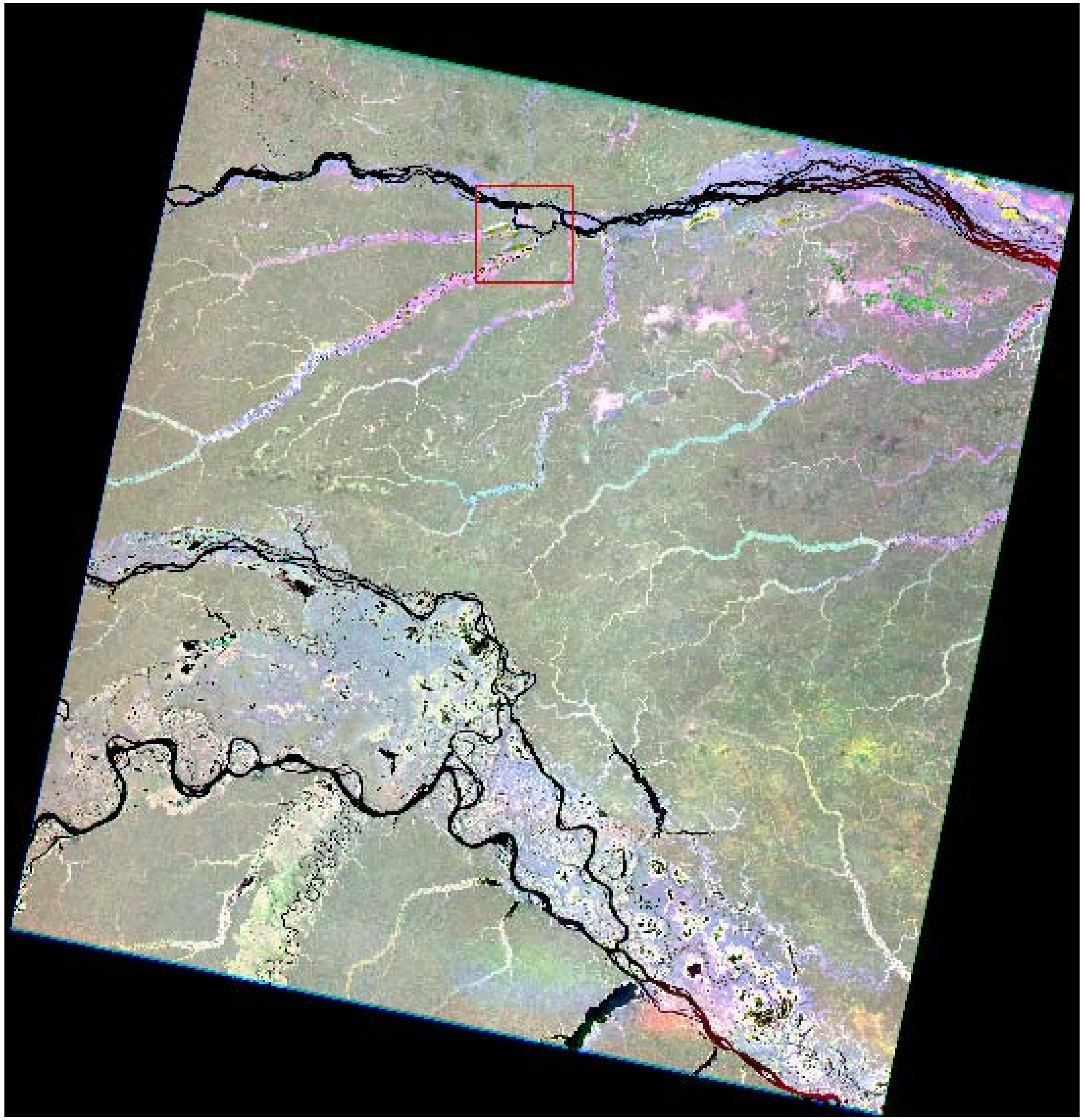
ScanSAR Pre-processing: multi-temporal filtering



