Amazon Wetlands Applications of JERS-1 SAR and ALOS PALSAR Datasets

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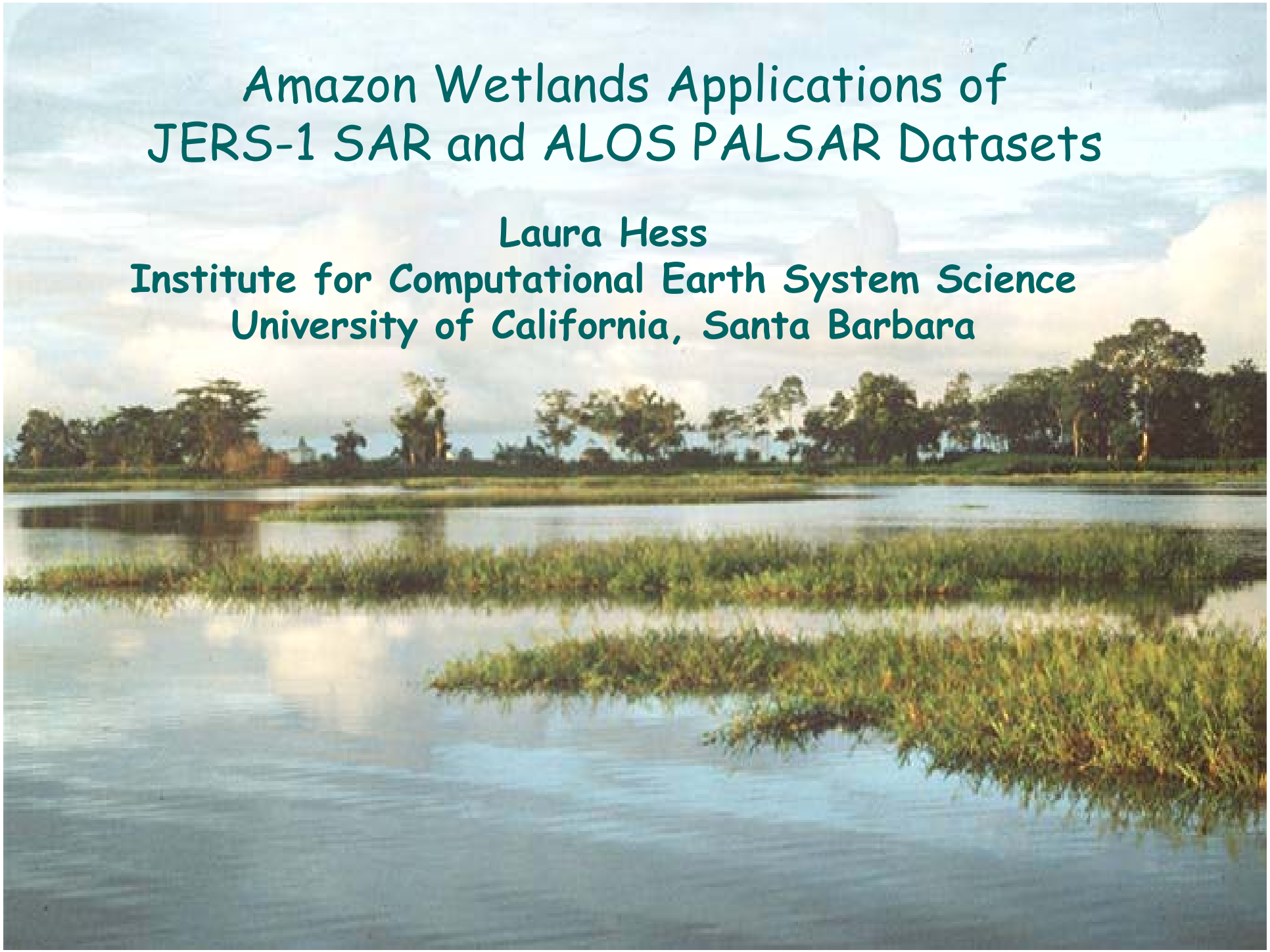
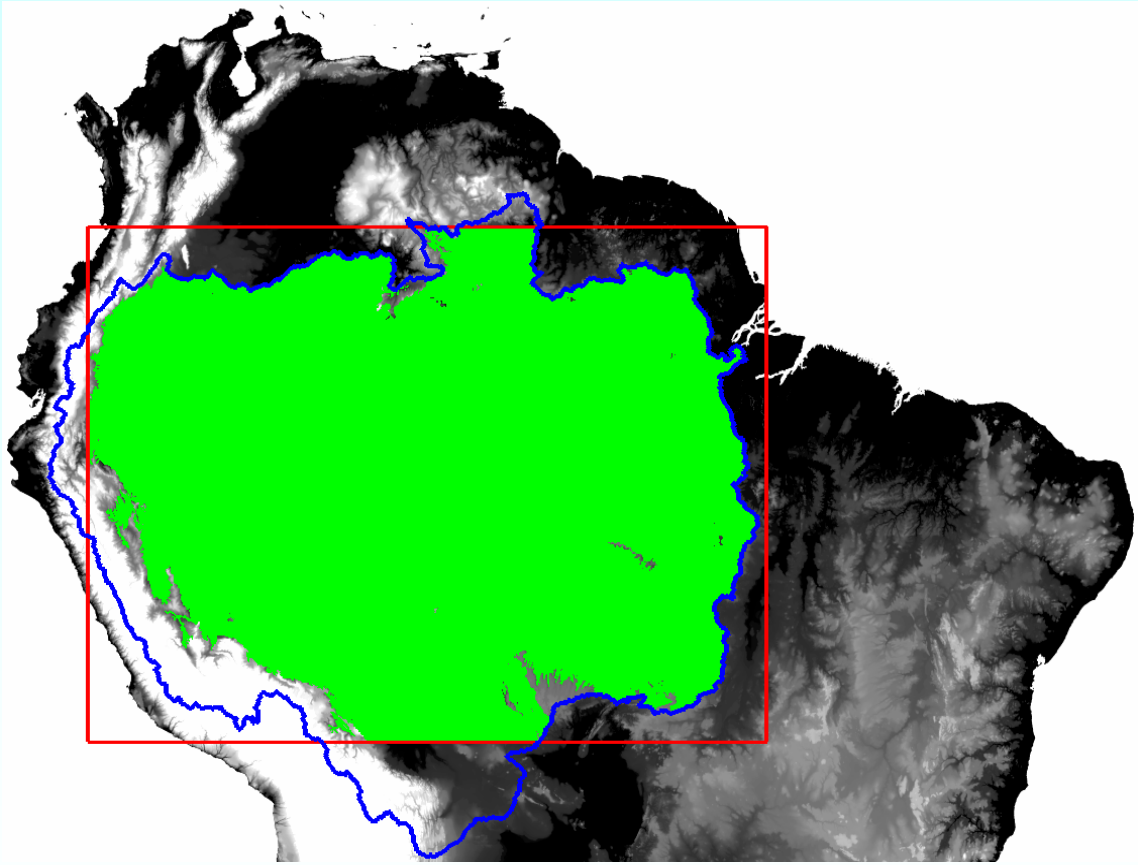


The Large-Scale Biosphere-Atmosphere Experiment in Amazonia (LBA-ECO)

"Linking remote sensing of variations in inundation and aquatic vegetation with regional analyses of carbon dynamics in Amazon wetlands"
(J. Melack and E. Novo, PIs)

- Multi-scale analyses of inundation and aquatic vegetation dynamics using microwave and optical satellite imagery
- Field measurements of CH_4 and CO_2 emissions and aquatic macrophyte biomass (B. Forsberg, INPA; M. Costa & T. Silva, Univ. of Victoria)
- Combine remote sensing-based mapping with field measurements to calculate regional fluxes
- Develop model of methane emission driven by remotely sensed data (collaboration with C. Potter, based on NASA-CASA model)
- Optical and biogeochemical properties of lake and river waters (E. Novo, M. Costa, C. Barbosa)

