THE NASA/CCAD MESOAMERICAN BIOLOGICAL CORRIDOR PROJECT

MONITORING THE MESOAMERICAN BIOLOGICAL CORRIDOR: A NASA/CCAD COOPERATIVE RESEARCH PROJECT

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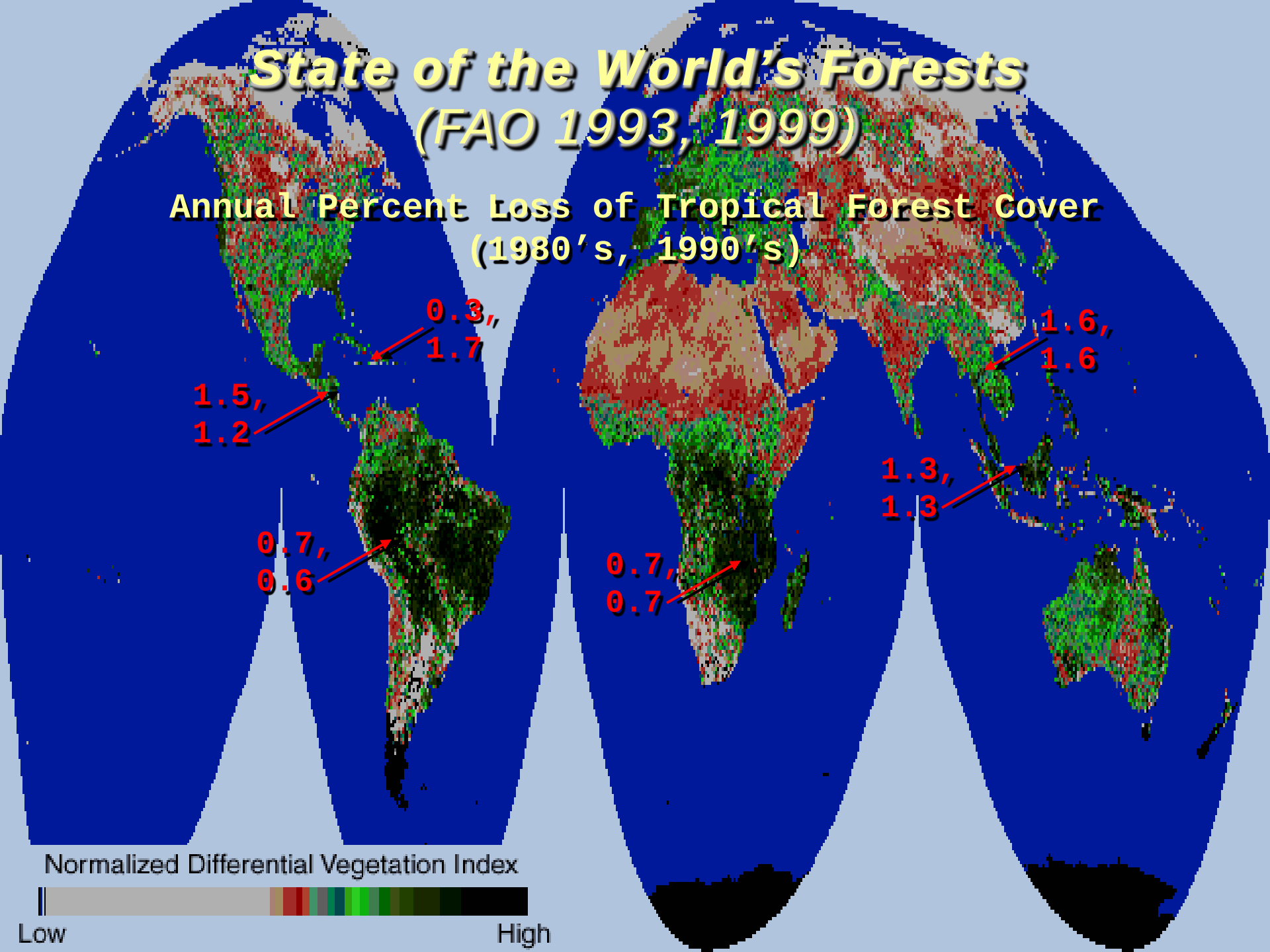
Corridor Concept

Biological Diversity

- Central America represents 1 % of Earth's landmass, but contains 7 to 8% of world's plant and animal species

State of the World's Forests
(FAO 1993, 1999)

Annual Percent Loss of Tropical Forest Cover
(1980's, 1990's)



