High Spatial Resolution Commercial Imagery Workshop

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IKONOS Imagery for Large-scale Biosphere Atmosphere Experiment in Amazonia

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Outline of the Presentation

1. **Overview of the LBA and LBA-Ecology programs**
2. **The status of acquisition and distribution of IKONOS images for the LBA-Ecology program**
3. **Scientific questions being addressed with IKONOS data**
4. **Strategies for the Future**

About LBA

Who

LBA is a Brazilian lead international study, with U.S. support from NASA.

What

The Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA) has two key questions: (1) How does Amazonia function as a regional entity, (2) How will changes in land use and climate affect the …functions of Amazonia, including the sustainability of development in the region and the influence of Amazonia on global climate.

When

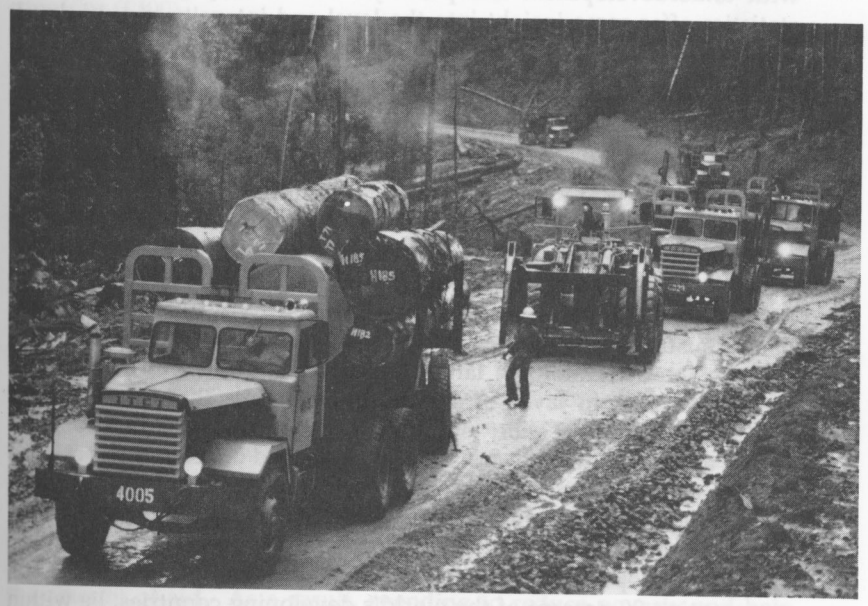
Begun in 1997, NASA support of this multi-year project is currently planned to extend through the year 2005.

Where

The Amazon basin lies mostly within Brazil, but includes several other South American countries.

The overall science question for LBA-Ecology

How do tropical forest conversion and re-growth, and selective logging influence carbon storage, nutrient dynamics, trace gas fluxes, and surface water chemistry and the prospects for sustainable land use in Amazonia?



Lumber workers transport dipterocarp logs, which command high prices on the international market, out of the tropical rain forest on the island of Borneo, Indonesia. If these tall trees are not harvested carefully, significant damage can be done to the surrounding forest. Credit: James P. Blair © 1983 National Geographic Society.

LBA-Ecology Study Sites

The LBA Scaling Strategy

Although the LBA scaling strategy builds partly on the methodology developed in previous land surface experiments, unlike these, LBA is concerned with the fate of the entire ecosystem. This is reflected in the time-scale of LBA field activities, which includes multi-year monitoring of environmental characteristics.

LBA-IKONOS Project Stats

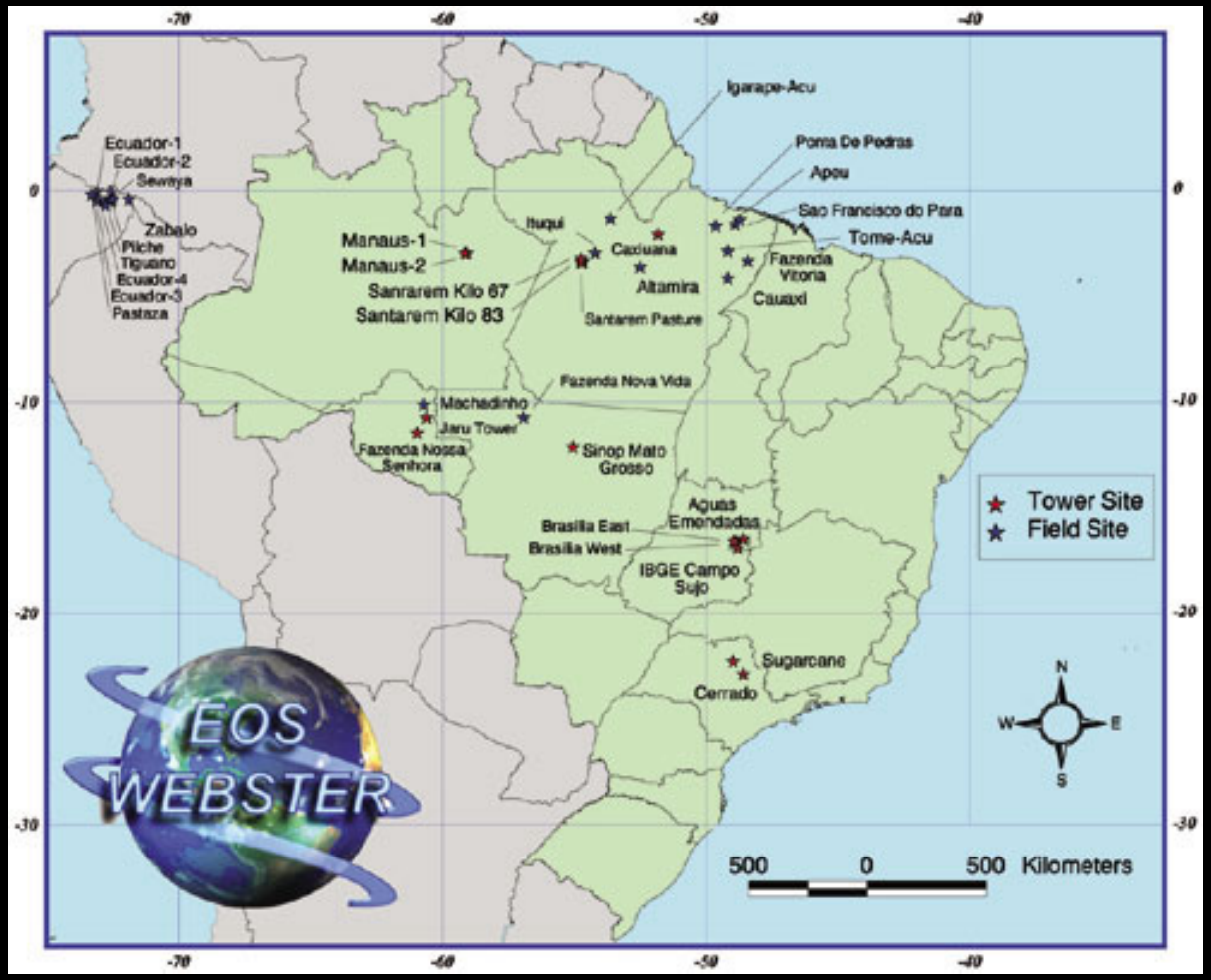
First Proposal:	**Early 2000**
Most Recent Proposal:	**February 2002**
Proposals to date:	**7**
N unique sites:	**29**
N total images:	**67**
Total Area Complete:	**4814 km2**
Total Area Complete+Tasking+Review+Que:	**6796 km2**

LBA-IKONOS User Stats

N Investigators/Teams Requests:	**19**
N Registered IKONOS Users:	**46**
N Visitors to IKONOS Subsystem:	**1155**
N IKONOS Products Ordered:	**656**
IKONOS Data Available to Users:	**15.5 GB**
IKONOS Data Distributed:	**86.2 GB**