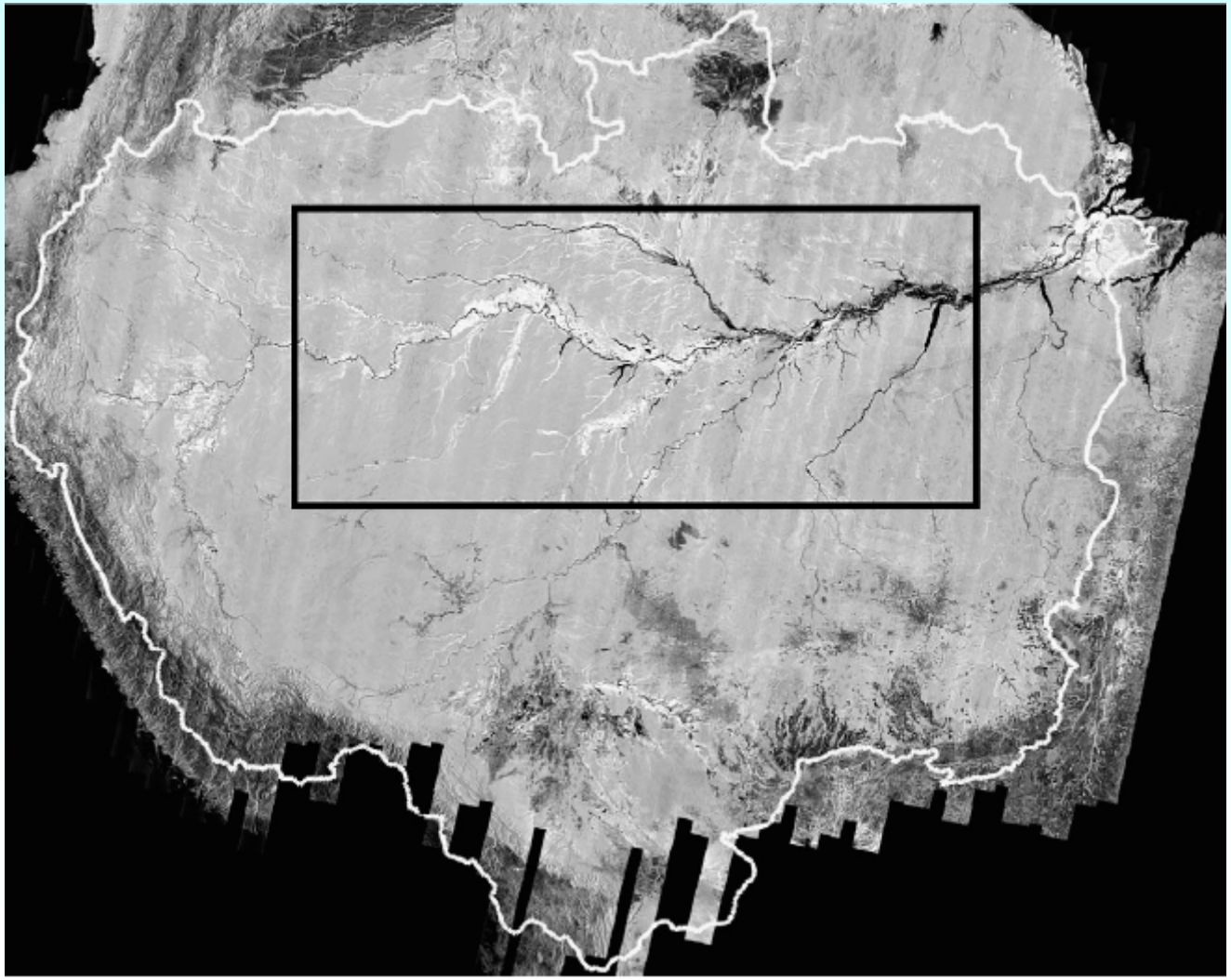
LBA Wetlands Study Area



Study area: 4.95 x 10^6 km^2

Amazon Watershed (HydroSHEDS, Lehner et al. 2006): 5.91 x 10^6 km^2

Global Rainforest Mapping Project
Amazon Mosaic (High Water)



Classification system

Vegetation Structure

- woodiness
- height
- stem density / canopy cover

+

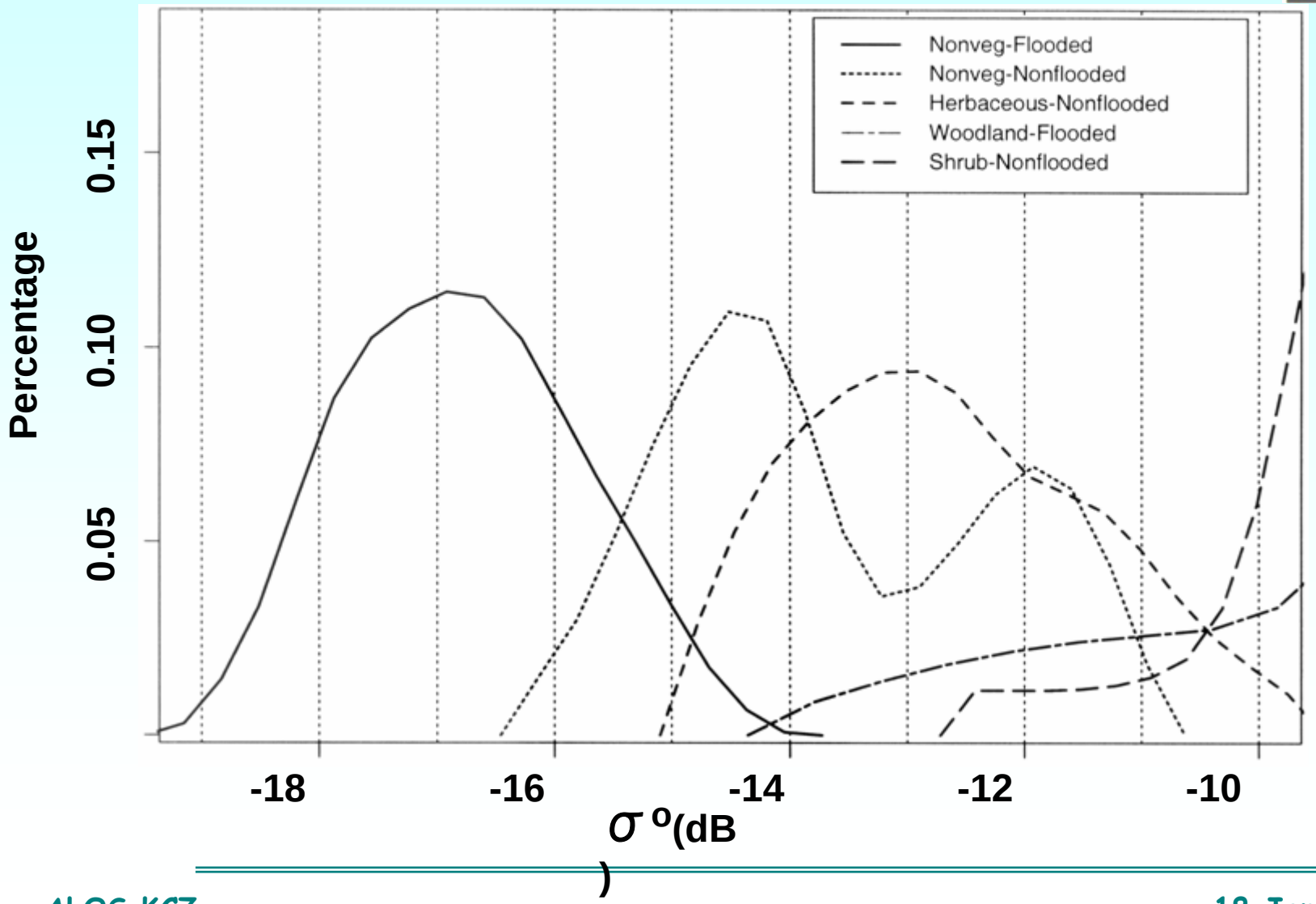
Hydrology

- inundation depth and duration
- seasonal variability
- interannual variability

10 "Cover States"

- Nonvegetated, nonflooded
- Nonvegetated, flooded
- Herbaceous, nonflooded
- Herbaceous, flooded
- Forest, nonflooded
- Forest, flooded
- Woodland, nonflooded
- Woodland, flooded
- Shrub, nonflooded
- Shrub, flooded

Backscattering signatures of wetland classes (probability density functions for training data)