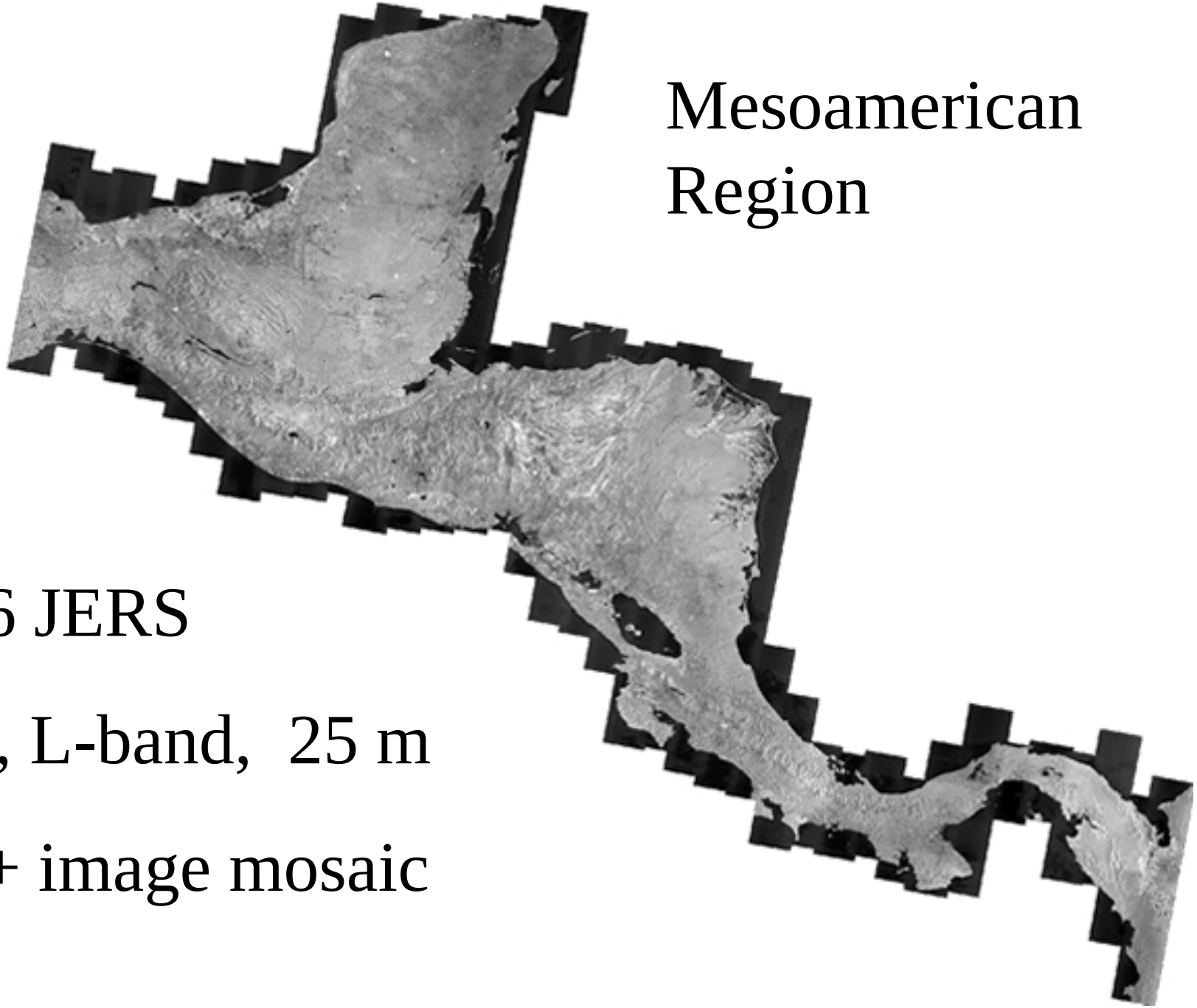
Scientific Objectives -

•What are the changes in land cover/land use in Central America, within and outside of the Mesoamerican Biological Corridor - MBC?

•What is the current status of forest cover in the MBC zone?

NASA/CCAD Mesoamerica Biological Corridor Monitoring Project

- Develop regional satellite data sets(JERS, MODIS, Landsat TM).
- Land cover/Land use mapping of Central America
- Analysis of forest cover and change throughout a range of life zones in the region.
- Validate TM land cover and forest change to support MODIS and JERS regional mapping.
- Predict forest cover scaling up from TM to MODIS.
- Develop landscape metrics to measure forest fragmentation for landscape characterization in MBC zones.
- Compare forest patch metrics between TM (30m) and MODIS (250 and 500m).
- Develop research partnerships with Central America scientists.