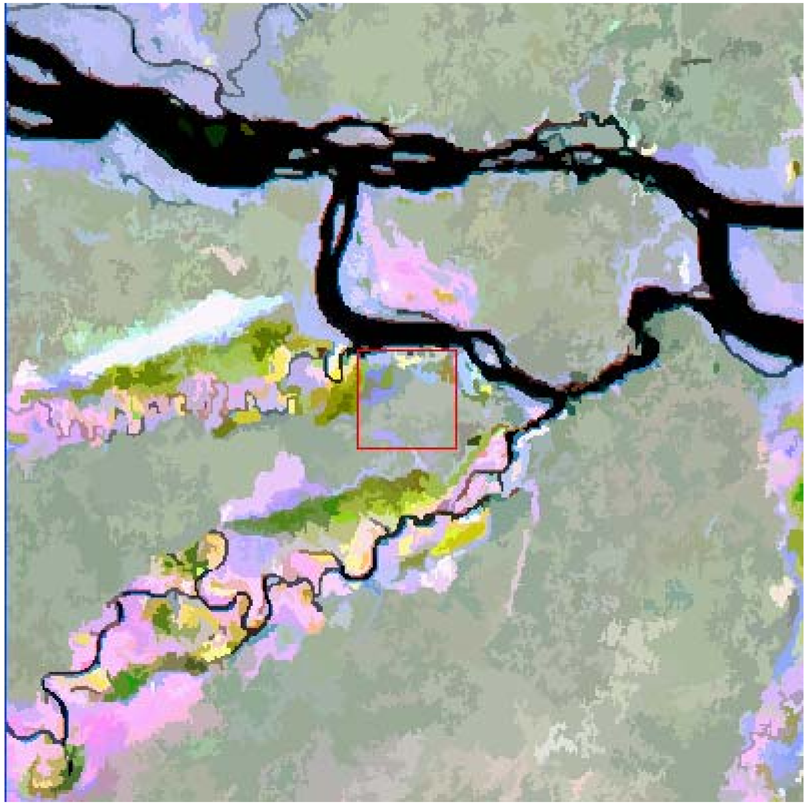
ScanSAR sub-scene, 17 Feb 2008



Multi-temporal mean amplitude (9 dates)



Segmented ScanSAR:
3-date polygon means



Validation: Aerial Overflights

- overflight with hi-res geocoded dual-camera and laser system was postponed until 2009 (June and October flights planned)

- reconnaissance survey was flown in late November 2008

ALOS

K&C Initiative
An international science collaboration led by JAXA

Validation: 1999 dataset (high water only)