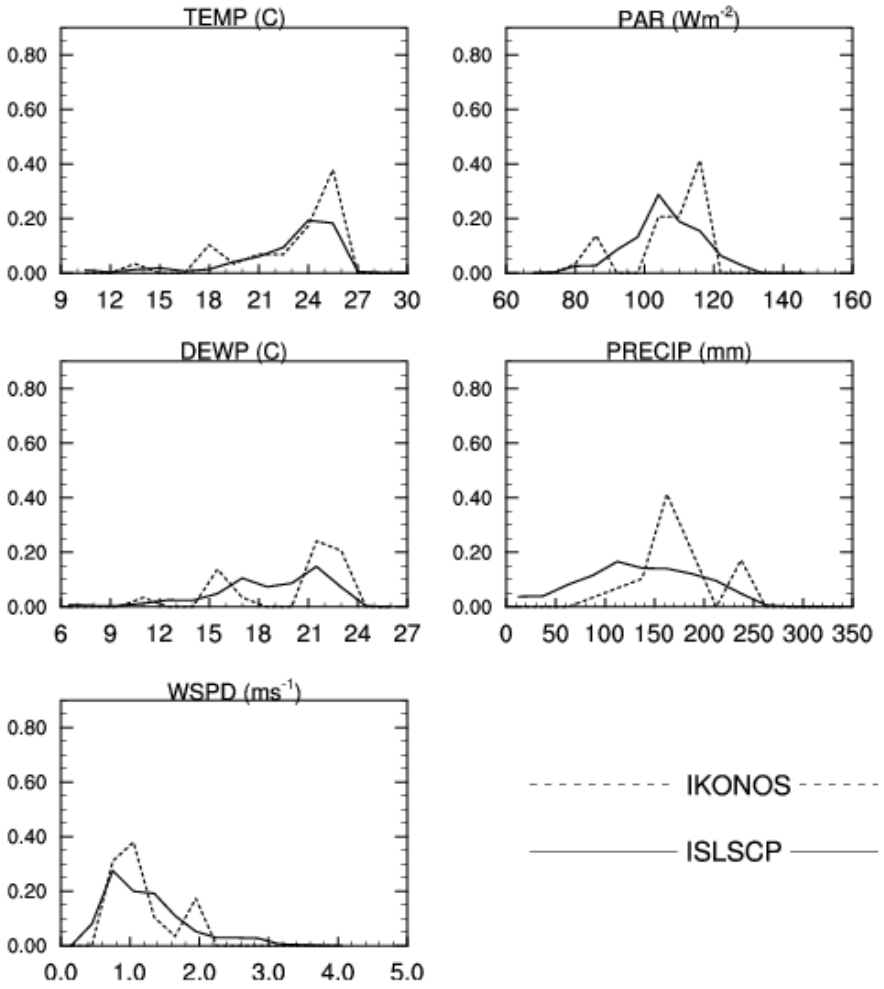
http://www.eos-webster.sr.unh.edu

IKONOS Images for LBA

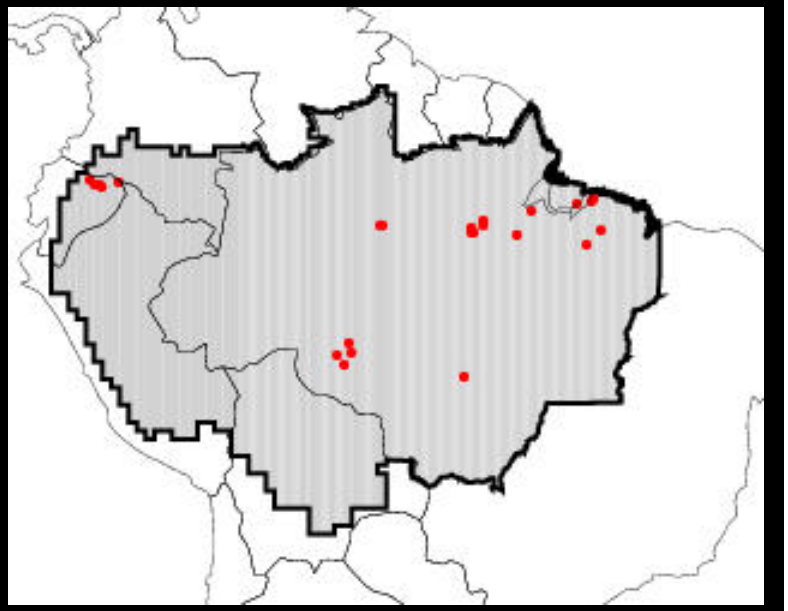


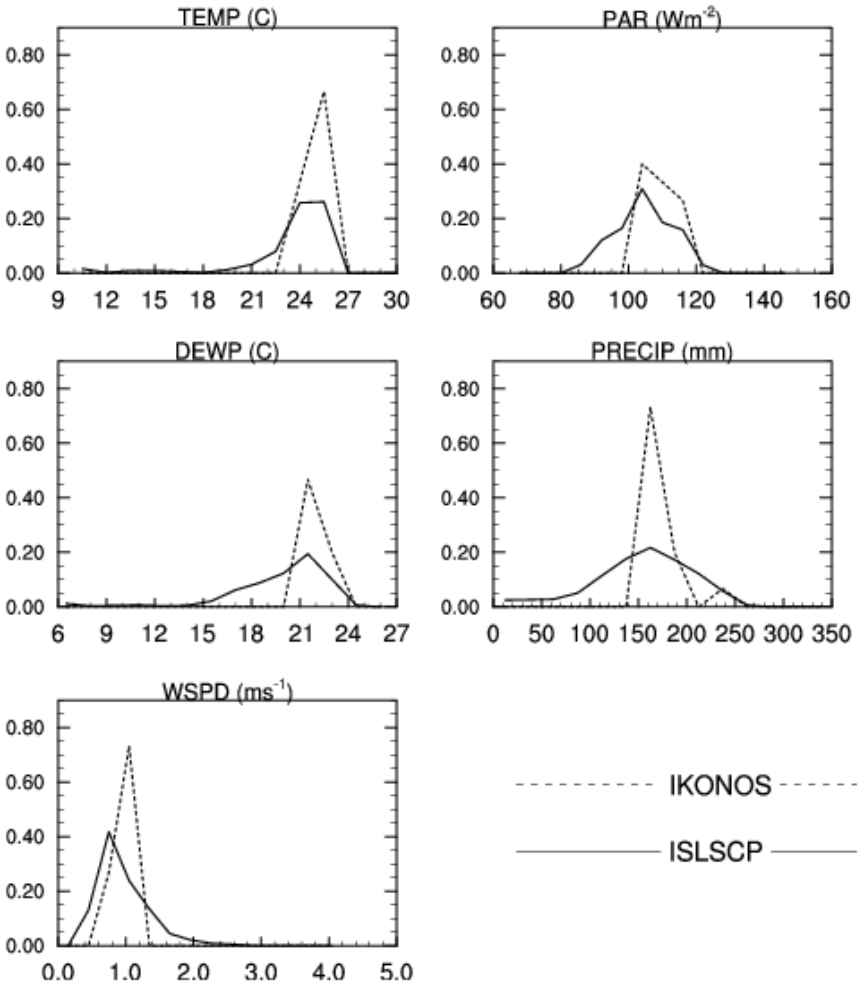
http://www.eos-webster.sr.unh.edu

Region

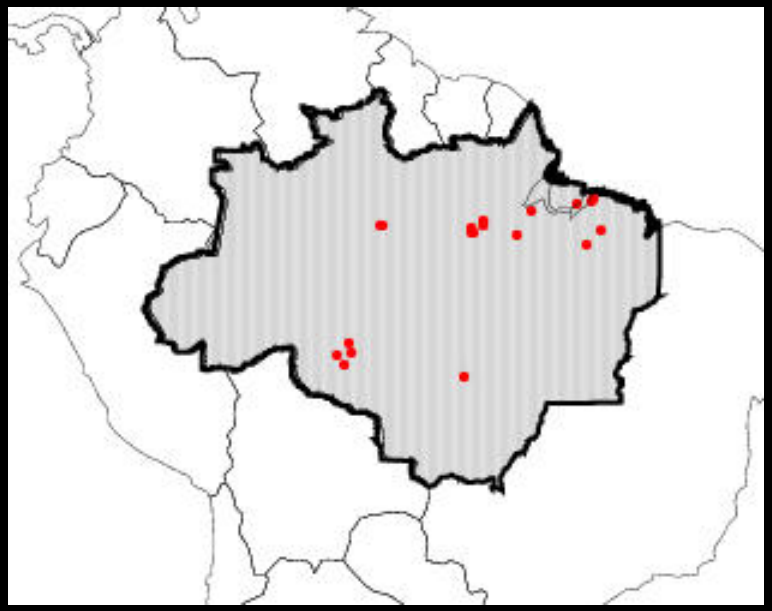

TEMP (C)
PAR (Wm-2)
DEWP (C)
PRECIP (mm)
WSPD (ms-1)
0.00
0.20
0.40
0.60
0.80
9 12 15 18 21 24 27 30
60 80 100 120 140 160
6 9 12 15 18 21 24 27
0 50 100 150 200 250 300 350
0.0 1.0 2.0 3.0 4.0 5.0
IKONOS
ISLSCP

