



Mangrove Forest Distributions of the World

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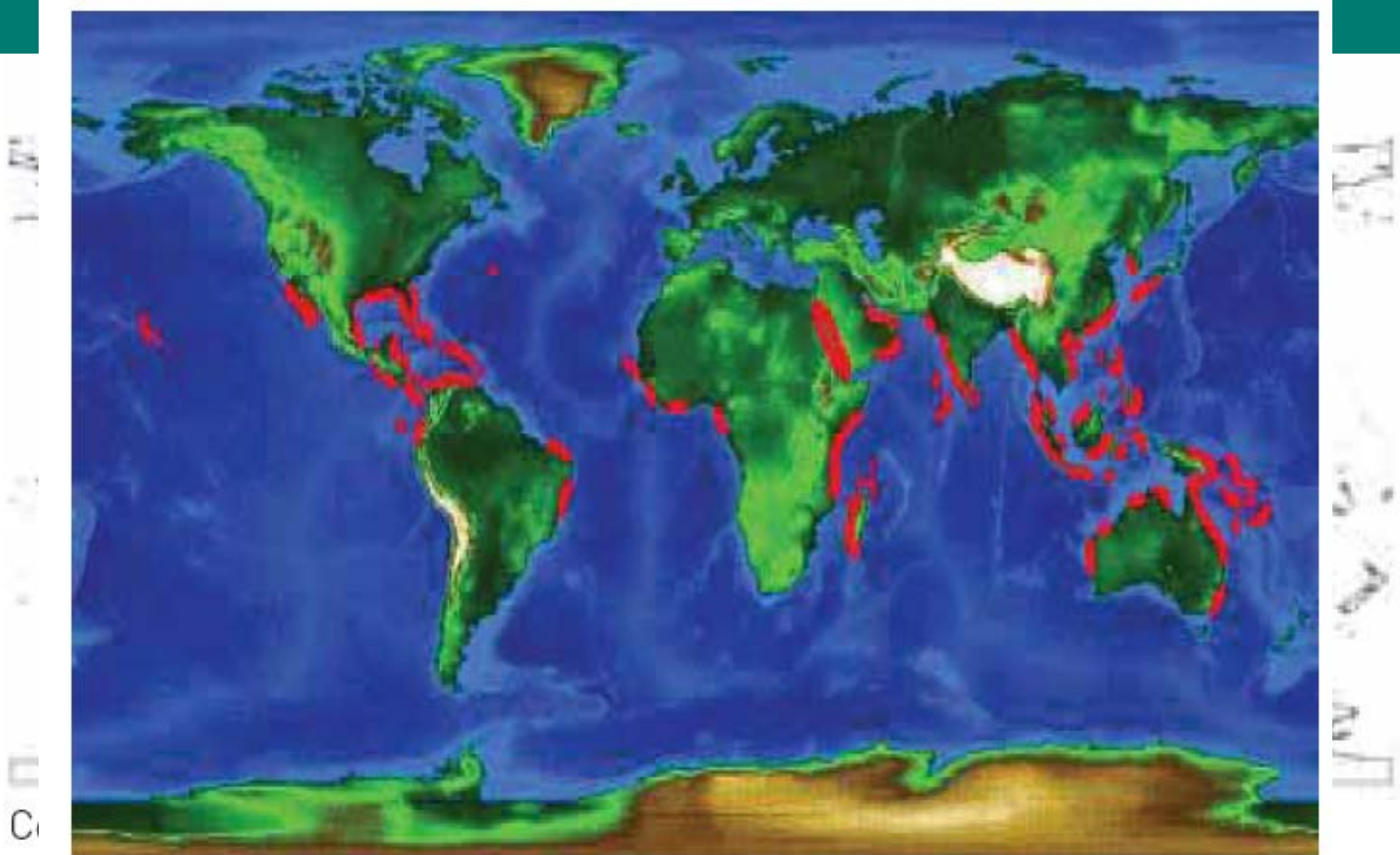
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Ashbindu Singh – United Nations Environment Programme