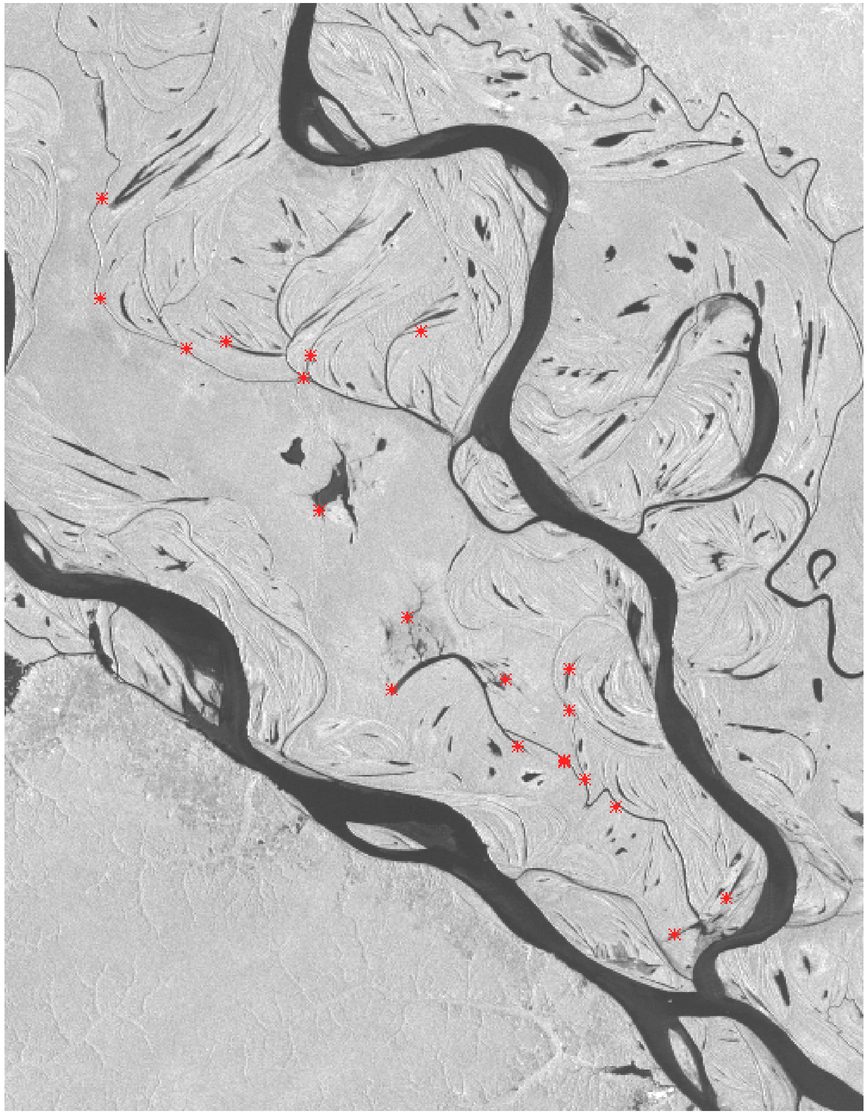
Validation: Thermochron iButtons

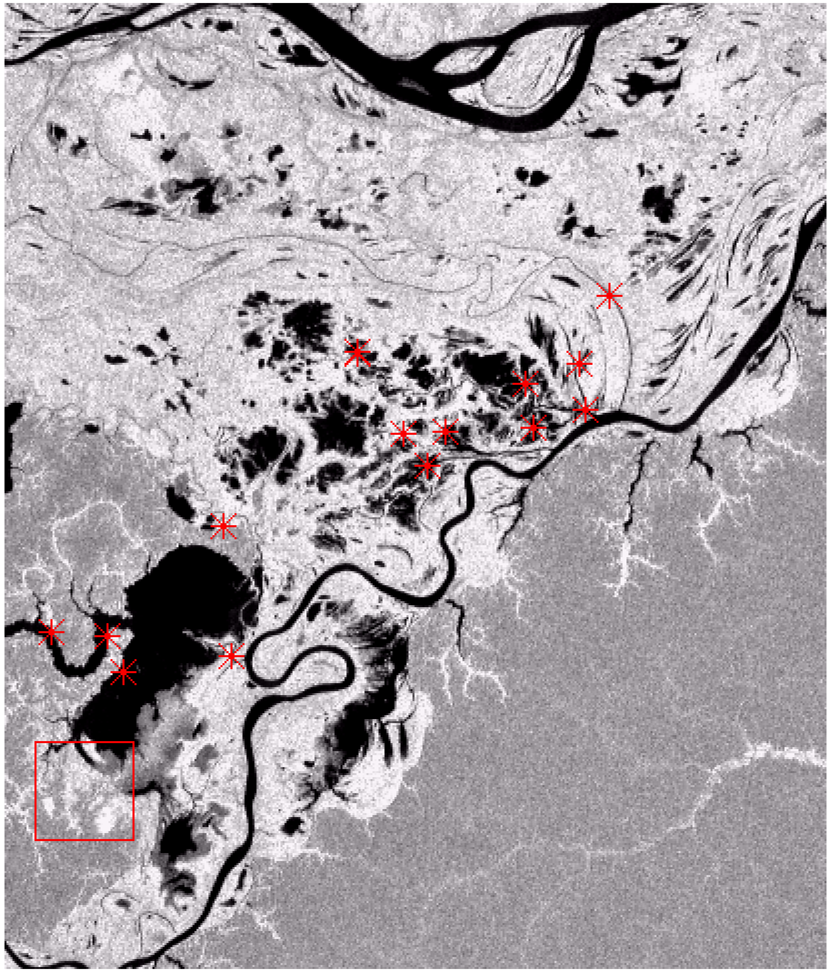
- deployed at Mamirauá in Nov 2009
- temperature readings every 6 hours
- testing suitability for low-cost floodplain gauging

ALOS K&C Initiative

An international science collaboration led by JAXA

Validation: Thermochron iButtons

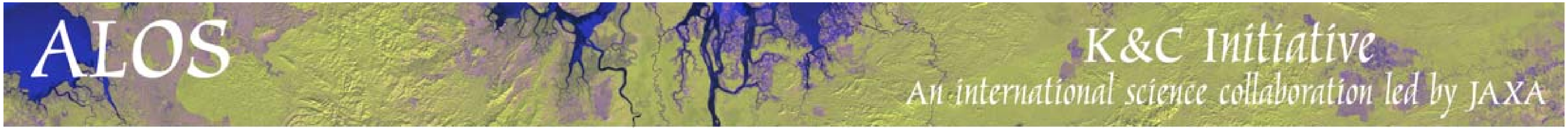




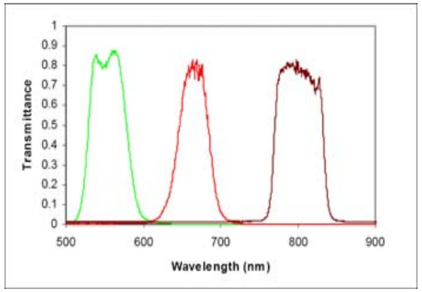
CAMELIA: Câmera Multispectral e Laser para Inventário Aéreo