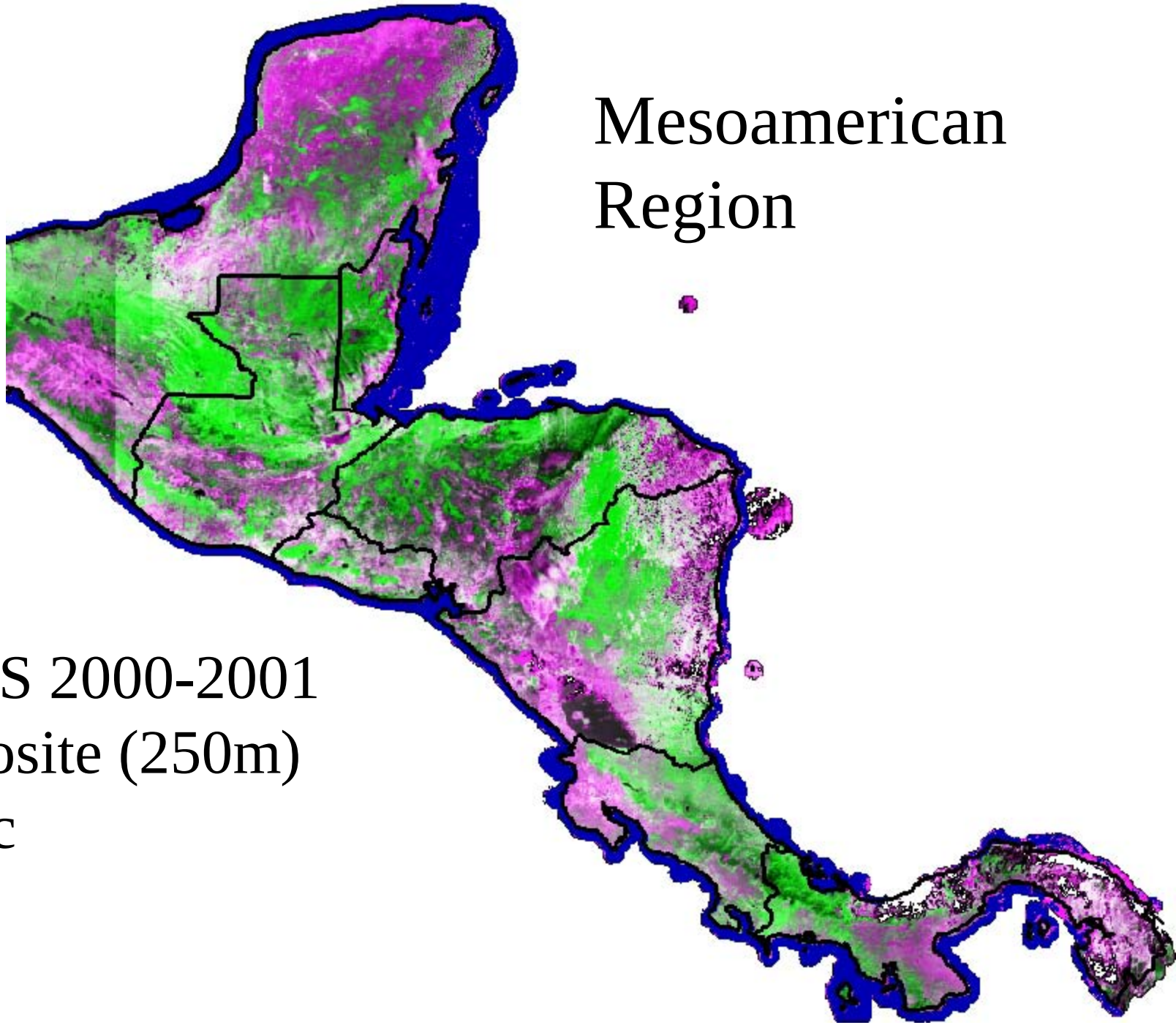


Mesoamerican Region

1996 JERS

HH, L-band, 25 m

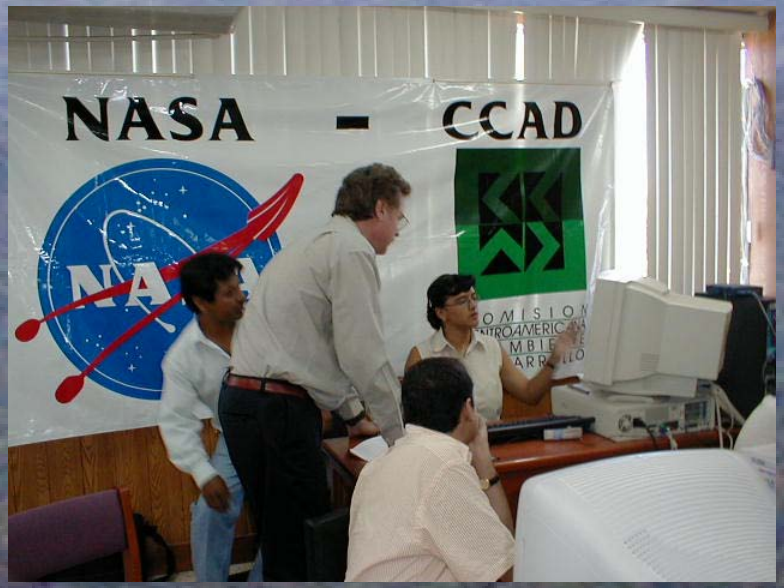
300+ image mosaic



Mesoamerican Region

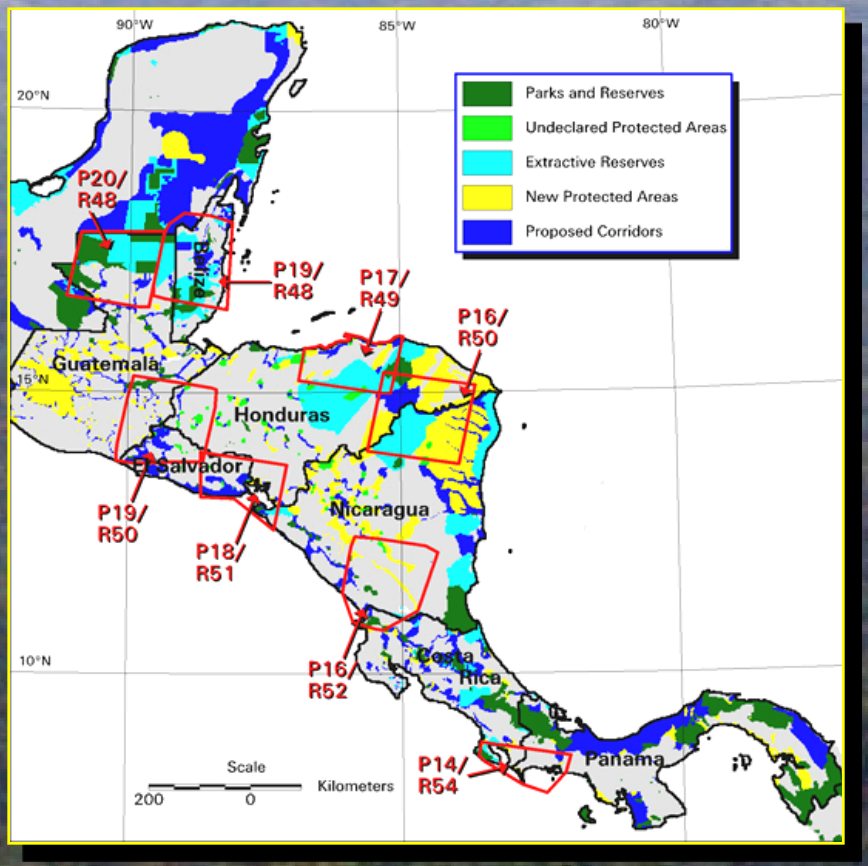
MODIS 2000-2001 Composite (250m) Mosaic

Training Workshops



Map Validation Workshop