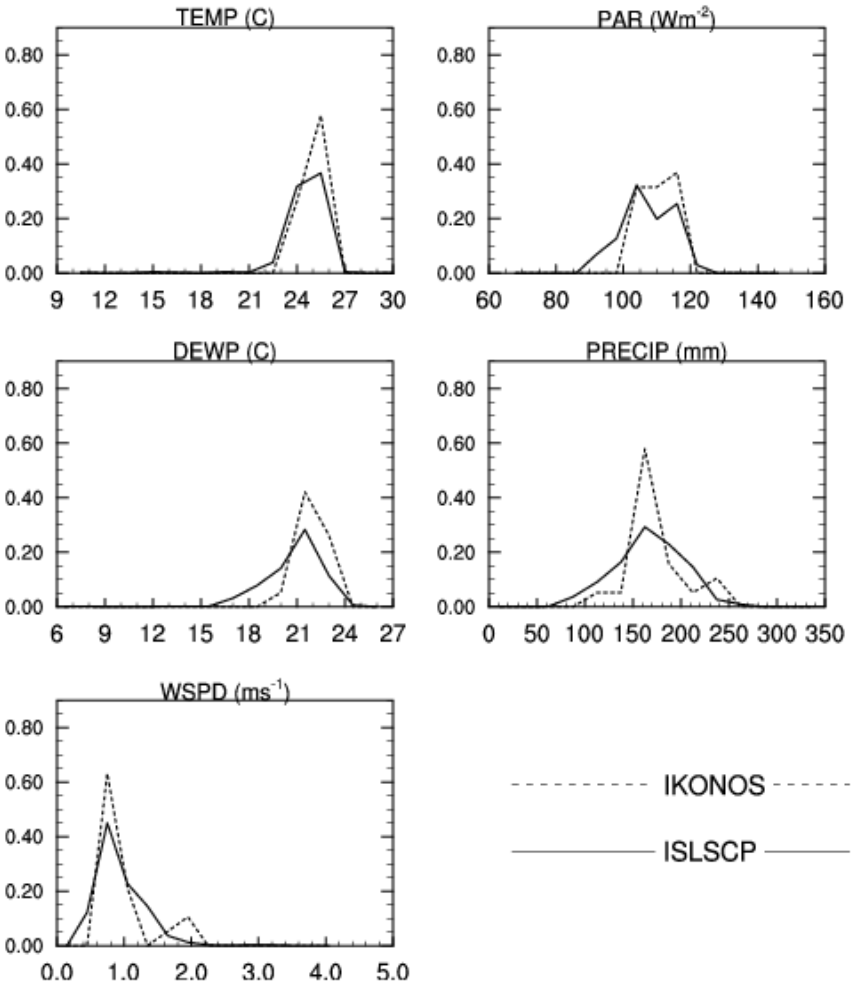
Hydro- and Brazilian-Legal Amazon





Brazilian-Legal Amazon

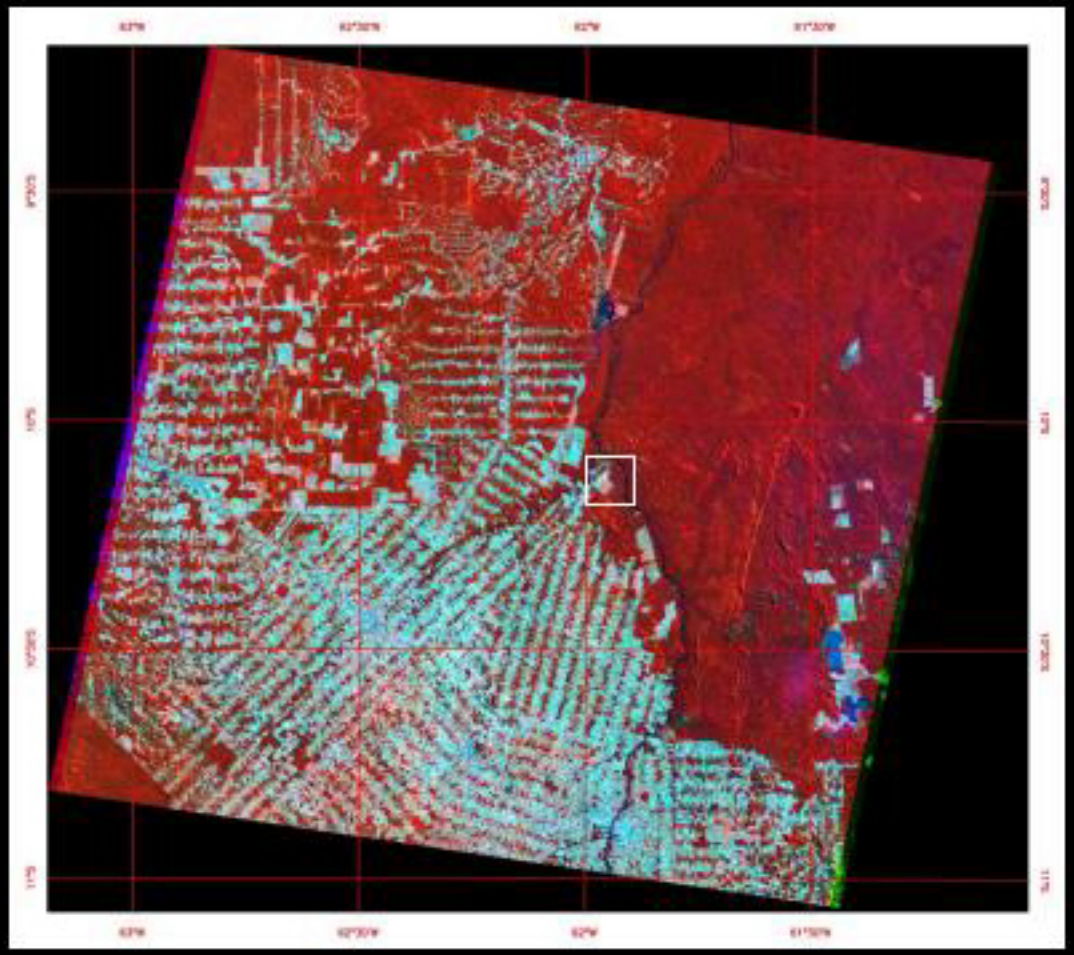




Specific Scientific Questions Being Addressed Using IKONOS

- **Effects of fine-scale heterogeneity at eddy-flux tower sites.**
- **End-member selection and validation for large-scale remote sensing.**
- **Detection of selective logging in forests**
- **Detection of secondary forests stage, age, pathway**
- **Forest canopy gap detection and natural disturbance**
- **Forest basal area and biomass**
- **Landscape description to inform aircraft campaign**
-

Landsat TM (Rhodonia, Brazil)