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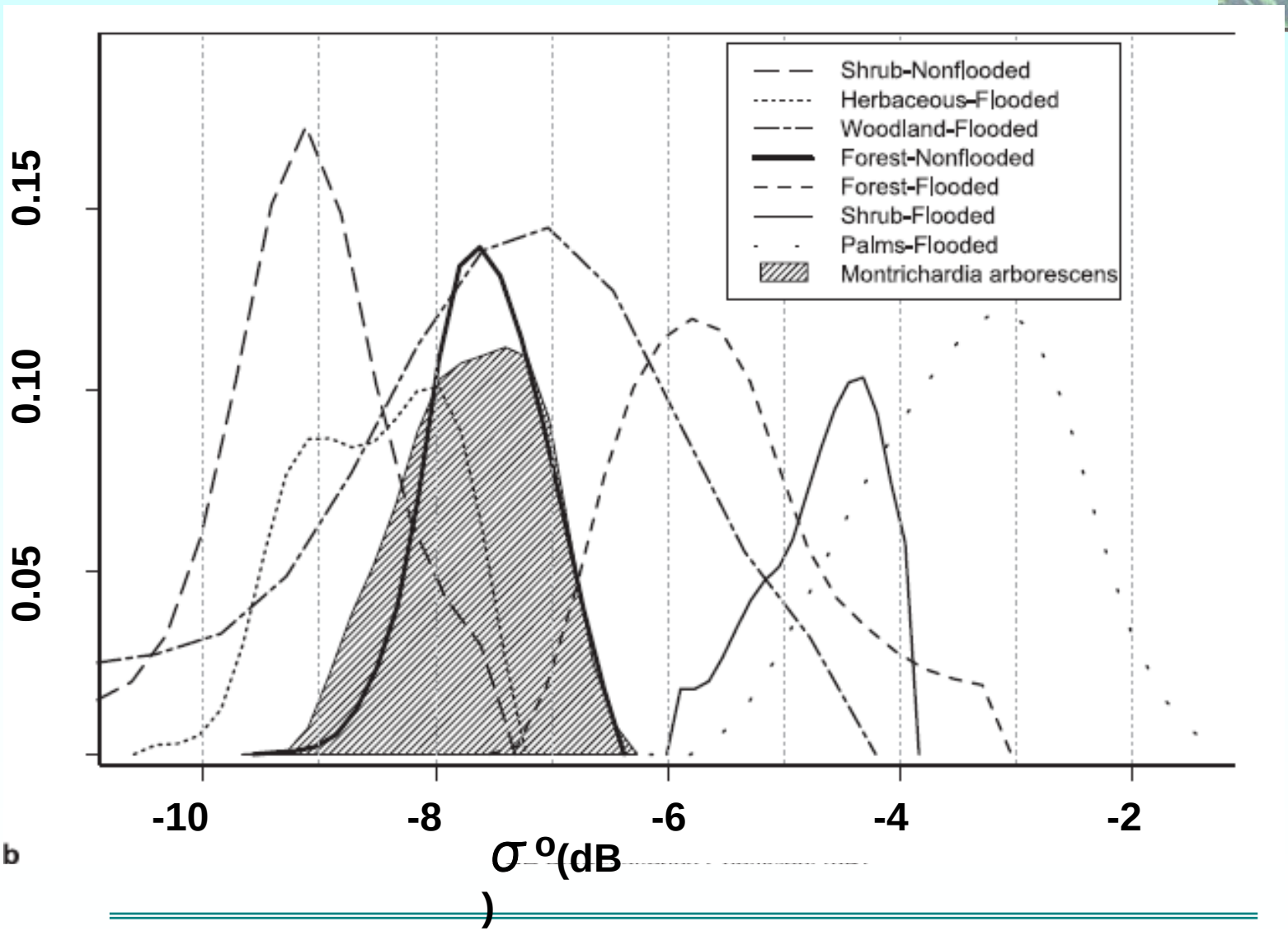
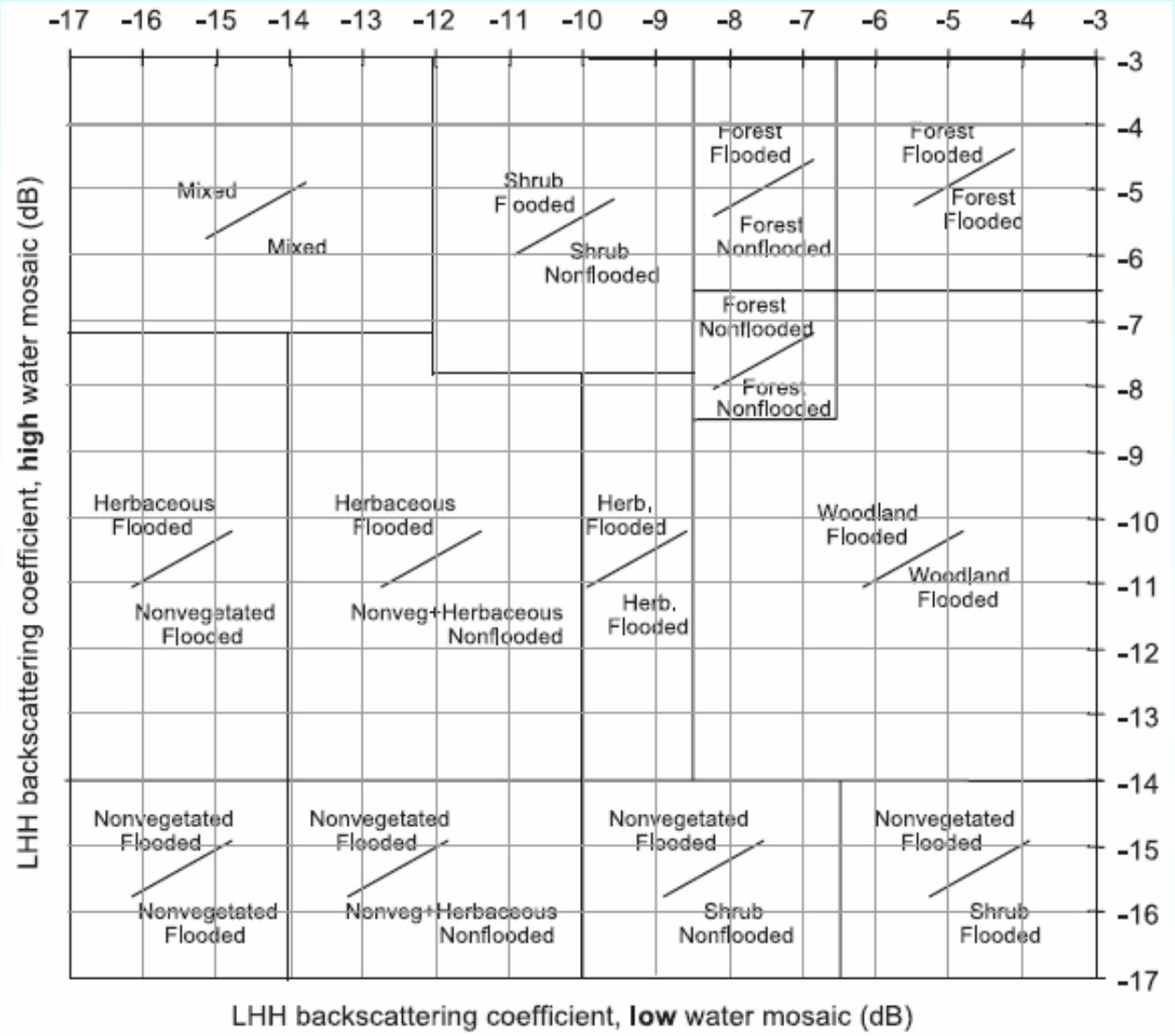


Classification Approach

1. Object-oriented (polygon-based): Mask out the non-wetland portion of the study area by semi-automated image segmentation and classification (INPE's SPRING software)