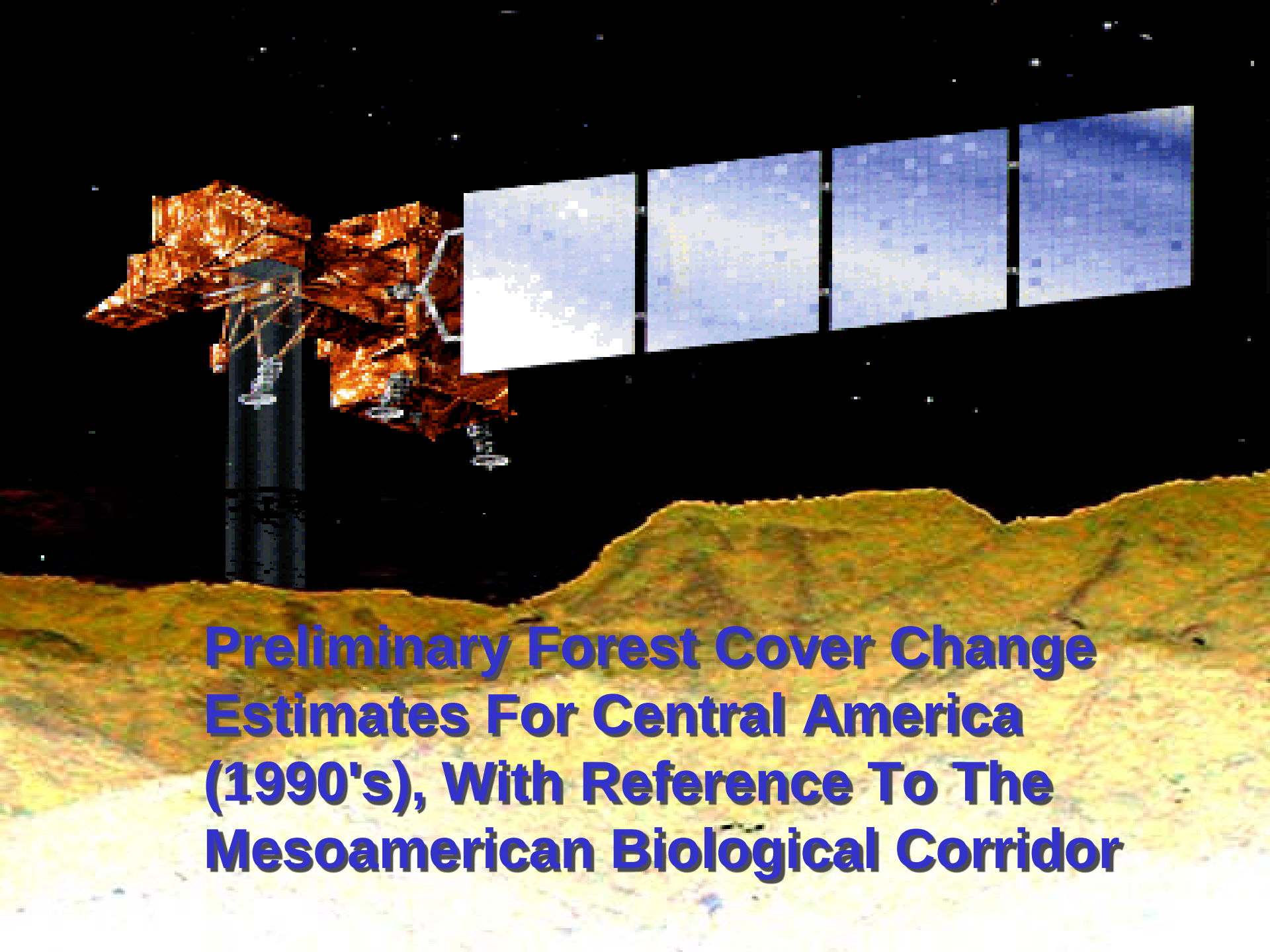
Nov. 12-15, 2001 Managua, Nicaragua



TM Intensive study sites

Sampling the Corridor:

- Land Cover
- Forest Area
- Forest Change



Preliminary Forest Cover Change Estimates For Central America (1990's), With Reference To The Mesoamerican Biological Corridor