Asner/Keller/Palace/Pereira/Silva

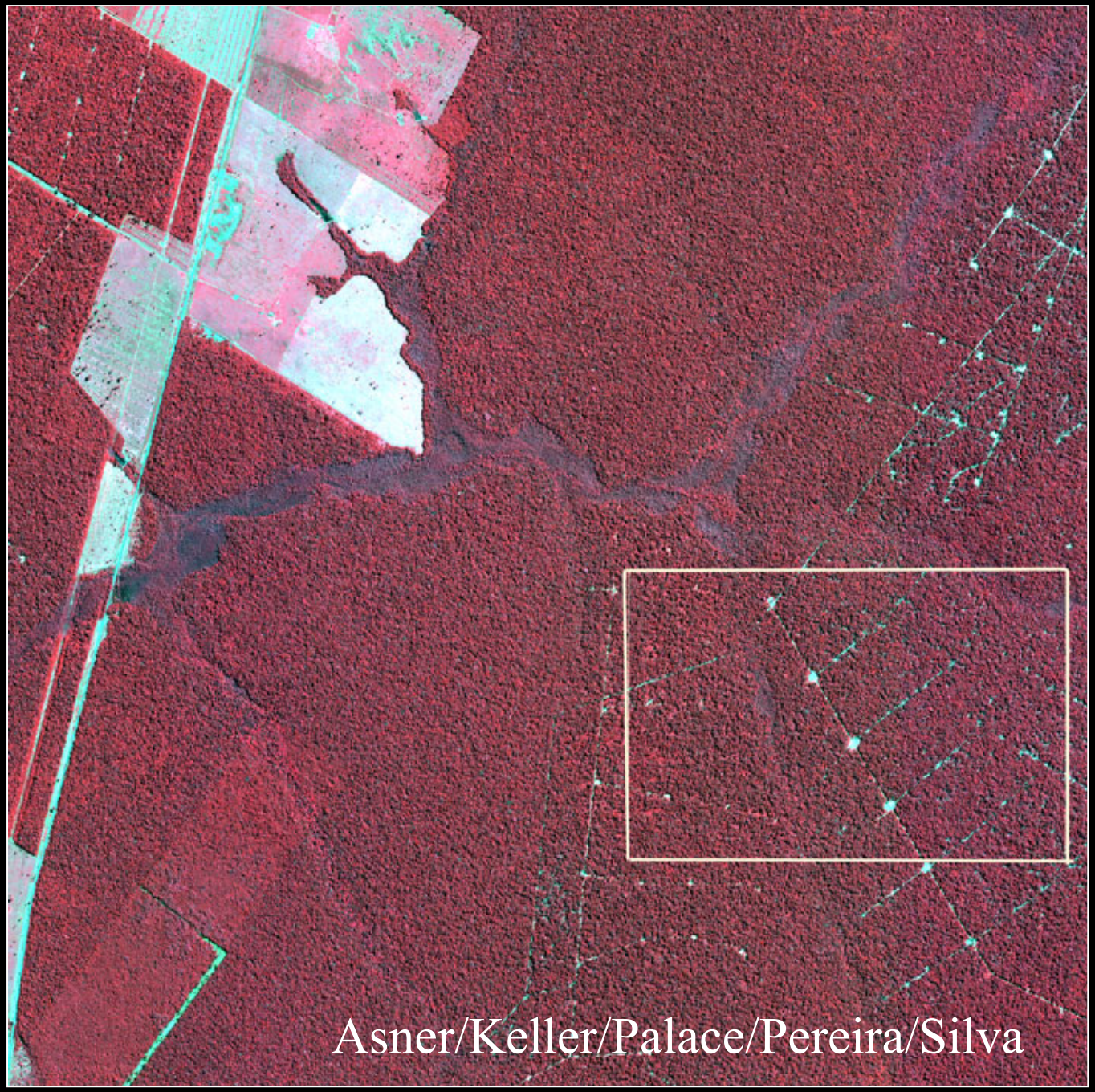
Heterogeneity like this

Asner/Keller/Palace/Pereira/Silva

And this

And this

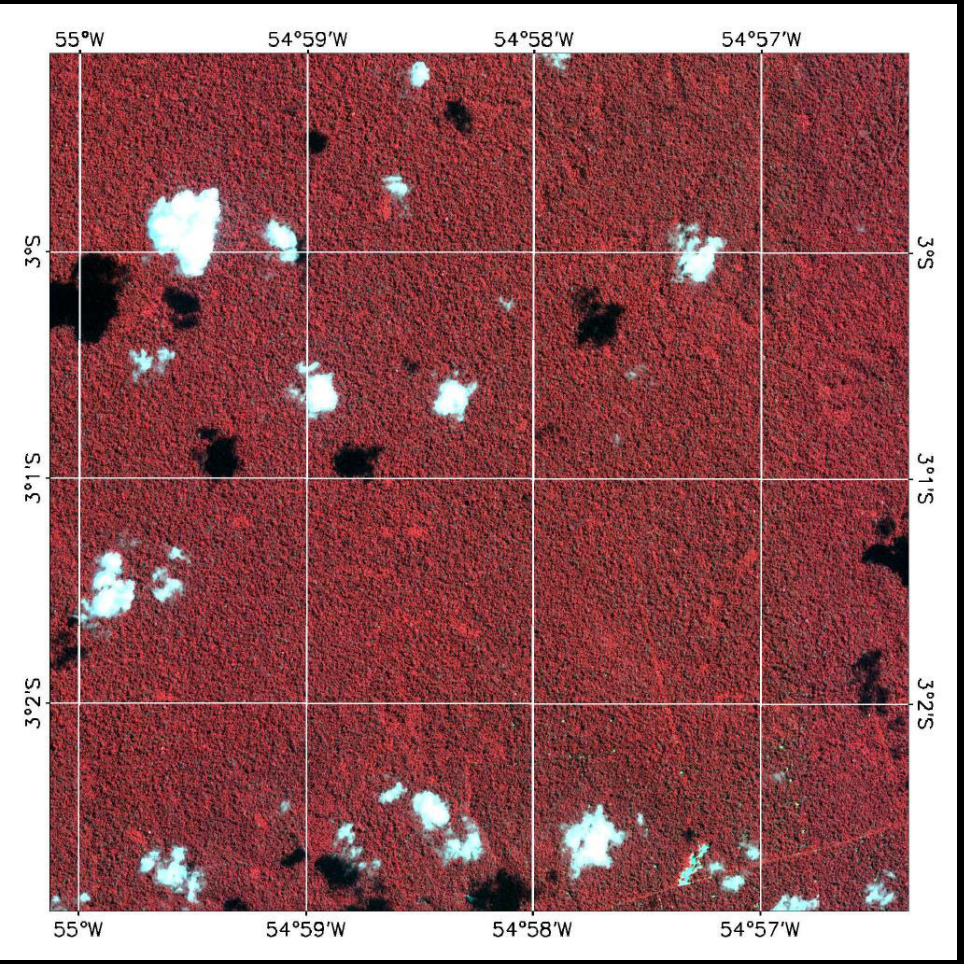
Can be remotely sensed like this

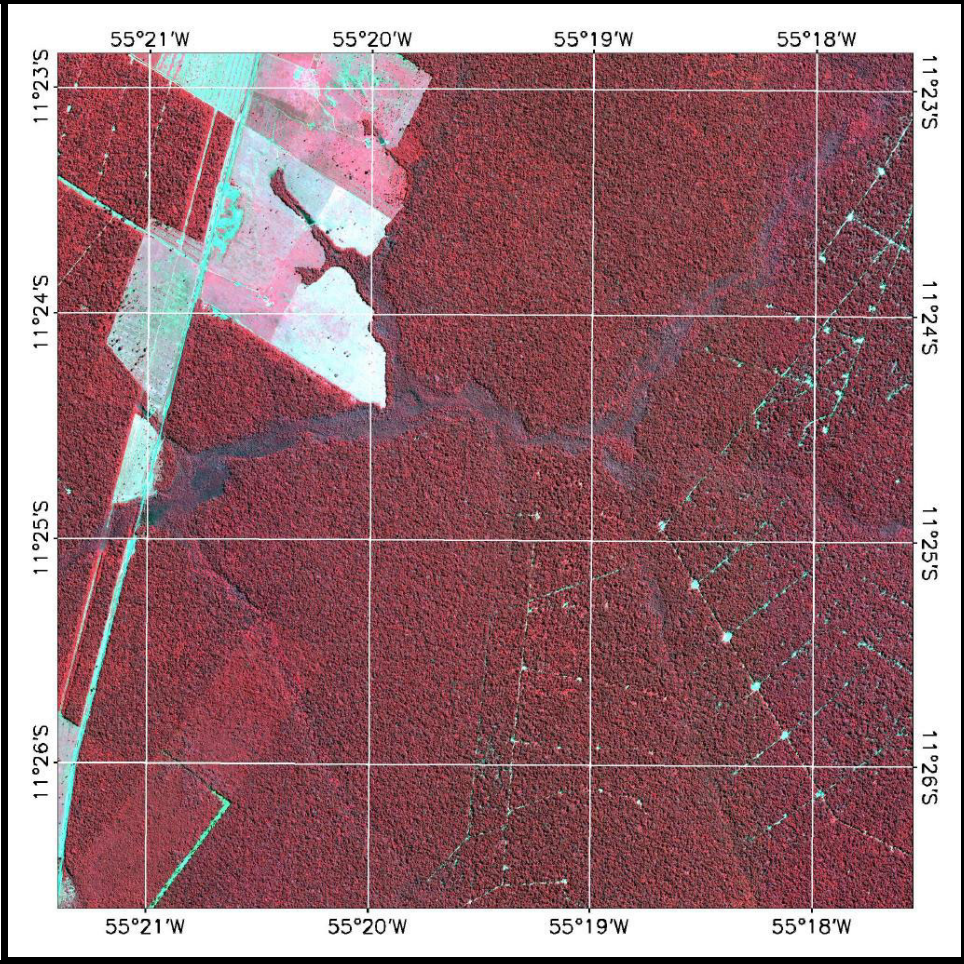


And this

And this

Visual Interpretation



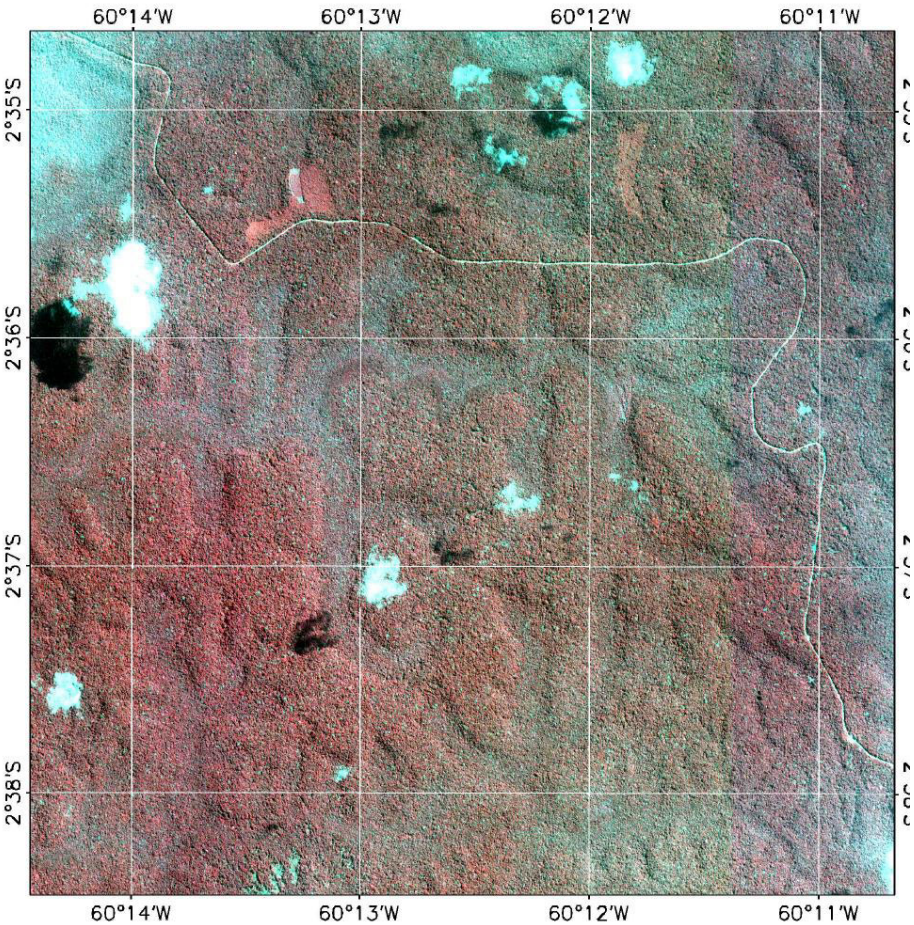


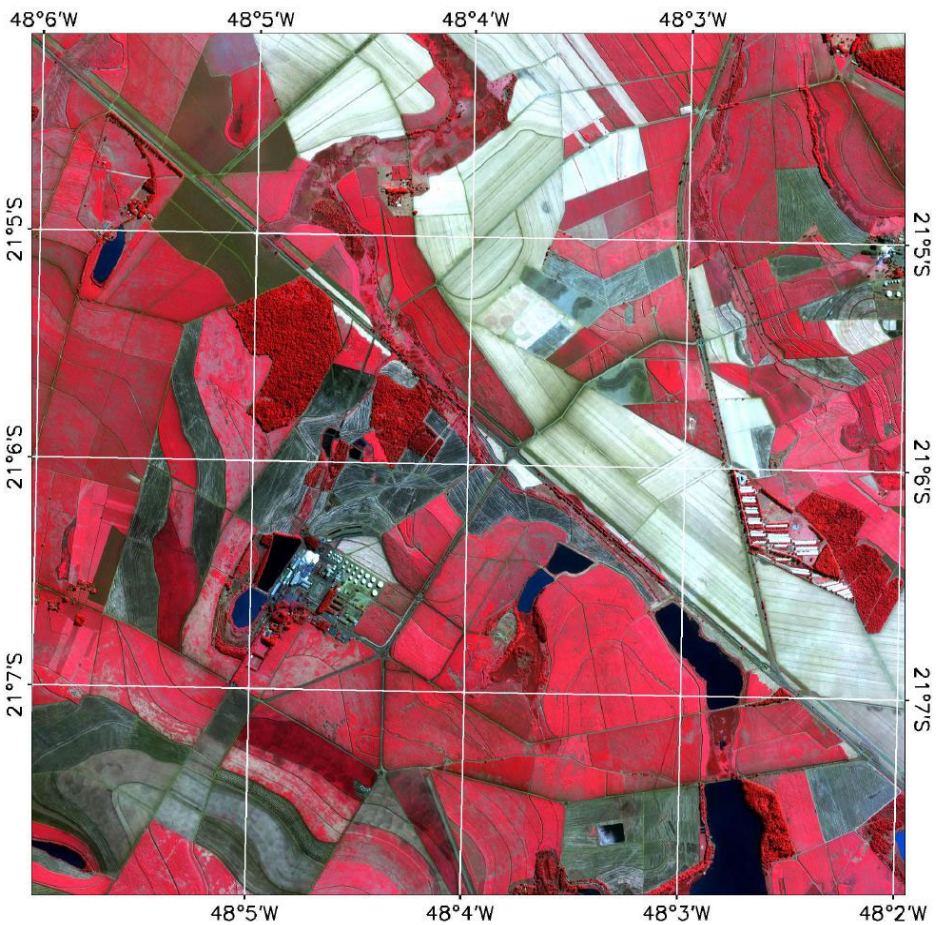
Forest eddy flux tower site at Santarem (#2), 8/29/2000

Forest eddy flux tower site at Mato Grosso, 4/30/2000

Xiao et al.

Visual Interpretation

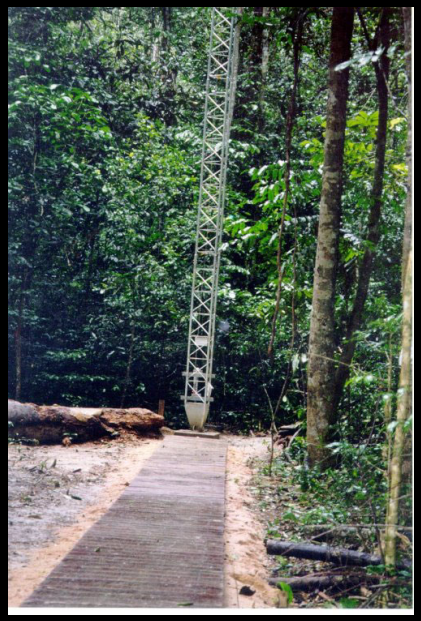