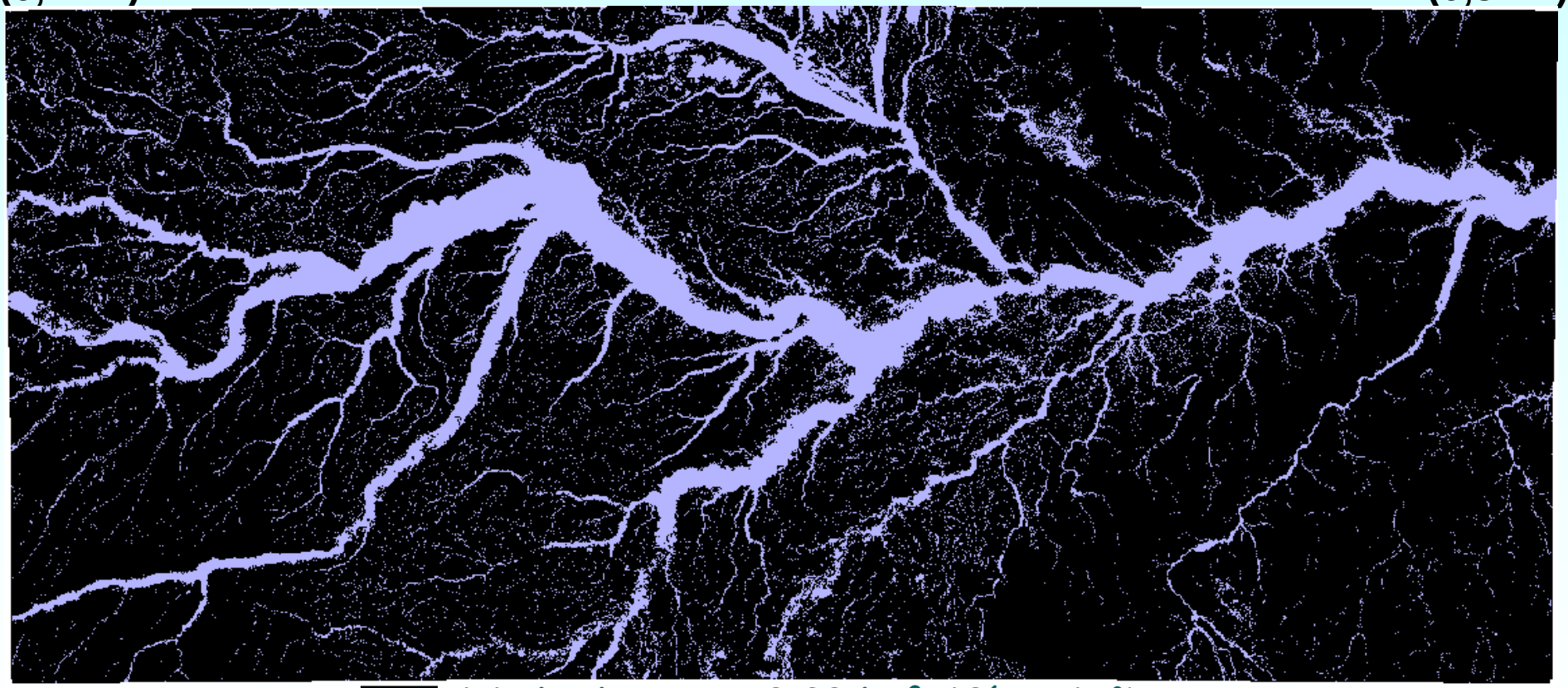
2. Pixel-based: For wetlands only, apply a rules-based classifier based on two-season backscattering signatures of individual pixels

Dual-season cover type classifier



Central Amazon Wetlands Mask (100 m)

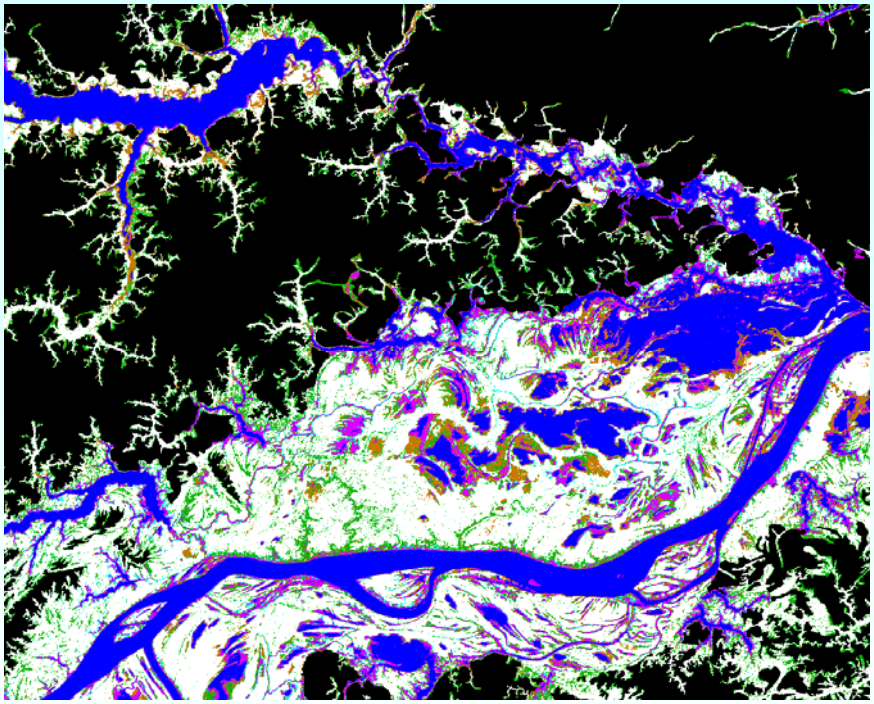
(0,72W) (0,54W)

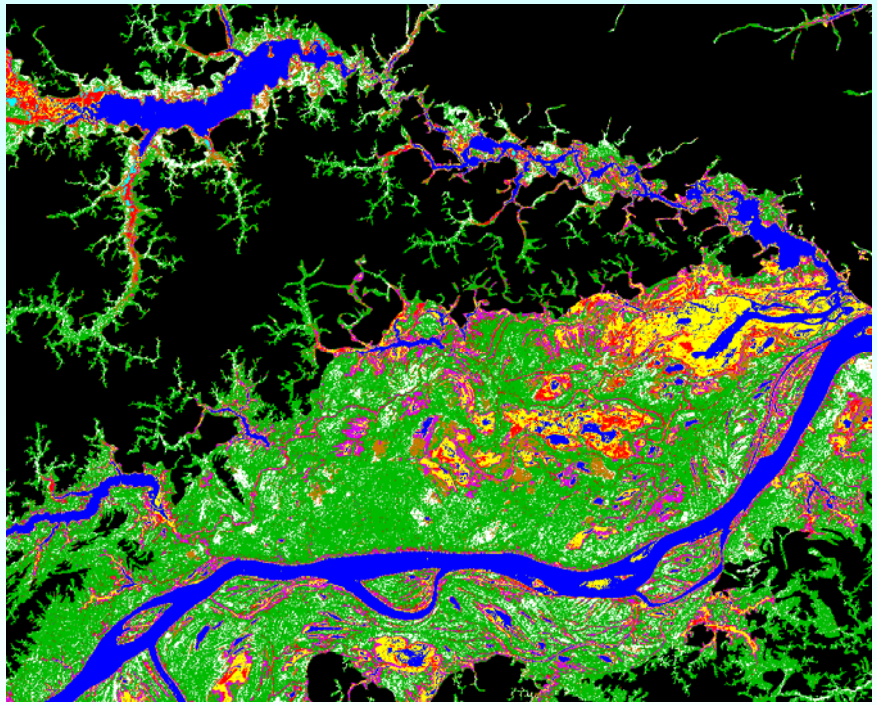


(8S,72W) (8S,54W)

Wetland	0.30 $km^2 x 10^6$	17%
Non-Wetland	1.47 $km^2 x 10^6$	83%
Total	1.77 $km^2 x 10^6$	