Forest Cover Change

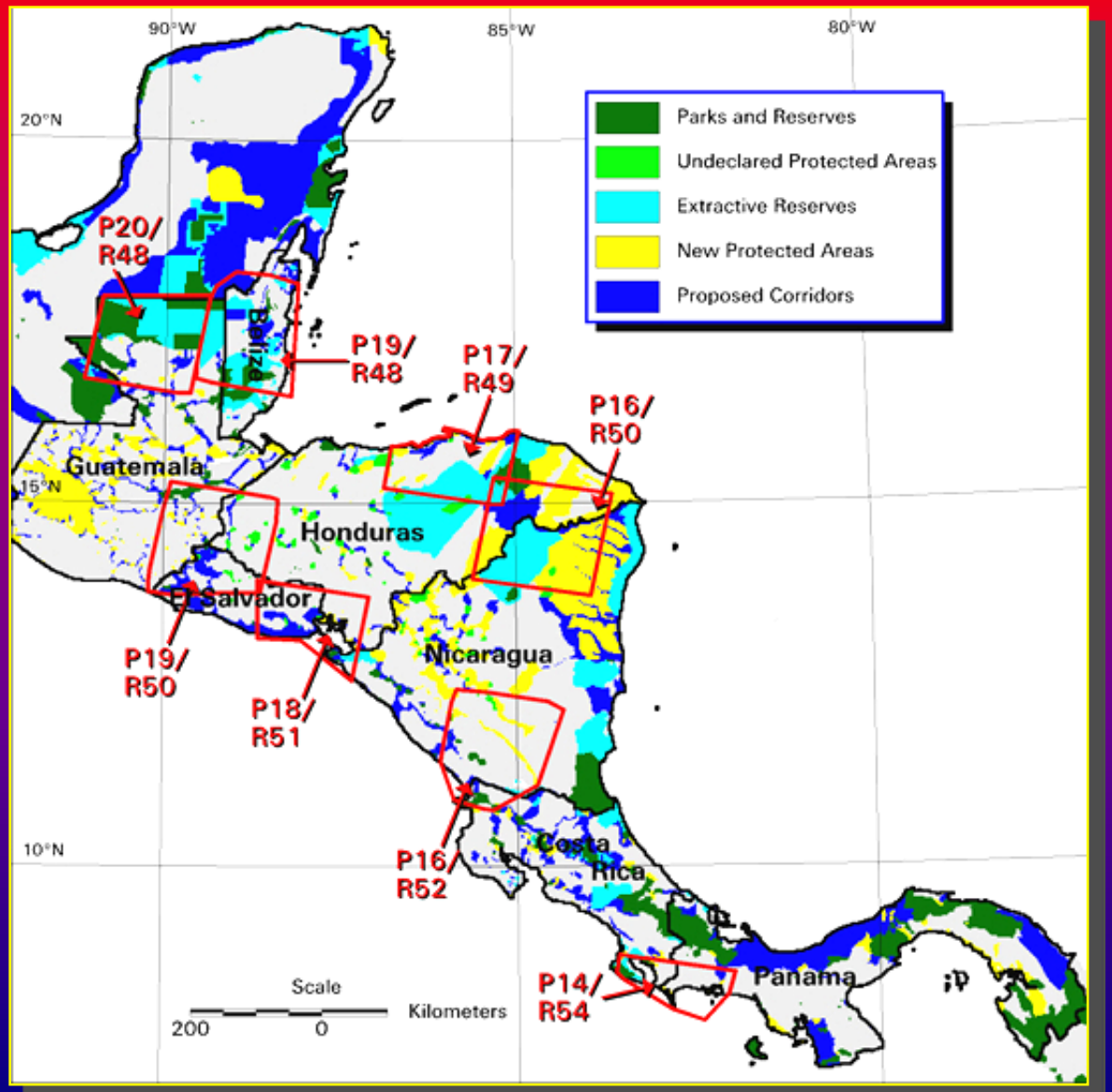
Objectives

1. estimate forest clearing rates (1990s) in Central America based on multi-temporal analysis of seven well-distributed Landsat TM scenes;

2. compare forest clearing rates inside and outside of protected areas of the proposed MBC; and

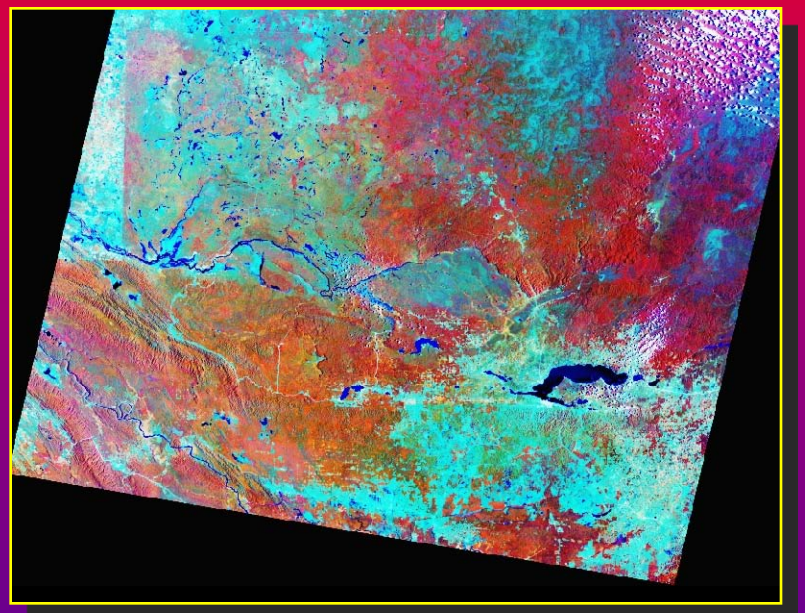
3. compare the area and percentage of forest cover in the protected areas using the most recent date of Landsat (1996 to 1998).