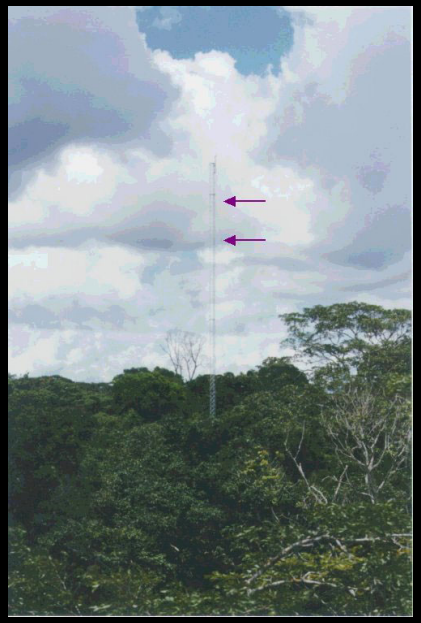


Forest eddy flux tower site at Manaus (#2), 8/24/2000

Sugarcane site, on 6/12/2000

Xiao et al.





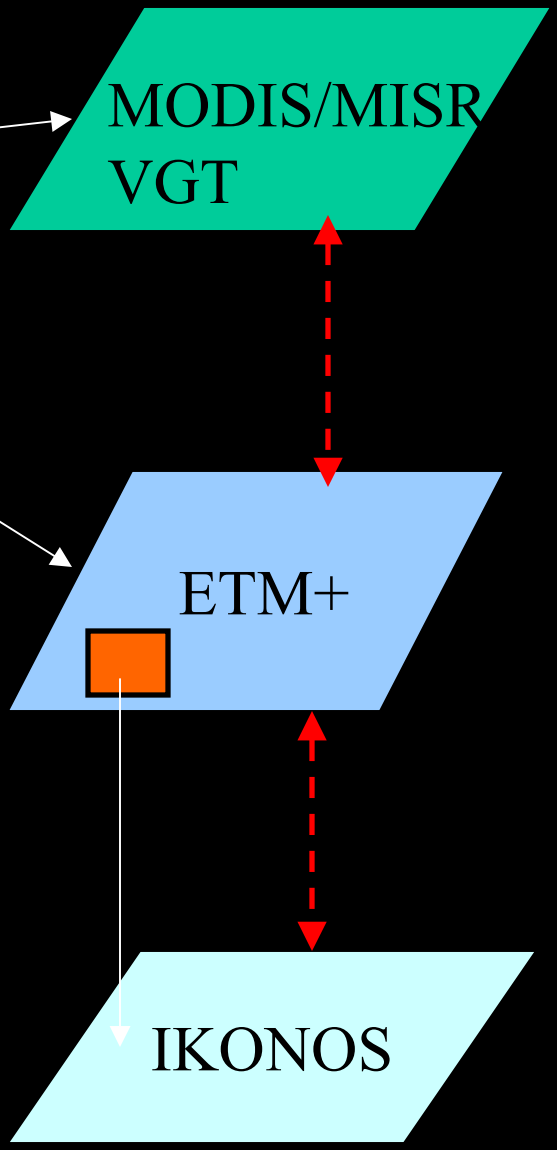
Eddy flux tower site at the Tapajós National Forest, (Steve Wofsy at Harvard University).

With its northern boundary located 50 km south of Santarém, Pará, Brazil, the Tapajós National Forest covers approximately 600,000 ha between the Rio Tapajós and the Santarém-Cuiabá Highway (BR-163).

It was constructed in 2000. Arrows indicates the location of eddy-covariance instruments at 60m (above all trees) and 45m (maximum height of emergent trees)