Wetland habitats at Cabaliana site, high and low water stages





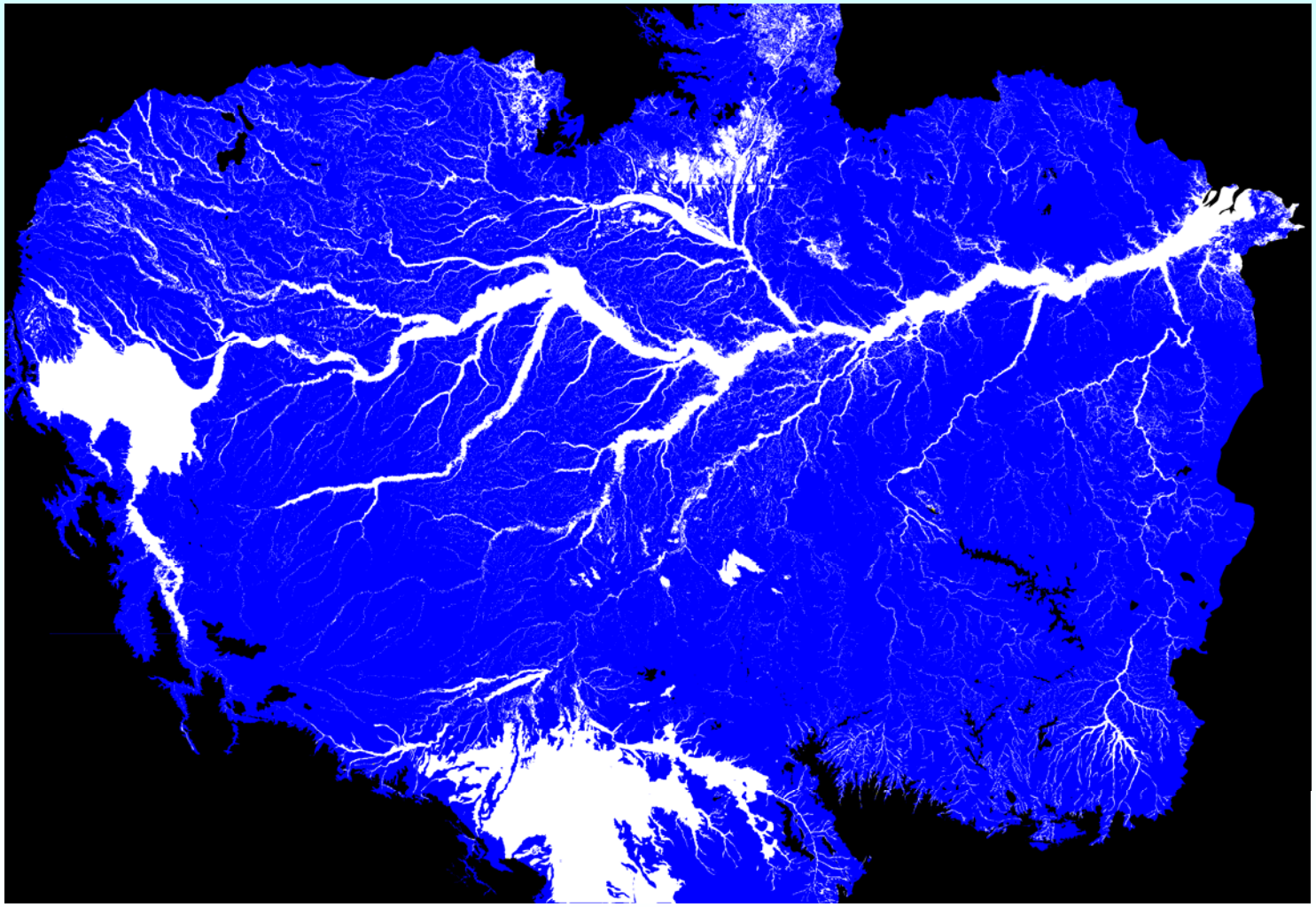
- Water
- Bare/herbaceous, non-flooded
- Herbaceous, flooded
- Shrub, non-flooded
- Shrub, flooded
- Woodland, flooded
- Forest, non-flooded
- Forest, flooded

Applications: Carbon Cycle

- Outgassing from Amazonian rivers and wetlands as a large tropical source of atmospheric CO2. *Nature*. J. Richey (Univ. of Washington), J. Melack, A. Aufdenkampe, V. Ballester, L. Hess.

- Regionalization of methane emissions in the Amazon Basin with microwave remote sensing. *Global Change Biology*. J. Melack, L. Hess, M. Gastil, B. Forsberg, S. Hamilton, I. Lima, E. Novo.

Central Amazon Wetlands Mask (100 m)

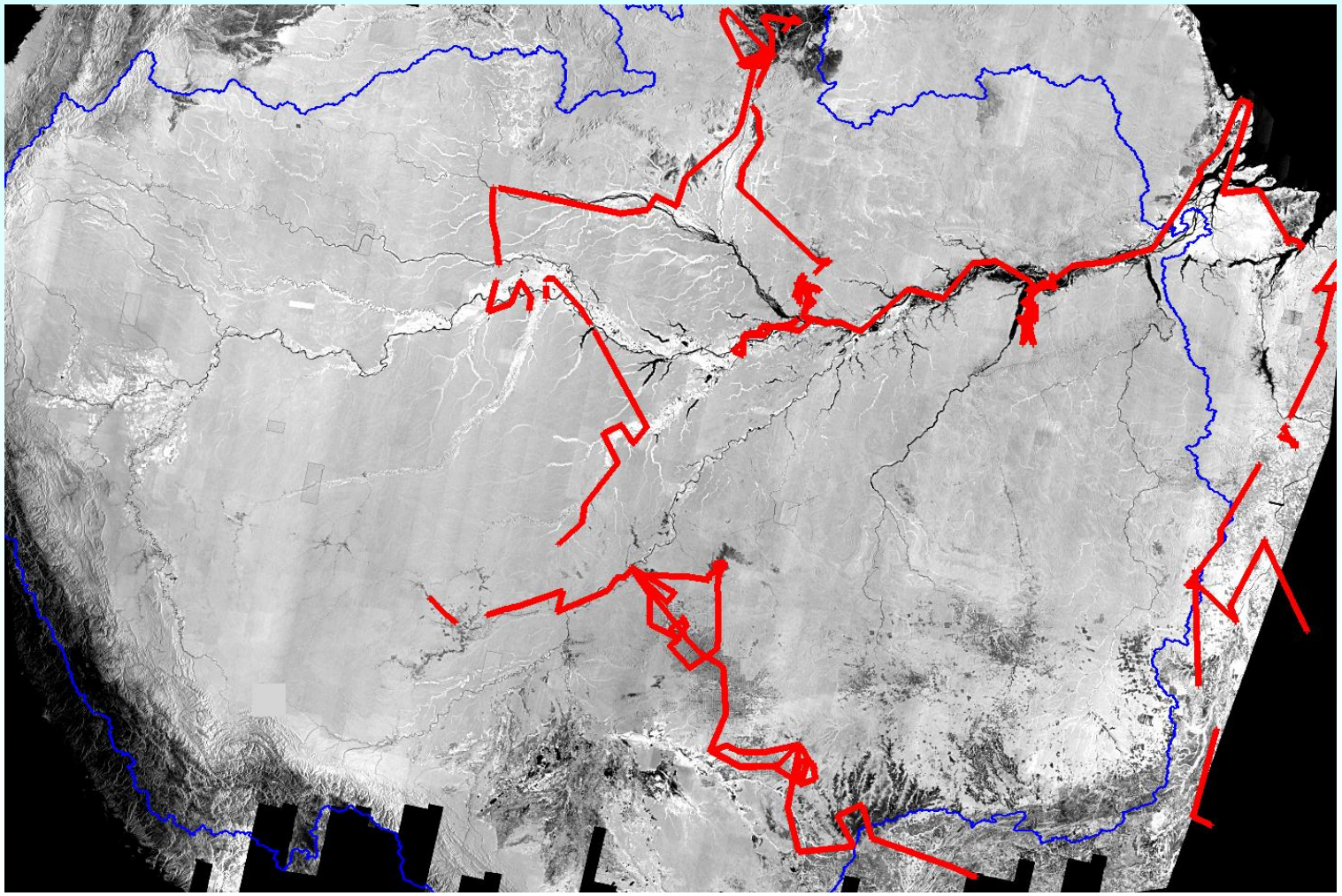


Amazon Basin below 500m: wetlands 17%, uplands 83%

Amazon floodable area (km^2): Inter-dataset comparisons

	GRFM Low	GRFM High	MODIS LC-IGBP	TREES	Prigent 2001
Floodable area	832,109	832,109	NA	NA	NA
Permanent wetland	NA	NA	9,953	NA	NA
Open water	66,947	86,828	96,511	70,197	NA
Floodable area, central Amazon	302,696	302,696	NA	NA	160,000
*MODIS Land Cover IGBP class Water; TREES class Inland Water					
**Floodable area within 0S,72W to 8S,54W quadrat					