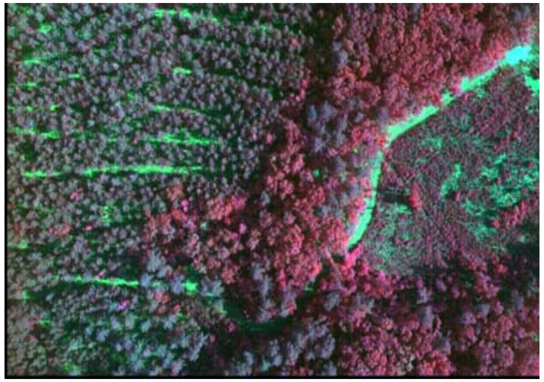
(designed by Dana Slaymaker)

- Primary mission: support validation of PRODES, DETER
- Will allow rigorous validation of KC products for central Amazon
- Flight on INPE Bandeirante Oct 2009 (low-water)
- Integrated dual cameras and profiling laser
    - Geospatial MS-4100 multispectral camera with bands matched to Landsat TM bands 2, 3, 4
    - Canon Mark III DS1 natural color camera
    - Laser Atlanta pulse laser (904 nm)
- Generates orthorectified image and DEM model from mosaicked TIFs (no videography)



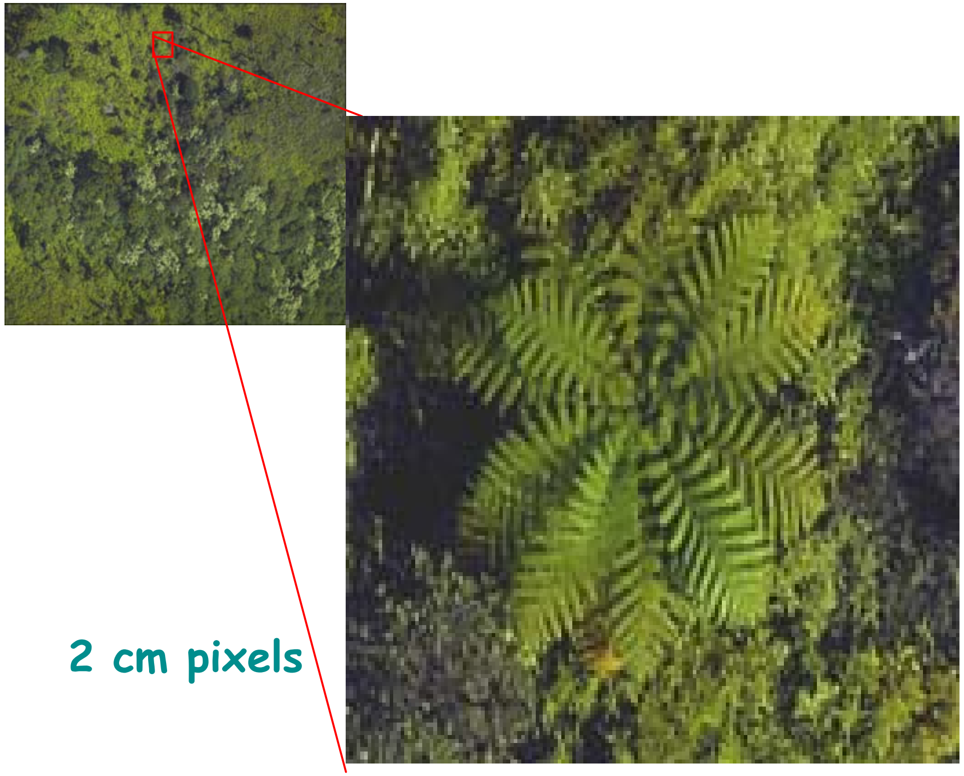
CAMELIA: Câmera Multispectral e Laser para Inventário Aéreo