Source:http://www-as.harvard.edu/chemistry/brazil/

Multi-sensor/resolution image database for eddy-flux tower sites



Spatial resolution

250-m, 500-m, 275-m

30-m, 15-m

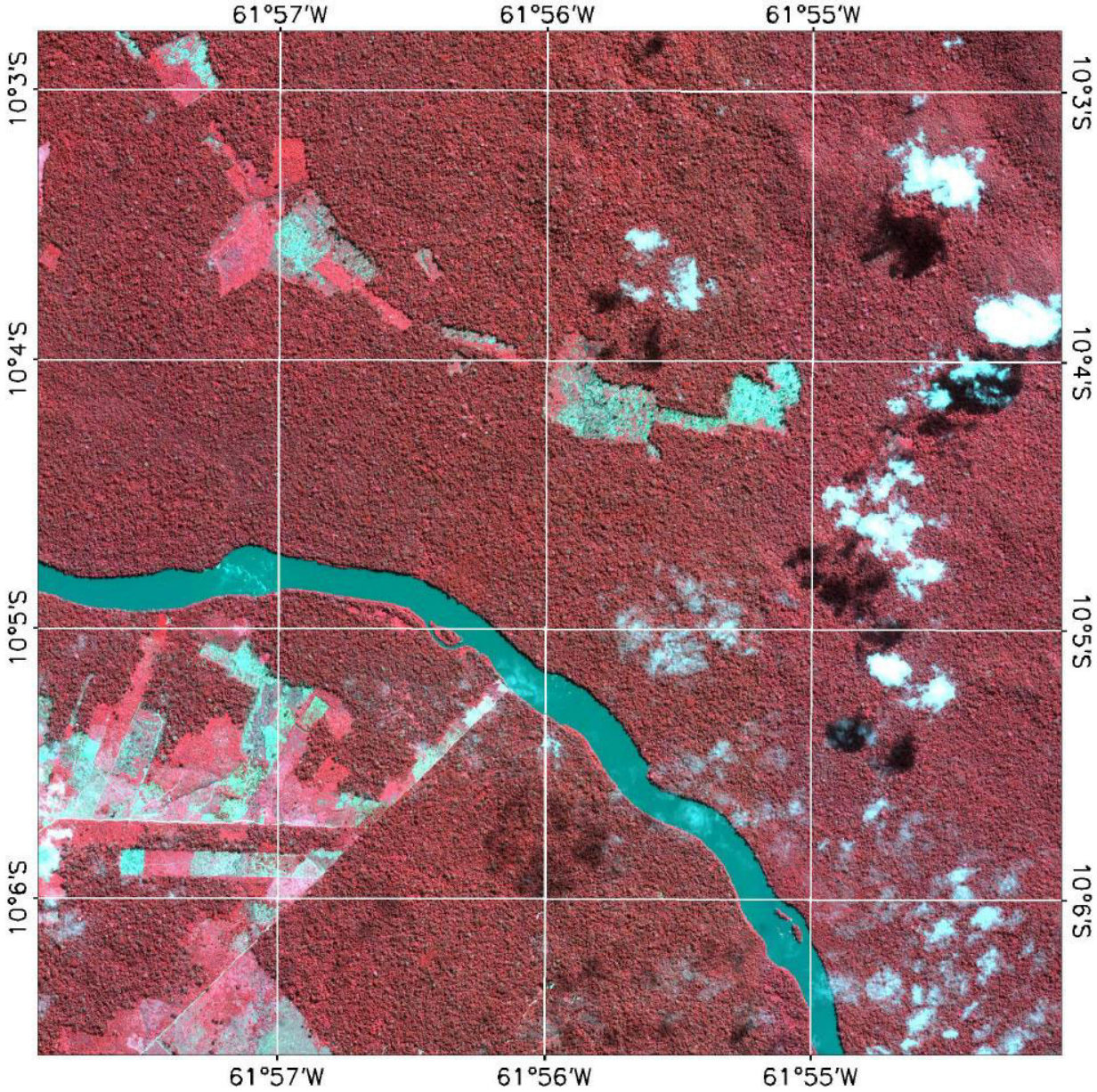
4-m, 1-m

Scientific question:

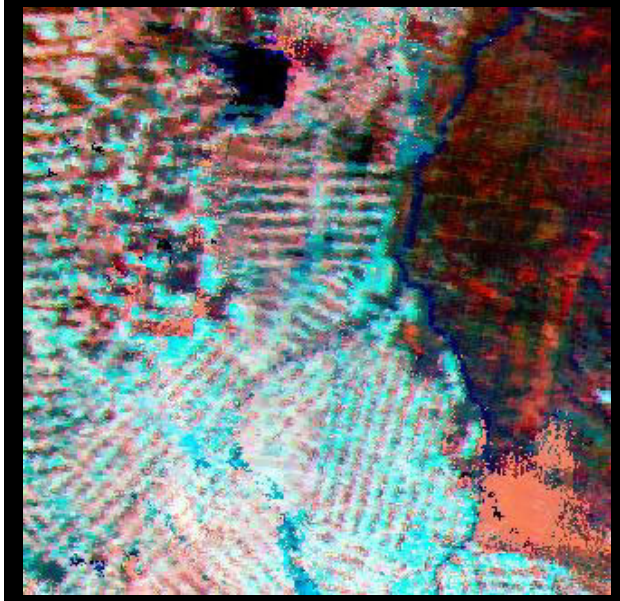
Sub-pixel heterogeneity and large-scale mapping

Image database needs to be linked with field databases

Xiao et al.



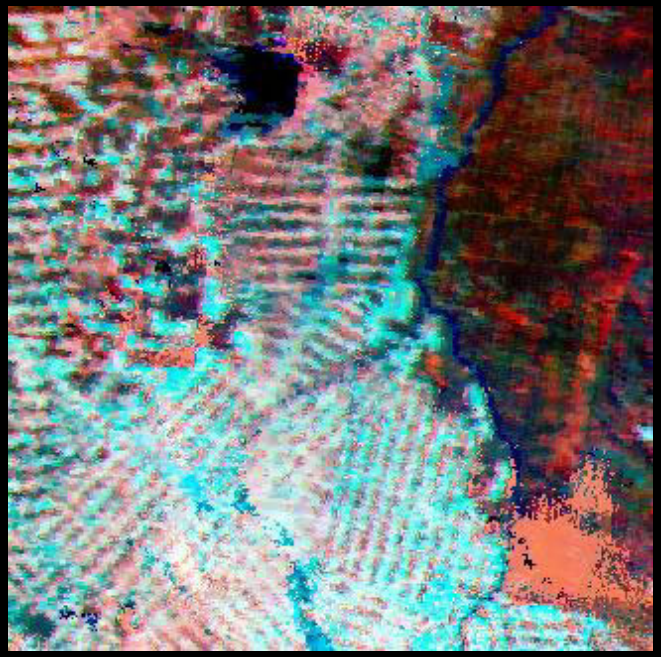
IKONOS image for the Jaru forest eddy flux tower site in Rondonia on 4/6/00 (NIR-RED-GREEN bands)

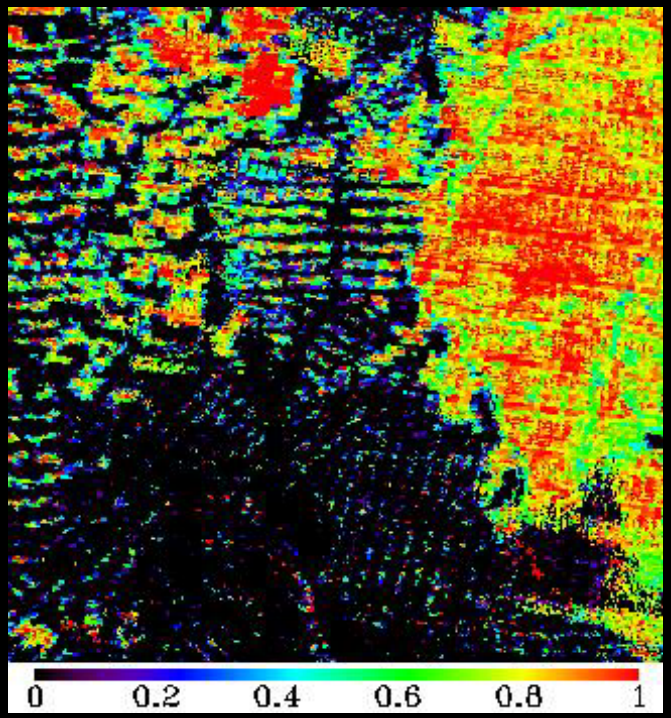


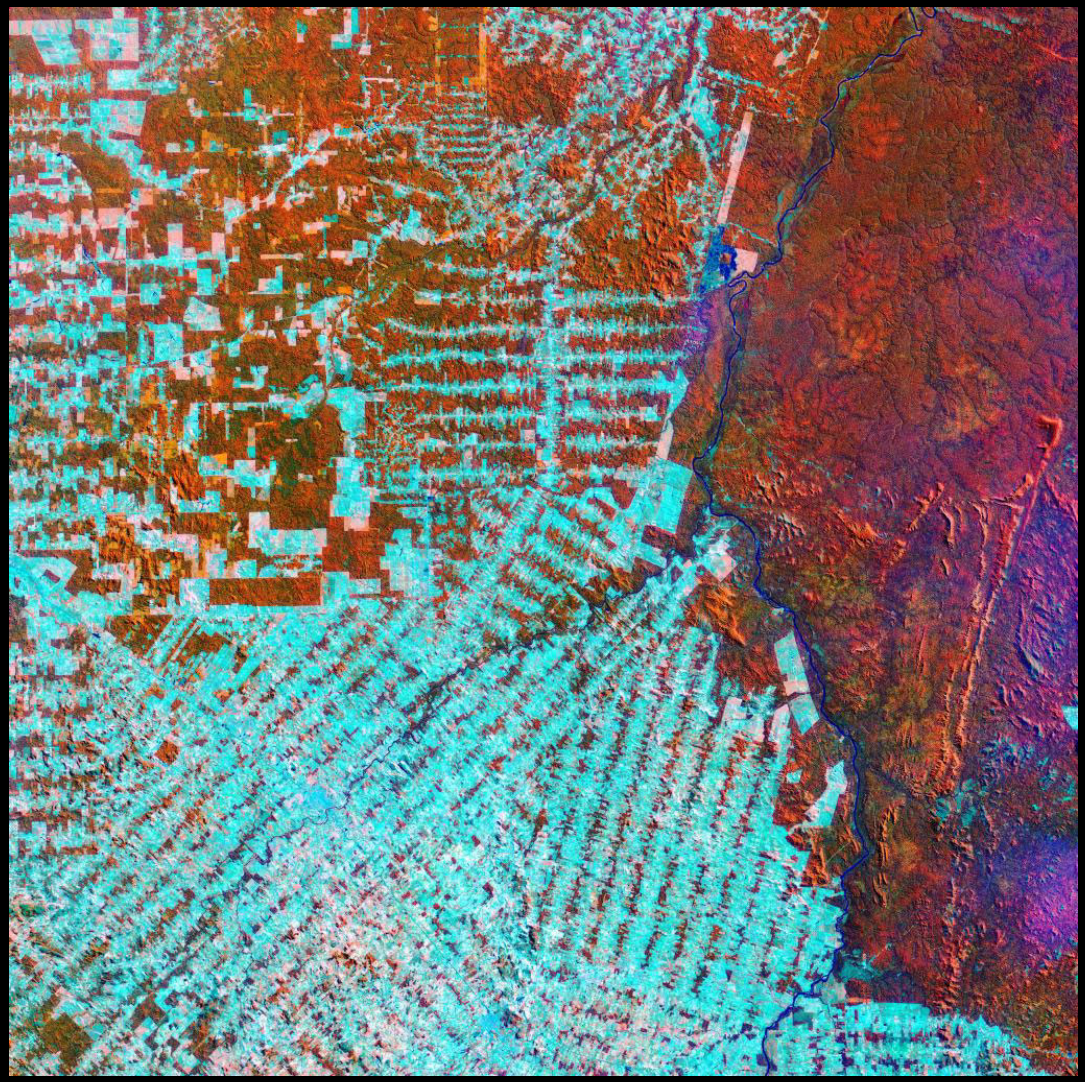
MODIS 8-day composite July 20-26, 2000

Spectral mixture analysis

Xiao et al.