INPE-UCSB Validation Survey (1999)

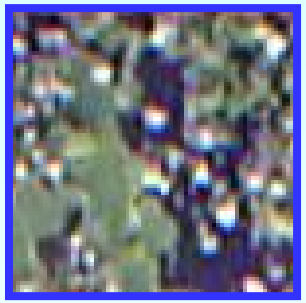


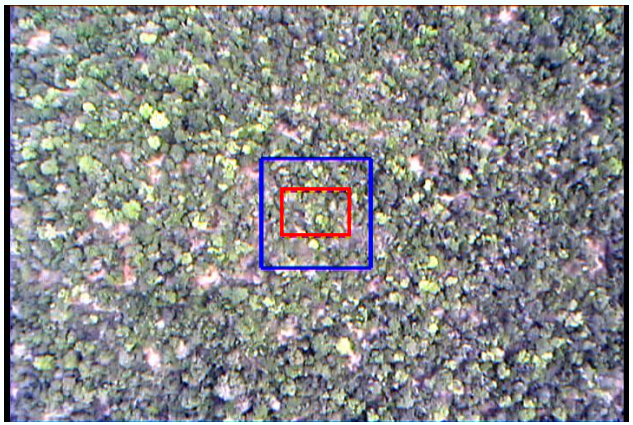
Dual-resolution validation dataset

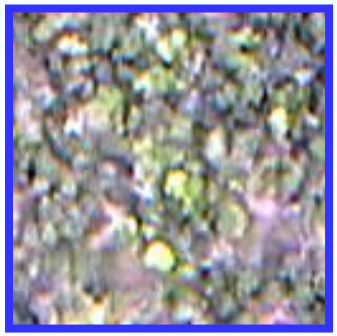
Wide angle frame

100m x 100m

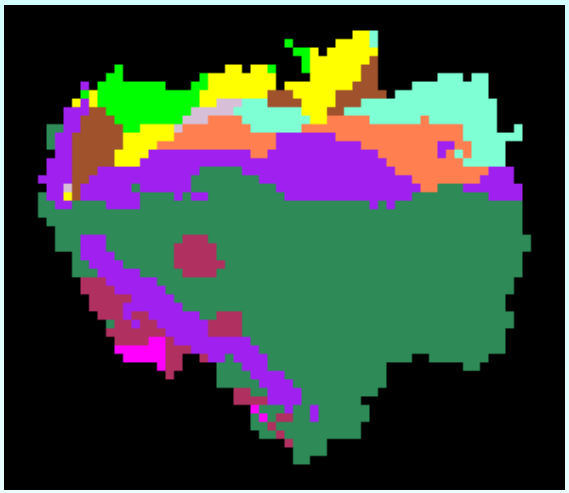
Zoom frame





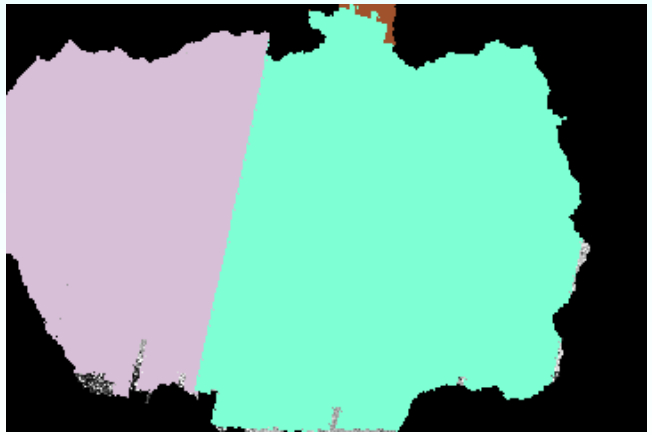


Timing of GRFM Amazon Mosaic swaths relative to average precipitation minimum and maximum (Climatic Research Unit TS 2.1 dataset, Mitchell & Jones 2005)



Minimum

Maximum

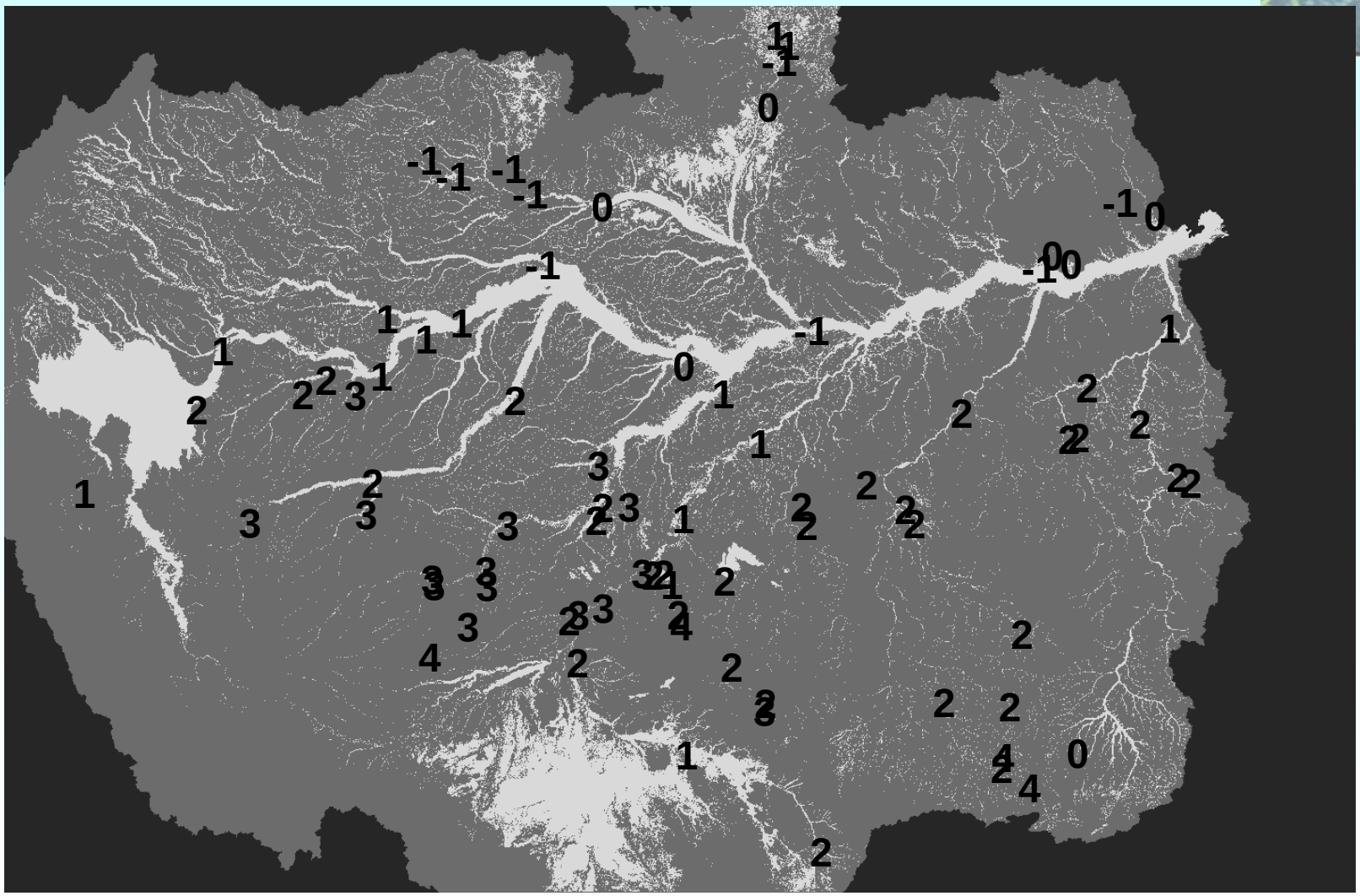


GRFM low-water acq.