RGB = NIR, R, G

50 cm pixels



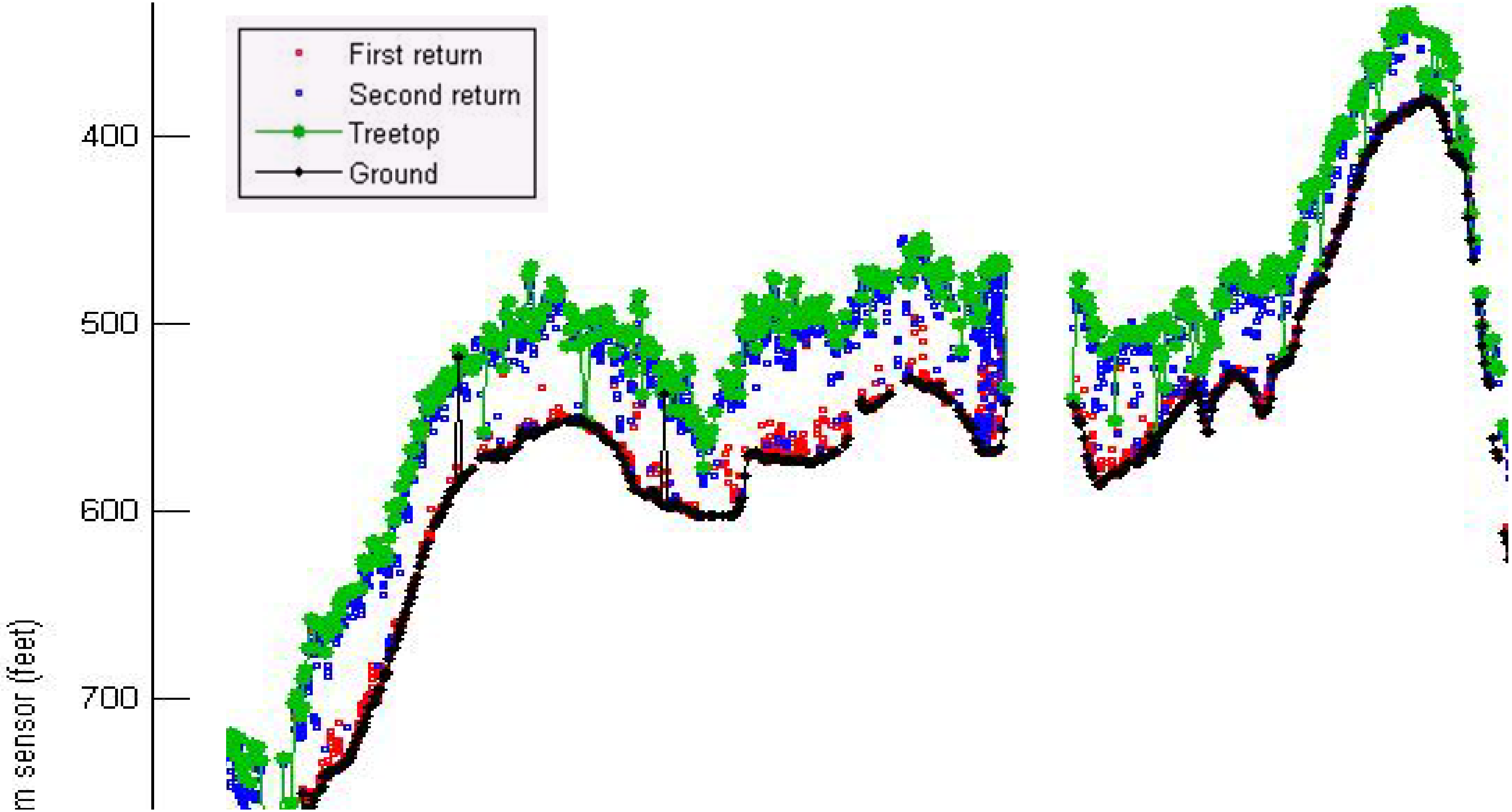
2 cm pixels

Canon natural color camera permits very high-resolution coverage even under low-light conditions.