Upper-left – MODIS surface reflectance

Lower-left --fractional of forest from MODIS

Right – Landsat 7 ETM+ on 8/6/1999 Xiao et al.

Forest succession: Aerial view of mature, *Vismia* and *Cecropia* forests

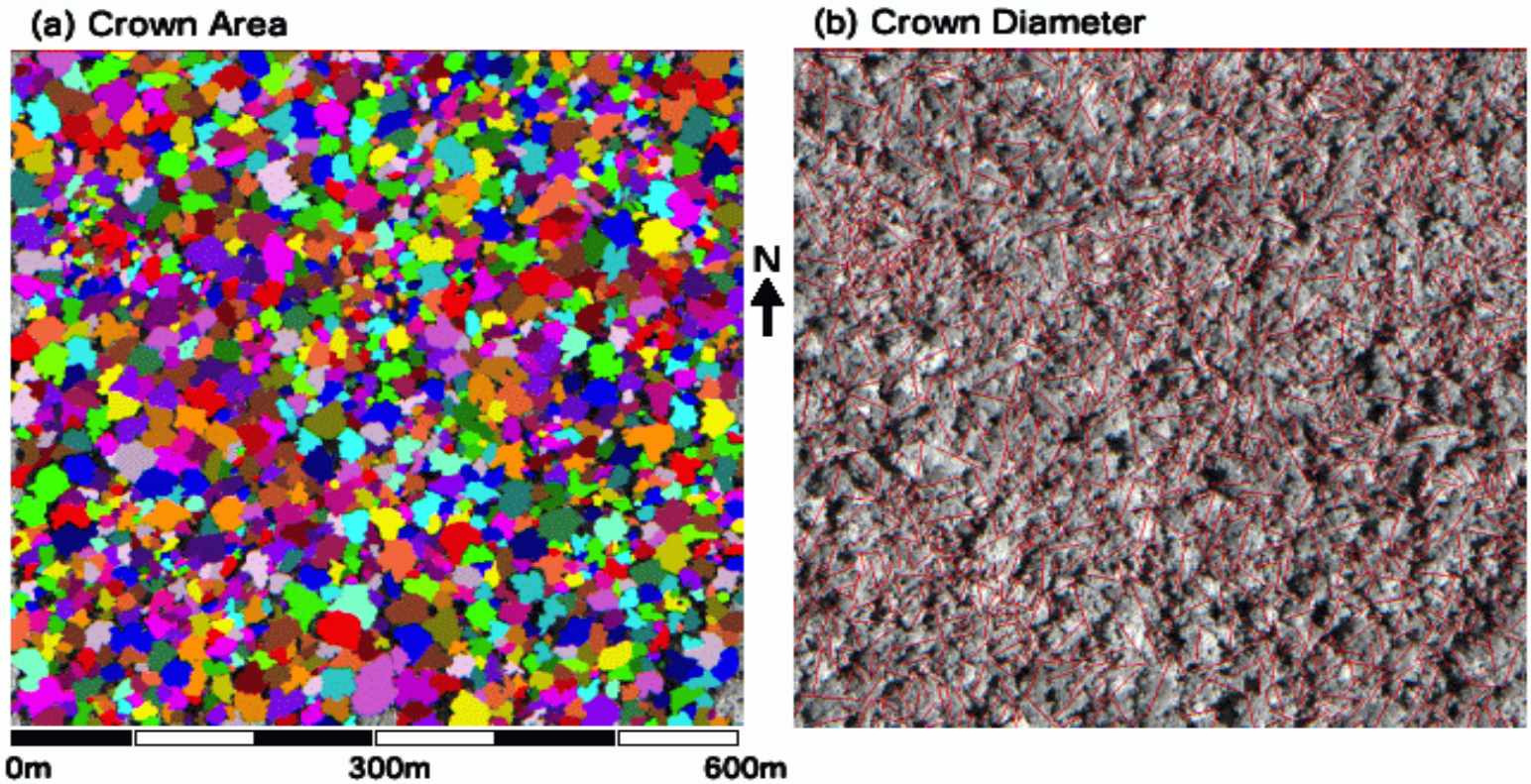
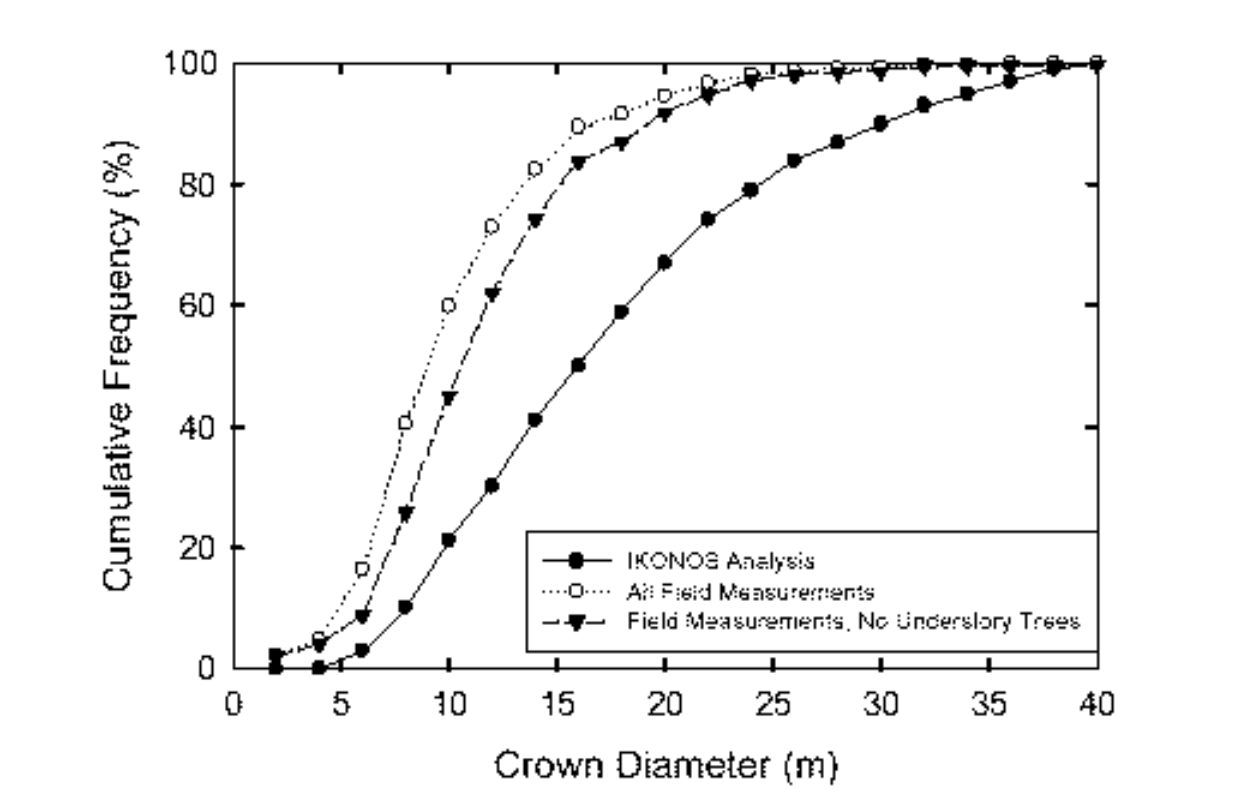


Figure 2. (a) Tree crown area delineated in 1789 polygons. (b) Tree crown diameter along longest axis of each crown area polygon.