Forest Cover Change

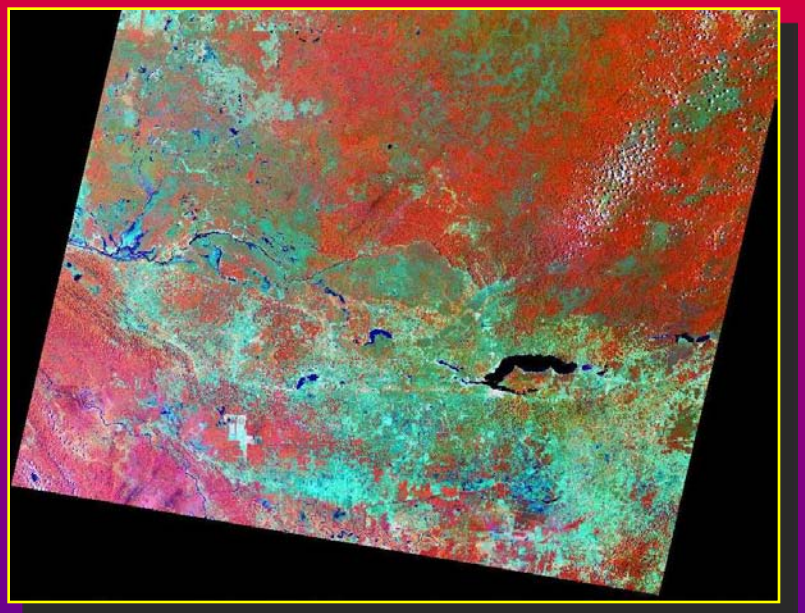


Forest Cover Change

Land Cover and Forest Change Classification



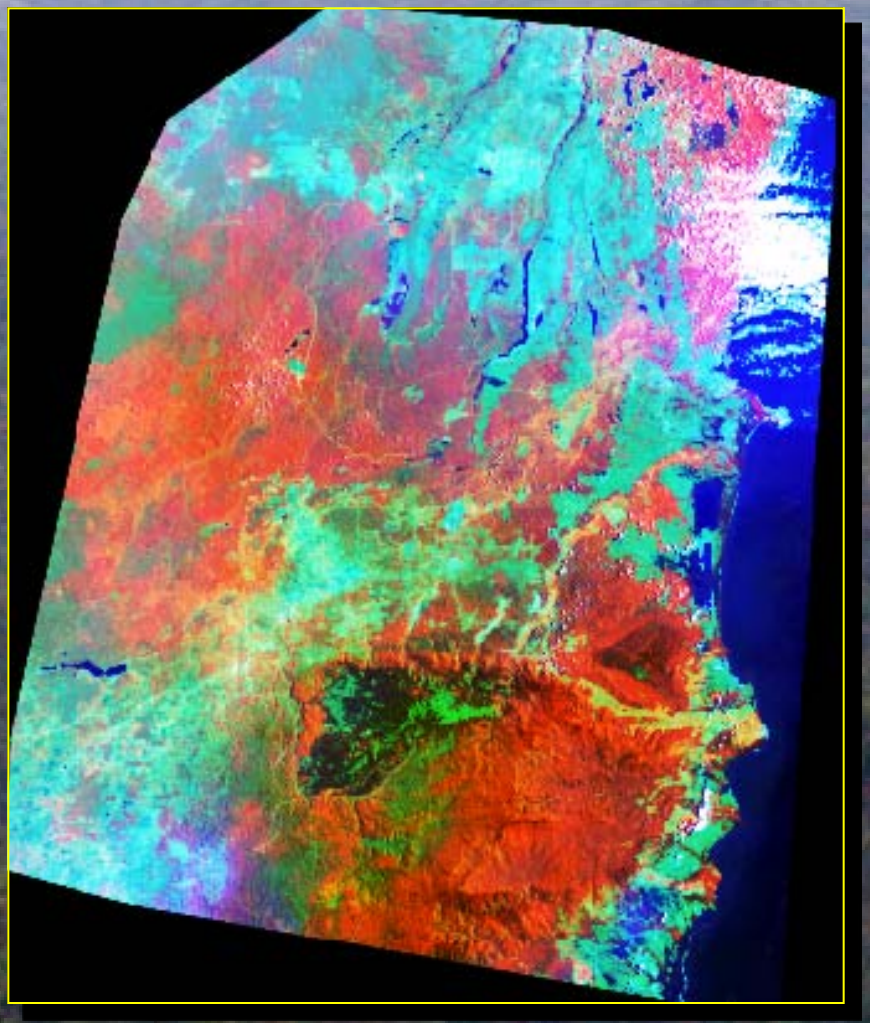
PATH 20 / ROW 48
14 APRIL 1986
RGB 453



PATH 20 / ROW 48
12 APRIL 1997
RGB 453

Los Sitios Intensivos:

Classificación de Cobertura de la Tierra



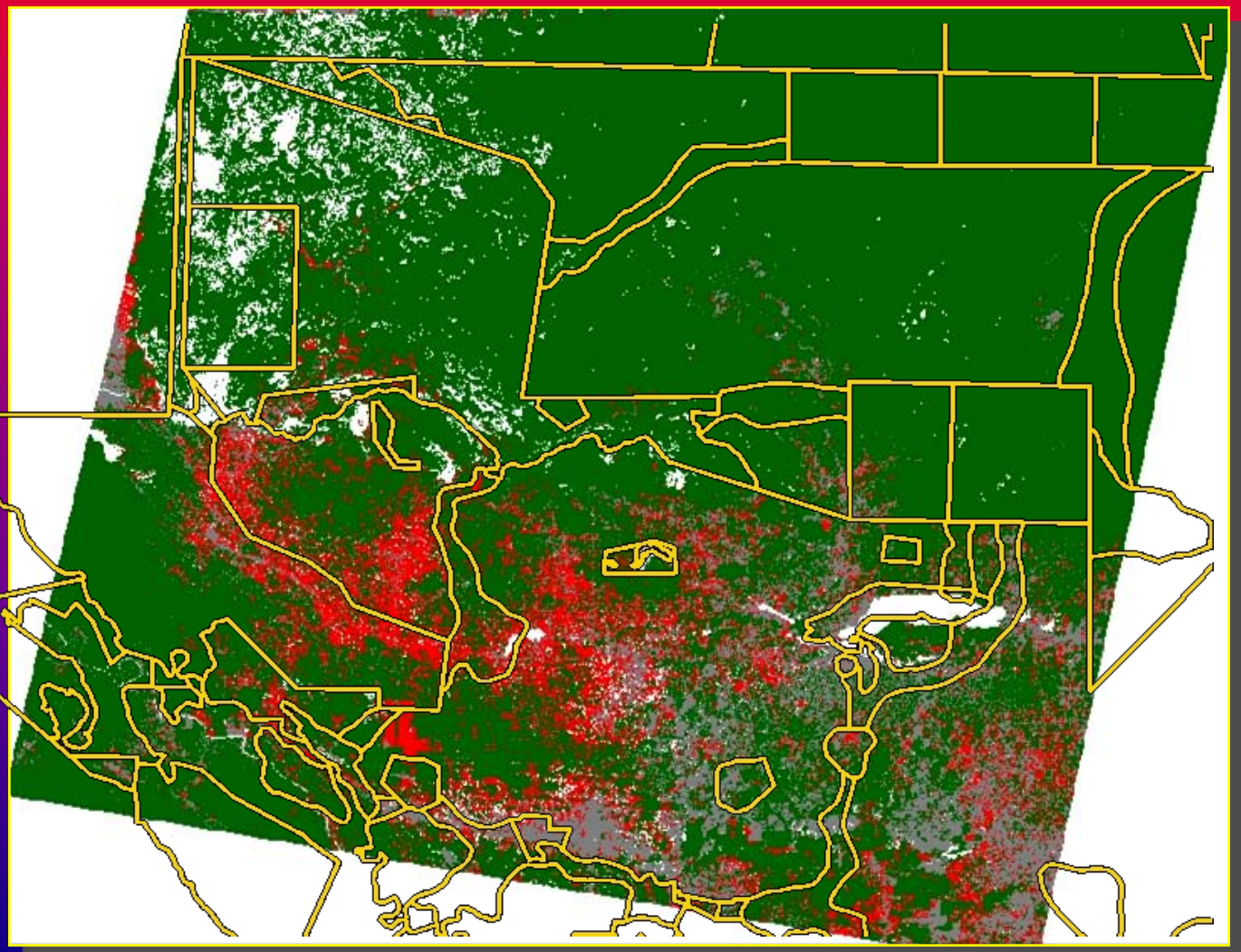
PROCEDURES:

1. Generate Data Layers
2. Initiate unsupervised clustering
3. Analyze / Inspect Clusters
4. Use *Spectral* Classes and Banco Mundial polygons to select training areas for "confused" classes
5. Supervised clasification

P19 R48 RVA 453

Forest Cover Change

Forest Cover and Forest Change Rates



Forest Cover Change

Forest Cover and Forest Change Rates

Annual forest clearing rates within the protected and proposed MBC zones, by TM site

Landsat Path/Row	% of MBC area in Forest	%/Year Forest Cleared in MBC	# Years
14 / 54	65.70%	0.17%	11
16 / 50	87.80%	0.15%	10
17 / 49	75.80%	0.33%	11
18 / 51	31.00%	0.34%	8
19 / 48	89.60%	0.31%	9
19 / 50	26.30%	0.60%	7
20 / 48	92.90%	0.32%	11
Total	80.40%	0.26%	10

Forest Cover Change

Forest Cover and Forest Change Rates

Annual forest clearing rates for protection zones of the proposed MBC; all TM sites combined, based on a 10 year median.

Protection Zone Status	Area of Forest Remaining (km^2)	%Forest Remaining	%/Year Forest Clearing
Parks and Reserves	812	93.77%	0.25%
Undeclared Protected Are	854	57.23%	0.26%
Extractive Reserves	24,123	91.48%	0.15%
New Protected Areas	12,692	76.17%	0.22%
Proposed Corridor	9,169	58.87%	0.57%
MBC Total	57,358	80.42%	0.26%
Outside the MBC	19,196	30.79%	1.44%
7 Countries Total	76,554	57.27%	0.58%

Forest Cover /Change

Significant Results

* 80% forest cover inside the protected zones compared to 31% outside based on 31% sample of region. MBC status affords some level of protection.

* There are some MBC segments and designated zones that have very low proportions of forest cover. This has implications for restoring function of MBC and biodiversity.

* "Proposed" corridor zone only 59% forest cover (90's) and annual clearing twice as high(0.57%) as any other MBC zone. This is important consideration for CCAD in maintaining proposed habitat links in MBC

* These preliminary forest change estimates are lower than FAO estimates (1.2-1.5%) for late 80's to mid 90's.

Mapping the Mesoamerican Biological Corridor

Land Cover and Forest Change Map Validation Workshop

AGENDA:

- Introduction / Background
- Land Cover Classification and Change Detection Methods
  (Landsat TM Intensive Study Sites)
- TM Map Validation, Part I
  (Interpretation of Sample Points for Reference Data)
- Regional Mapping and Monitoring
  (Introduction to MODIS Data)
- TM Map Validation, Part II
  (Assessment of Classification Accuracy)

Future Research

MODIS

500 / 250 m
Regional Monitoring
Repeat Coverage

Landsat 7

30 / 15 m
Scaling up-MODIS
Land Cover and
Change Detection

Ikonos

4 / 1 m
Ground reference
Sub-pixel training

Schedule

Data Analysis	2001							2002											
	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Land Cover Classification	-------																		
Forest Change Detection	-------																		
Forest Fragmentation/ Landscape Metrics					----------														
Forest Second-Growth/Biomass	----------																		
IKONOS		----------																	
MODIS/TM			----------																
Corridor GIS								----------											
Validation																			
Land Cover Map			--------																
Forest Change			--------																
Forest Second-Growth				-------															
Workshop																			
Validation Procedures			-----																
Reports/Manuscripts																			
Progress Report	*											*							
Land Cover					*														
Forest Change					*														
IKONOS						*													
Forest Second-Growth							*												
MODIS/TM								*											
Forest Fragmentation/Metrics									*										
Corridor GIS												*							

Recent Manuscripts

Hayes, D.J. and S.A. Sader. 2001. Change Detection Techniques for Monitoring Forest Clearing and Regrowth in a Tropical Moist Forest. *Photogrammetric Engineering and Remote sensing 67(9):1067-1075.*

Hayes, D.J., S.A. Sader, and N.B. Schwartz. Analyzing a forest conversion history database to explore the temporal and spatial characteristics of forest change *Landscape Ecology*. In Press.