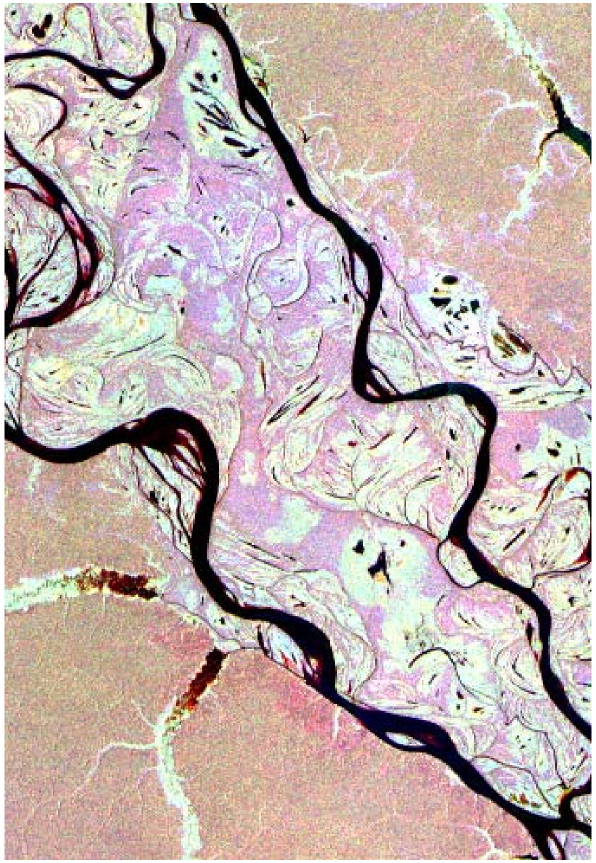
MS-4100 multispectral camera

Canon Mark III DS1 camera

CAMELIA: Câmera Multispectral e Laser para Inventário Aéreo



Next Steps



-Continue to add to ScanSAR training set and multi-temporal backscattering database

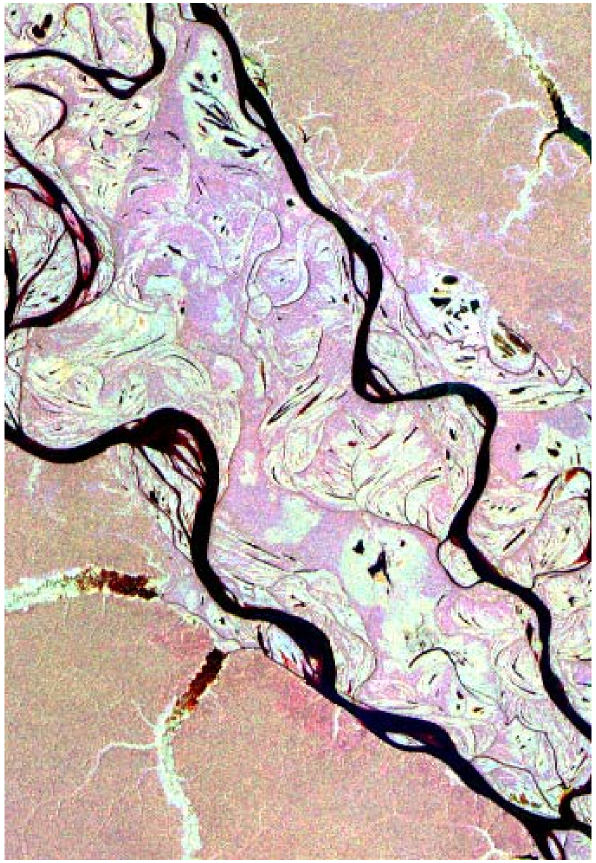
-Use SRTM-derived features for better screening of non-wetlands (HAND: Height Above Nearest Drainage; Renno et al. 2008)

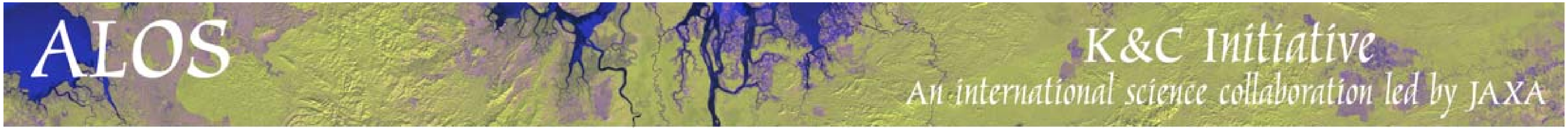
- Additional optical fusion for poorly characterized cover types (sand bars; short shrub vs. macrophyte)

- Robust validation

- Mosaic-based analysis

- Incorporate Topex-Poseidon altimetry (F. Seyler, IRD)





Agradecimentos!

Instituto Mamirauá
Instuto Piagaçu