Asner/Keller/Palace/Pereira/Silva



Asner/Keller/Palace/Pereira/Silva

Future

I. Acquisitions at key sites

II. Objective/efficient sampling design

Objective/Efficient Sampling Design

Goals

•Objective/efficient resource allocation

•Specified/constant uncertainty

Assumptions

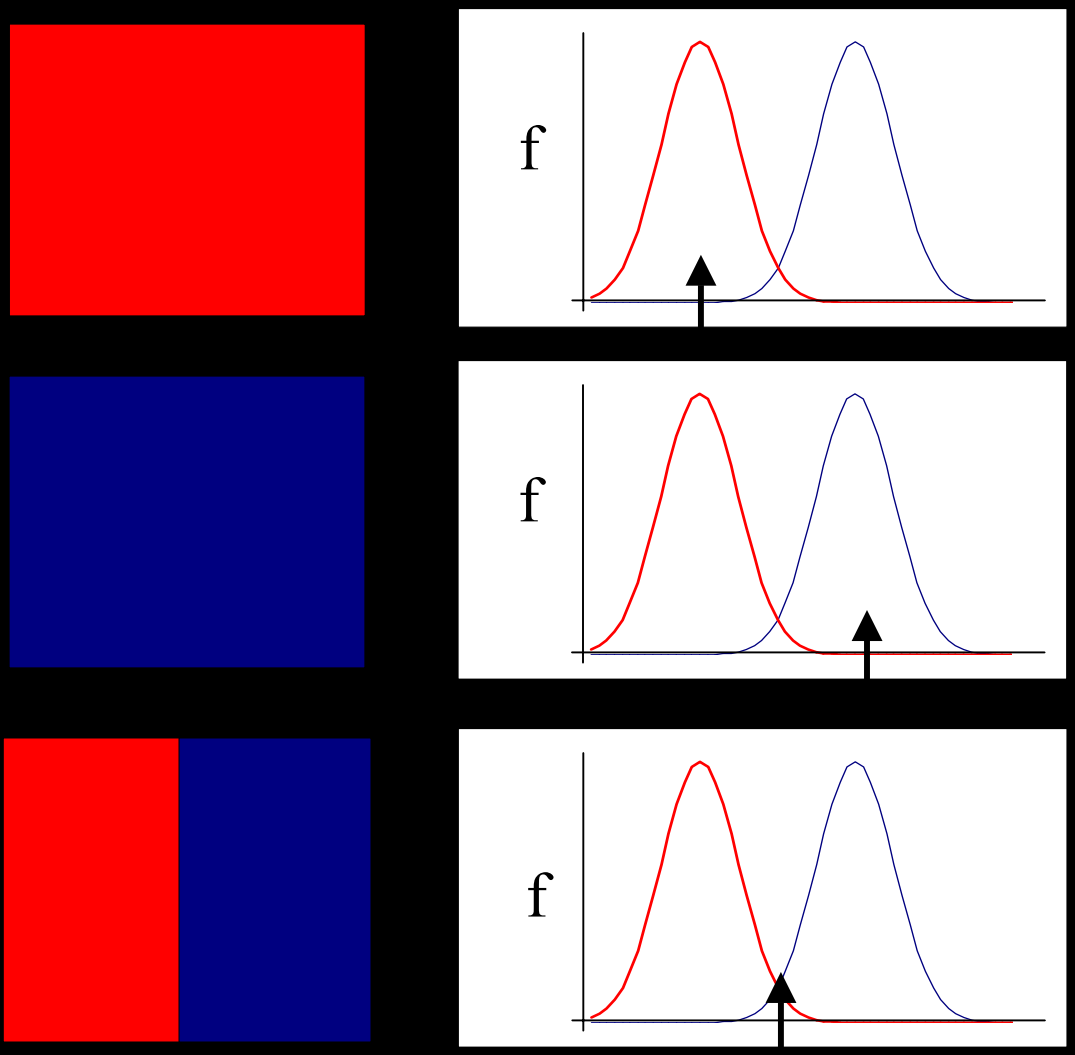
•Classification uncertainty caused by sub-pixel heterogeneity

•Cost of High resolution data > Cost of Coarse resolution data

Form of Solution

•Coarse resolution over homogeneous areas, high resolution over heterogeneous areas

Example

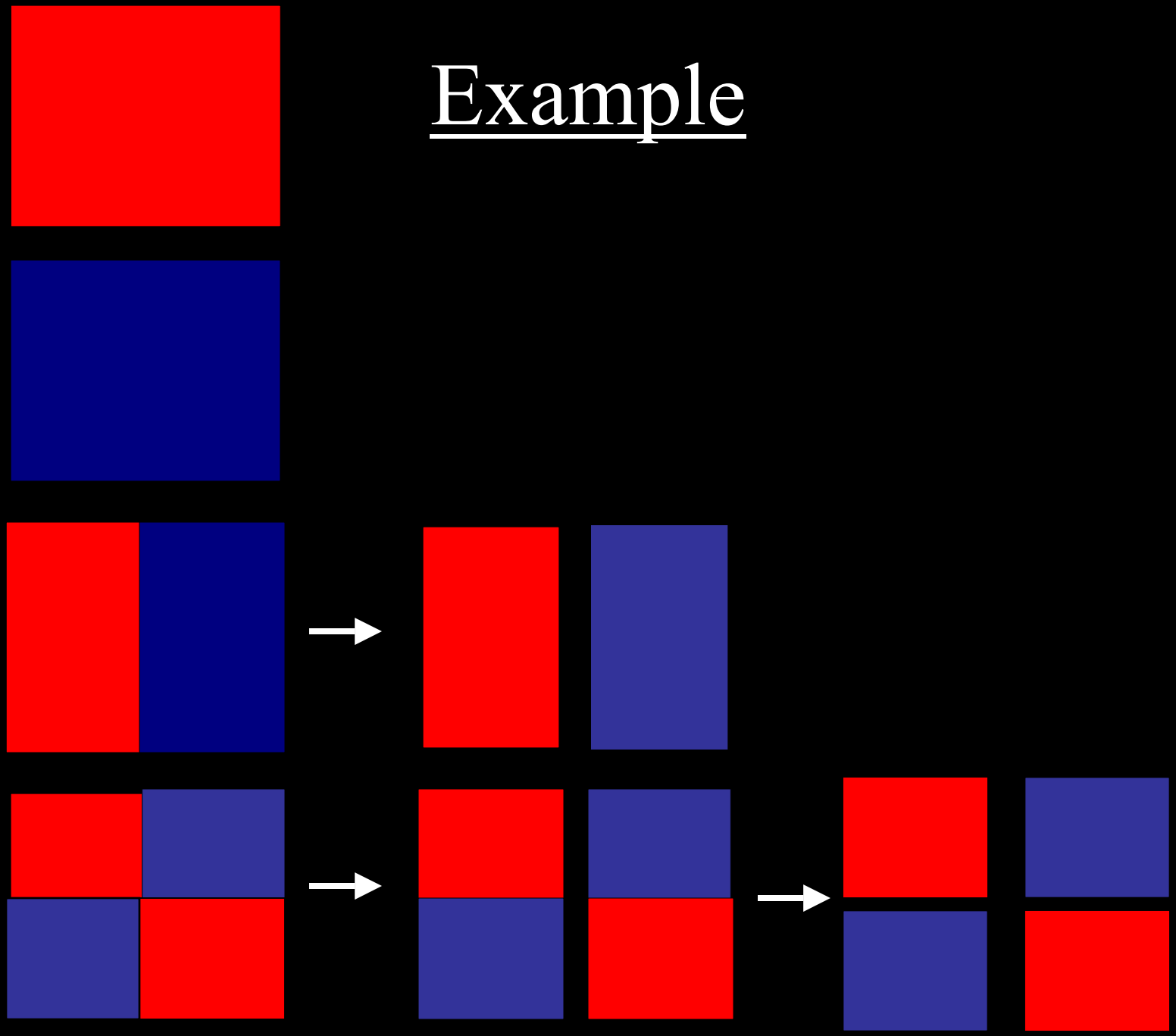


$\geq$ 99% pure red
< 1% pure blue

< 1% pure red
$\geq$99% pure blue

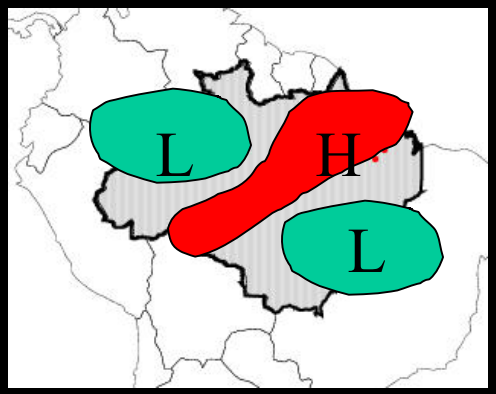
< 5% pure red
< 5% pure blue
…

Example

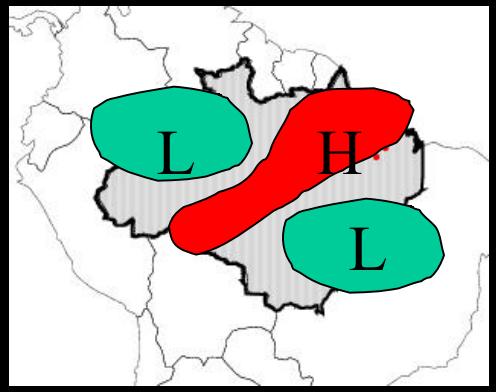


Example

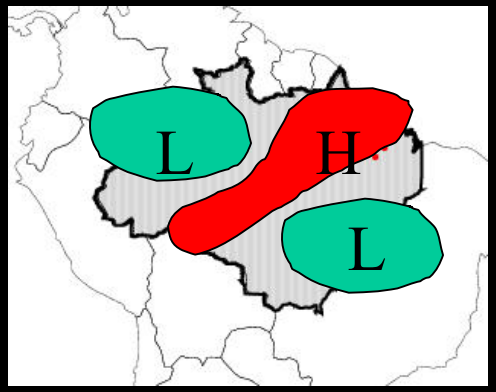
Heterogeneity



Uncertainty at R1



Resolution Needed for u<T



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