Sader, S.A., D.J. Hayes, M. Coan, J.A. Hepinstall, T.L. Sever and C. Soza 2001. Forest change monitoring of a remote biosphere reserve. *International Journal of Remote Sensing* 22(10):1937-1950

Sader S.A.,D.J.Hayes, D.Irwin and S.Saatchi 2001. Preliminary forest cover change estimates for Central America (1990's) with reference to the Mesoamerican Biological Corridor. ASPRS 2001 St.Louis, MO

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Monitoring the Mesoamerican Biological Corridor

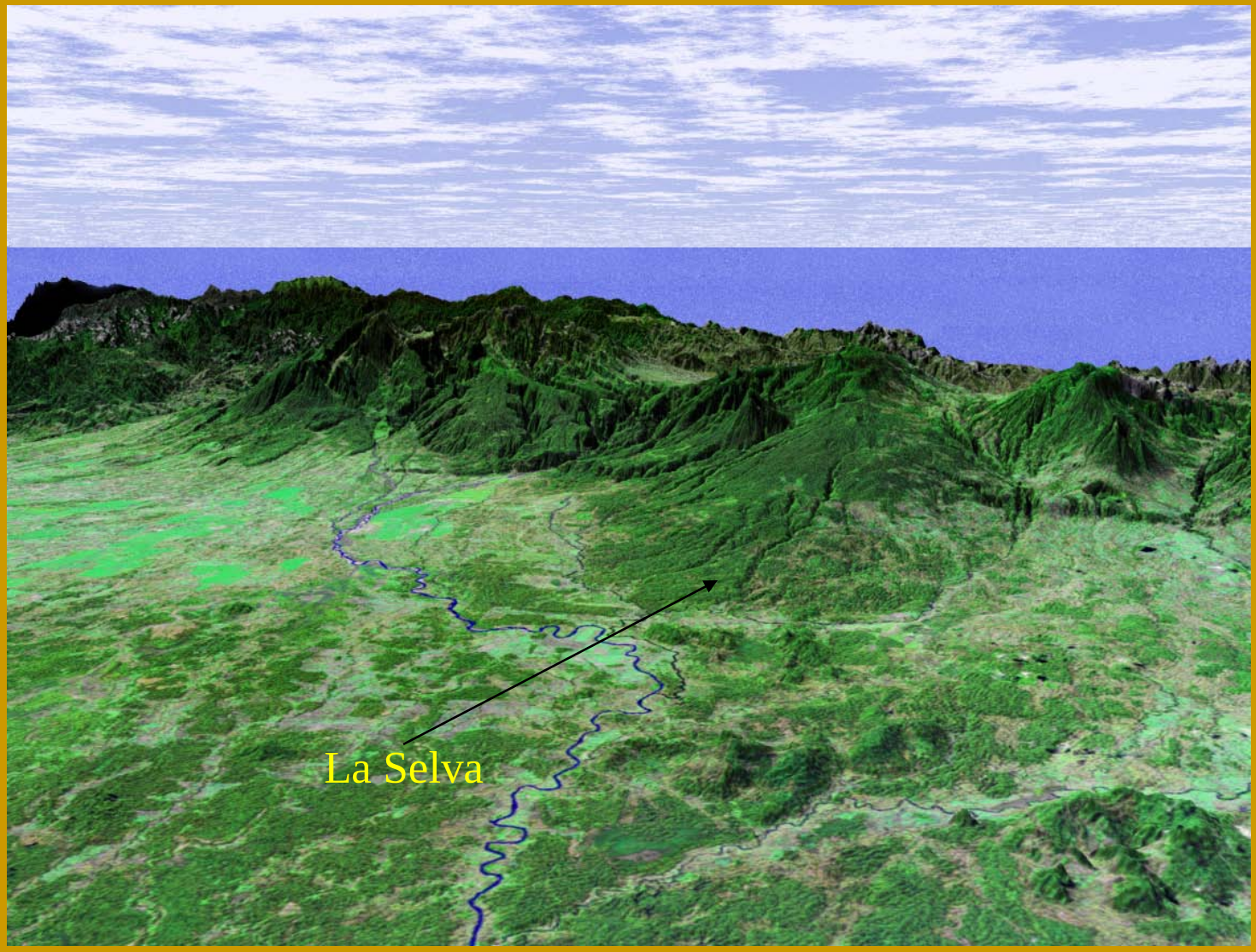
Gaps/Issues:

Optical data acquisitions for regional mosaics (Landsat and MODIS) are hampered by clouds in Panama and eastern Honduras ,especially. We need more seasonal MODIS data to prepare a good temporal mosaic and support the forest/land cover mapping.

We need the SRTM DEM to ortho-rectify the regional mosaics in the mountainous Central American region.

There are institutional barriers in getting our CCAD country cooperator working with us as true research partners. For example , government agency technicians (rather than university researchers) have been appointed as our working partners. There are also equipment and software limitations. Despite the fact that we have an MOU, the cooperators cannot seem to perform some routine analysis tasks or get release time from their employers without significant bureaucratic intervention for each request. We made this point strongly at our meetings (during the June 2001 NASA Delegation visit) in El Salvador. We have CCAD participant cooperation in validation activities scheduled for November, 2001.

Landsat TM
Draped On
SRTM DEM



Northeast Costa Rica -Perspective view looking south toward La Selva Biological Reserve

Programmatic Summary

Monitoring the Mesoamerican Biological Corridor

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Programmatic Summary

Monitoring the Mesoamerican Biological Corridor

Scientific Question: What are the changes in land cover/land use in the Central American region?

Proportion of Social Science: 0

GOFC Themes: map/monitor-50%, change-25%, other (training-25%).

New Findings: Nothing to report this period.

New Potential: Nothing to report this period.

Programmatic Summary

Monitoring the Mesoamerican Biological Corridor

New Products:

- JERS-1 regional mosaic (1996) at 100m rectified to 3 arc-second DEM.
- MODIS regional mosaic (2000-2001) at 250m.
- Landsat TM 4,5,3 mosaic (late1980's-early 1990's) at 250m developed from NASA Scientific Purchase (Earthsat geo-rectification).
- CD-ROM containing 3 regional mosaics and other research products delivered by NASA Delegation to Central America in June 2001.