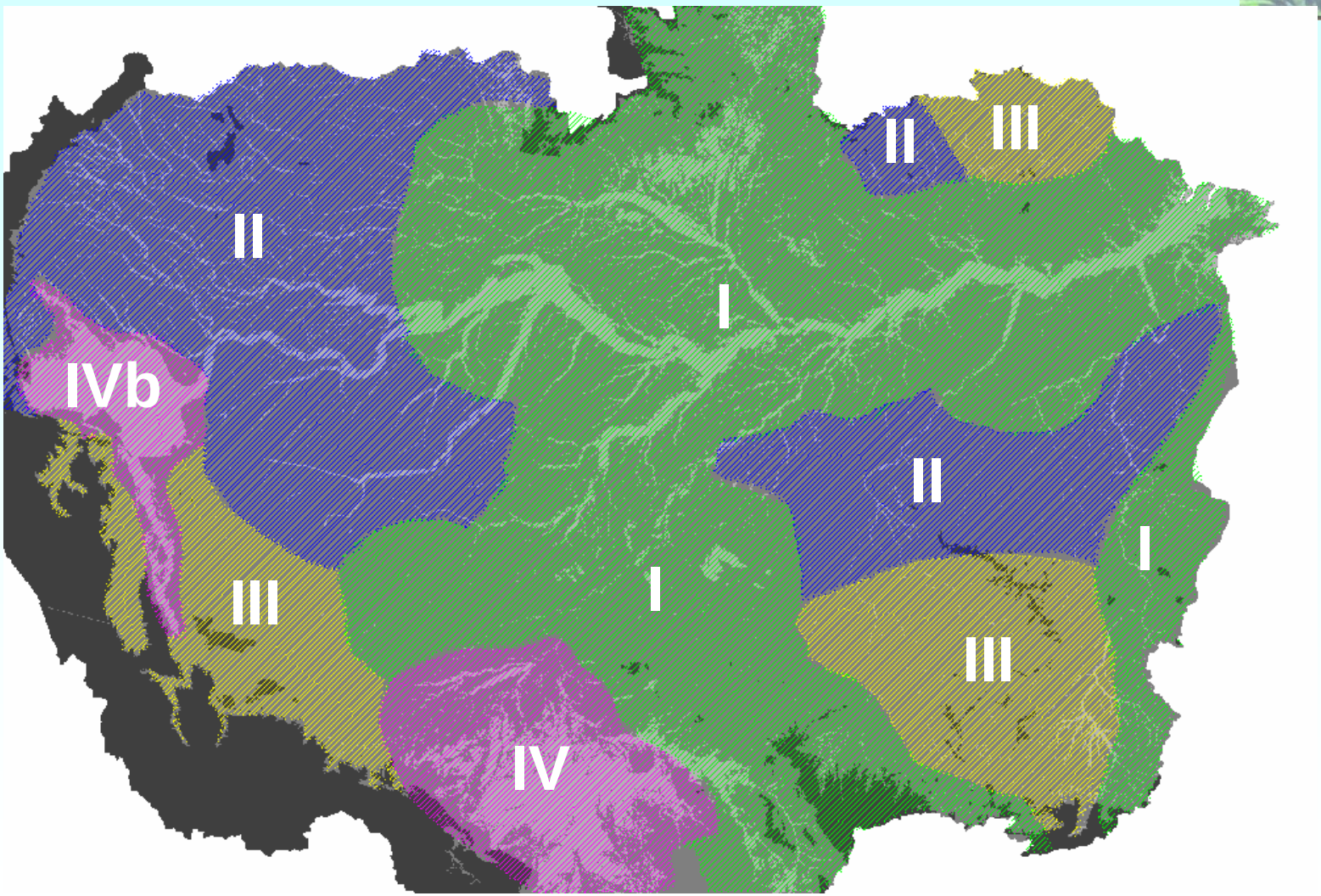
GRFM high-water acq.

Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

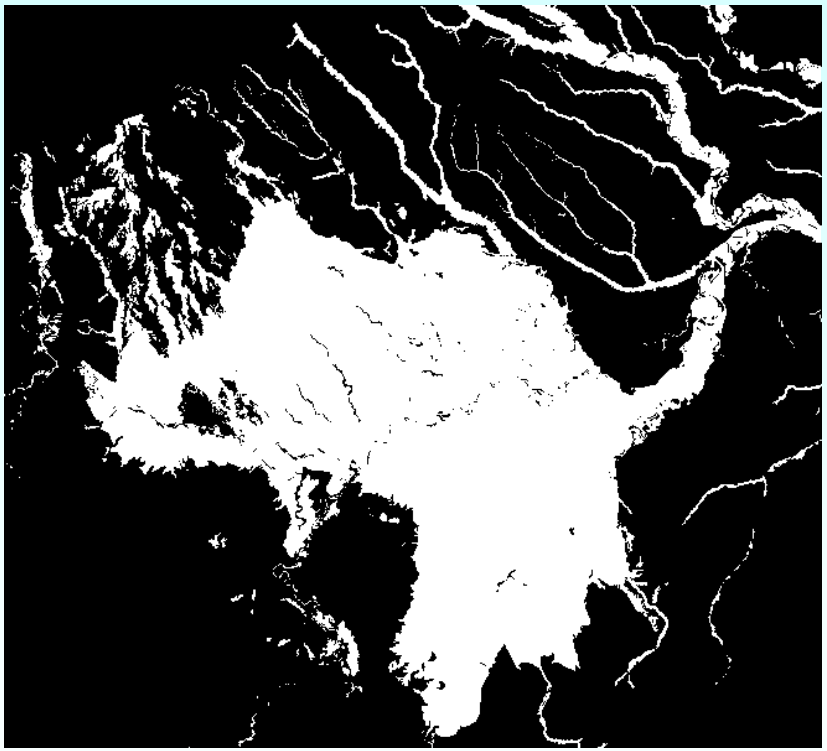
GRFM Amazon High-water Mosaic date vs. river stage maxima
Brazil: Costa et al. 2002
Peru: Servicio Nacional de Meteorologia e Hidrologia del Peru

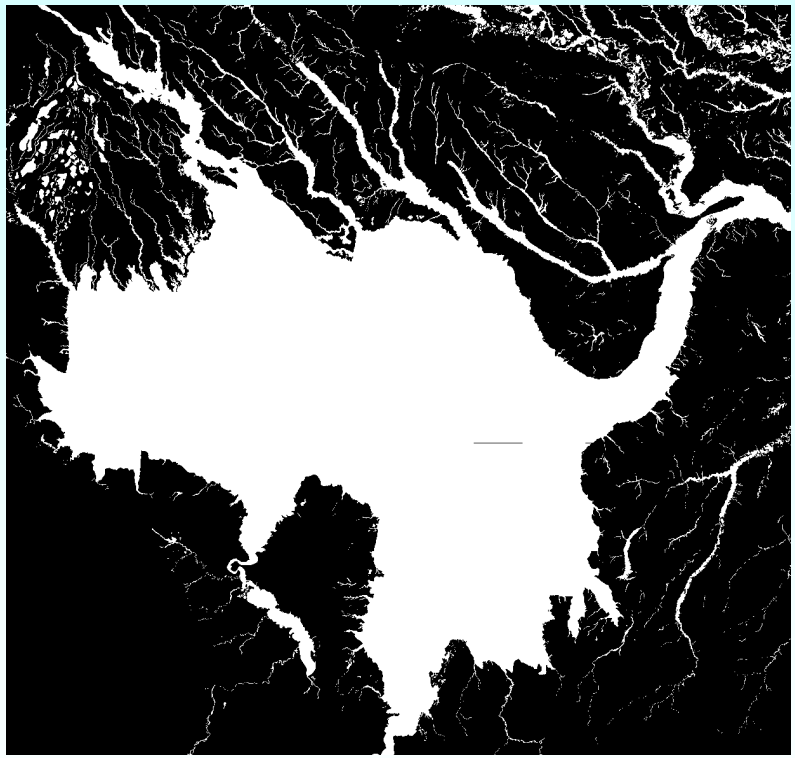


Validation Regions



Cross-dataset comparison: Peruvian palm swamps



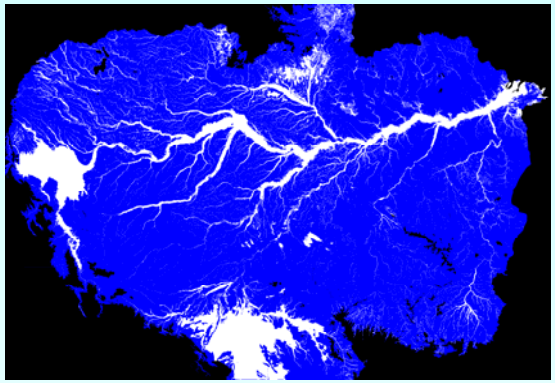


IIAP (Iquitos) – NatureServe

TM-based; 30 m

GRFM-based; 100 m

Remaining LBA Activities Using GRFM Mapping



- Basinwide dataset article to Earth Interactions (Jan 07)

- Integration of dual-season GRFM mapping with
  - -multi-season JERS
  - -macrophyte productivity studies (field & RS)
  - -MODIS-based flooded forest phenology
  - -field measurements of CH4

  for input to NASA-CASA model for CH4 model (central Amazon)

- Summary paper of geography of Amazon wetlands (chapter in Junk book)

NASA Funding Climate: Chilly

Cutbacks Impede Climate Studies
U.S. Earth Programs In Peril, Panel Finds

By Marc Kaufman
Washington Post Staff Writer
Tuesday, January 16, 2007; A01

The government's ability to understand and predict hurricanes, drought and climate changes of all kinds is in danger because of deep cuts facing many Earth satellite programs and major delays in launching some of its most important new instruments, a panel of experts has concluded.

The two-year study by the National Academy of Sciences, released yesterday, determined that NASA's earth science budget has declined 30 percent since 2000. It stands to fall further as funding shifts to plans for a manned mission to the moon and Mars.

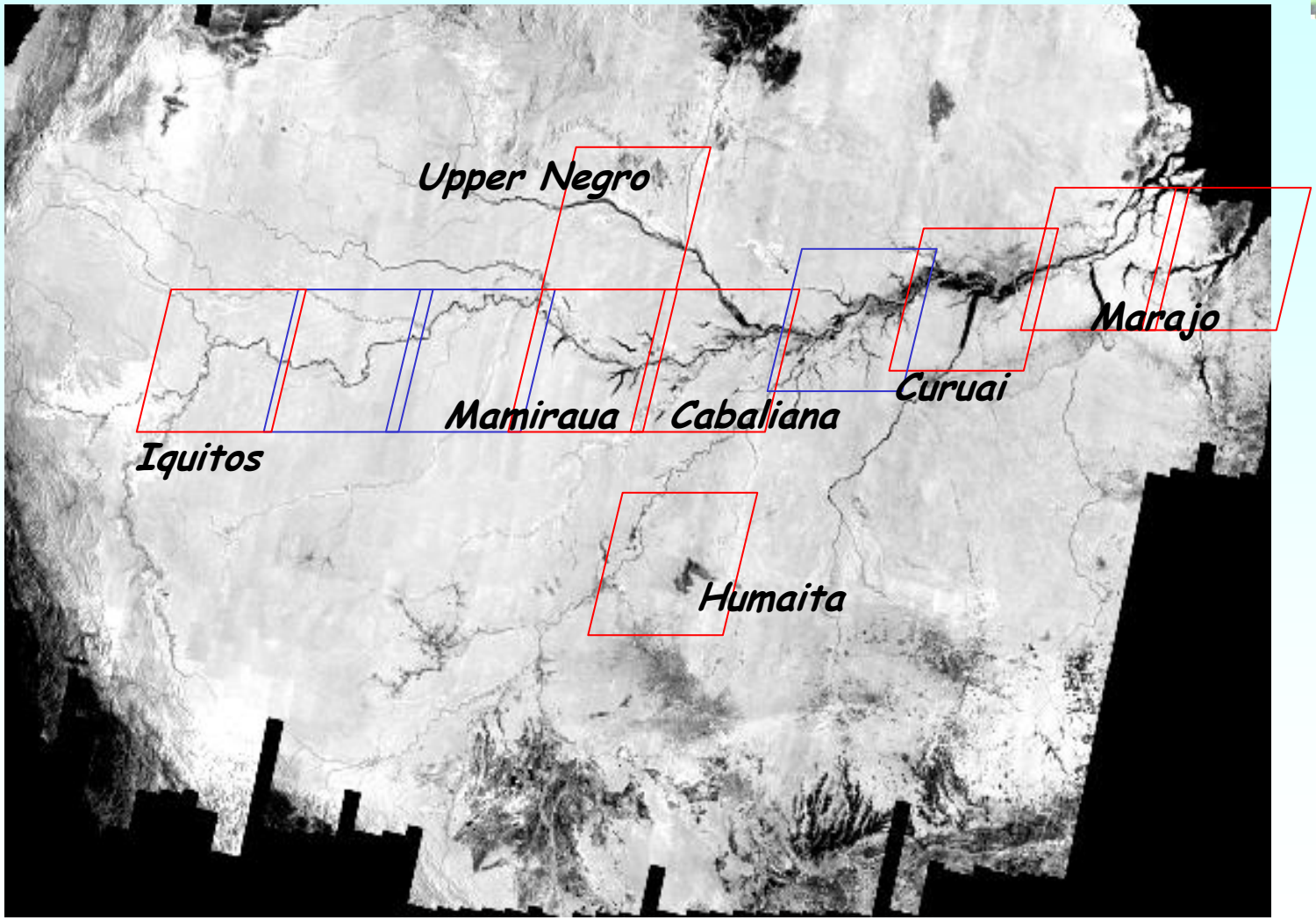
Conservation and Biodiversity

Proposal to FAPESP (with Evlyn Novo, INPE):

SAR-based mapping of vegetation and hydrology of Amazonian wetlands: Applications for biodiversity and conservation planning

- analysis of species occurrence records in conjunction with map-derived habitat metrics (Ana Albernaz, Goeldi Museum; GEOMA project)
- assessing regional differences in extent and seasonality of habitat types and degree of protection by existing conservation units (Gap analysis)
- optimizing location of future wetland reserves using the C-Plan and MARXAN decision support systems (Robert Pressey, Univ. Queensland)
- interrelationships among geomorphology, flooding, and biodiversity, Marajo Island and Amazon estuary (Dilce Rossetti, INPE)

Varzea habitat mapping for reserve planning: ALOS ScanSAR polygons



Amazon K&C Products

- Wetland extent and structure, northern South America
- Seasonal monitoring of inundation and vegetation

Collaborators:

Maycira Costa, Bruce Chapman, Evlyn Novo (INPE), Bruce Forsberg (INPA), Fernando Pellon (Petrobras),

2007-2008: demonstration for prototype sites in Amazon basin

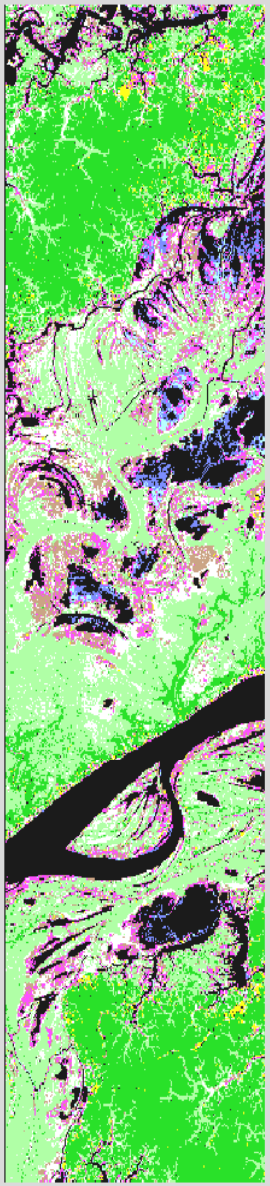
2008-2009: extension to ScanSAR polygon G1

Current focus of algorithm development:

- Using JERS-based basinwide mapping to test PALSAR- and SRTM-derived inputs for optimal wetlands delineation; 50 m vs. ScanSAR; utility of dual-pol

- Develop multi-date flooding and veg cover algorithms; main issue: contiguous scenes with dissimilar flooding conditions due to temporal offset

Cabaliana floodplain habitats



- *Open water, flooded > 8 mos/yr*
- *Herbaceous vegetation, flooded < 2 mos/yr*
- *Herbaceous vegetation, flooded 2-8 mos/yr*
- *Herbaceous vegetation, flooded > 8 mos/yr*
- *Shrub, flooded > 8 mos/yr*
- *Forest, flooded < 2 mos/yr*
- *Forest, flooded 2-8 mos/yr*
- *Forest, flooded > 8 mos/yr*
- *Woodland, flooded > 8 mos/yr*
- *Woodland with macrophyte, flooded > 8 mos/yr*