Norman Duke – University of Queensland, Australia

Outline

- Mangrove Forest Distributions of the World
- GLS Data Issues



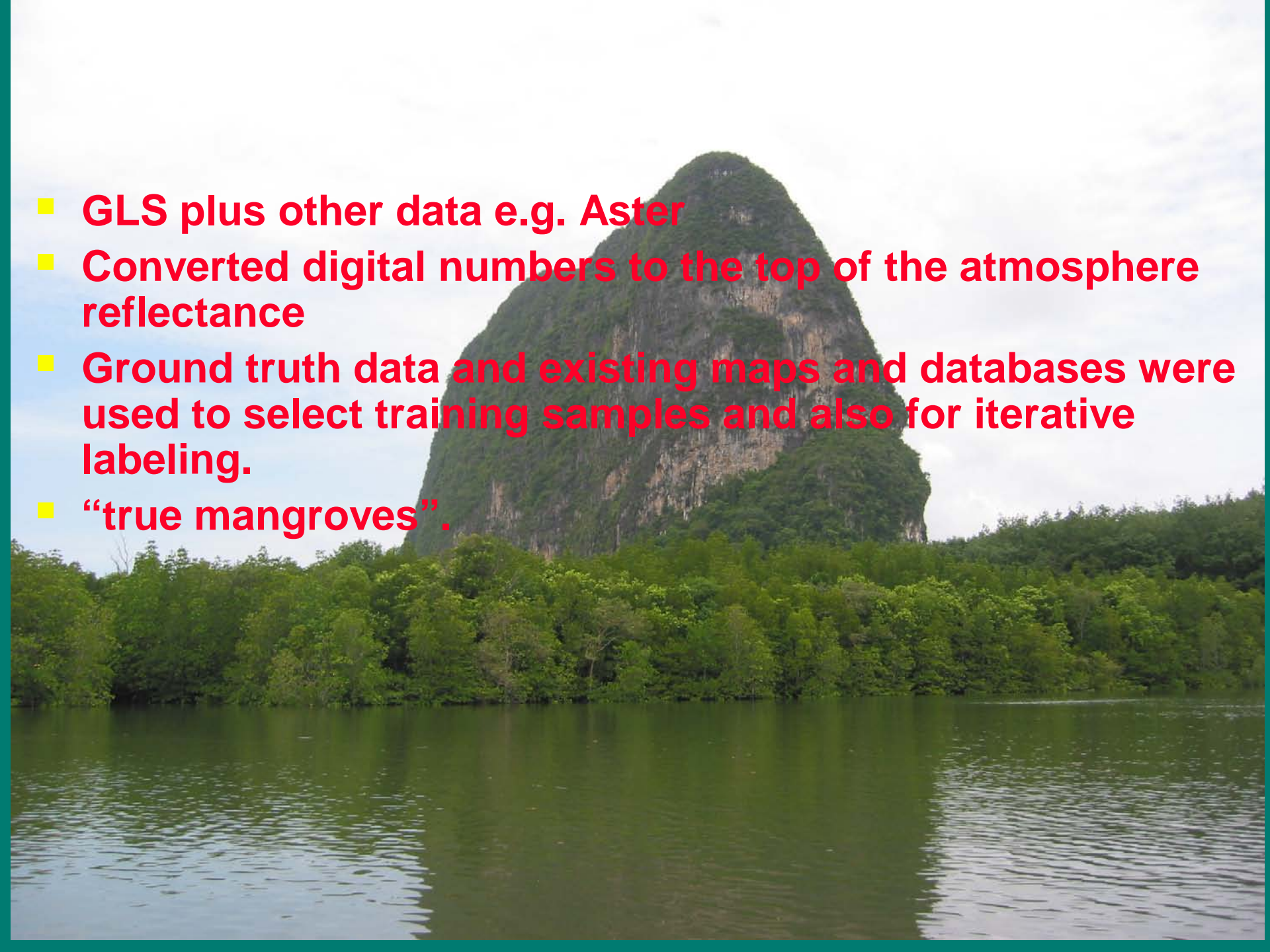
Global distribution of mangroves

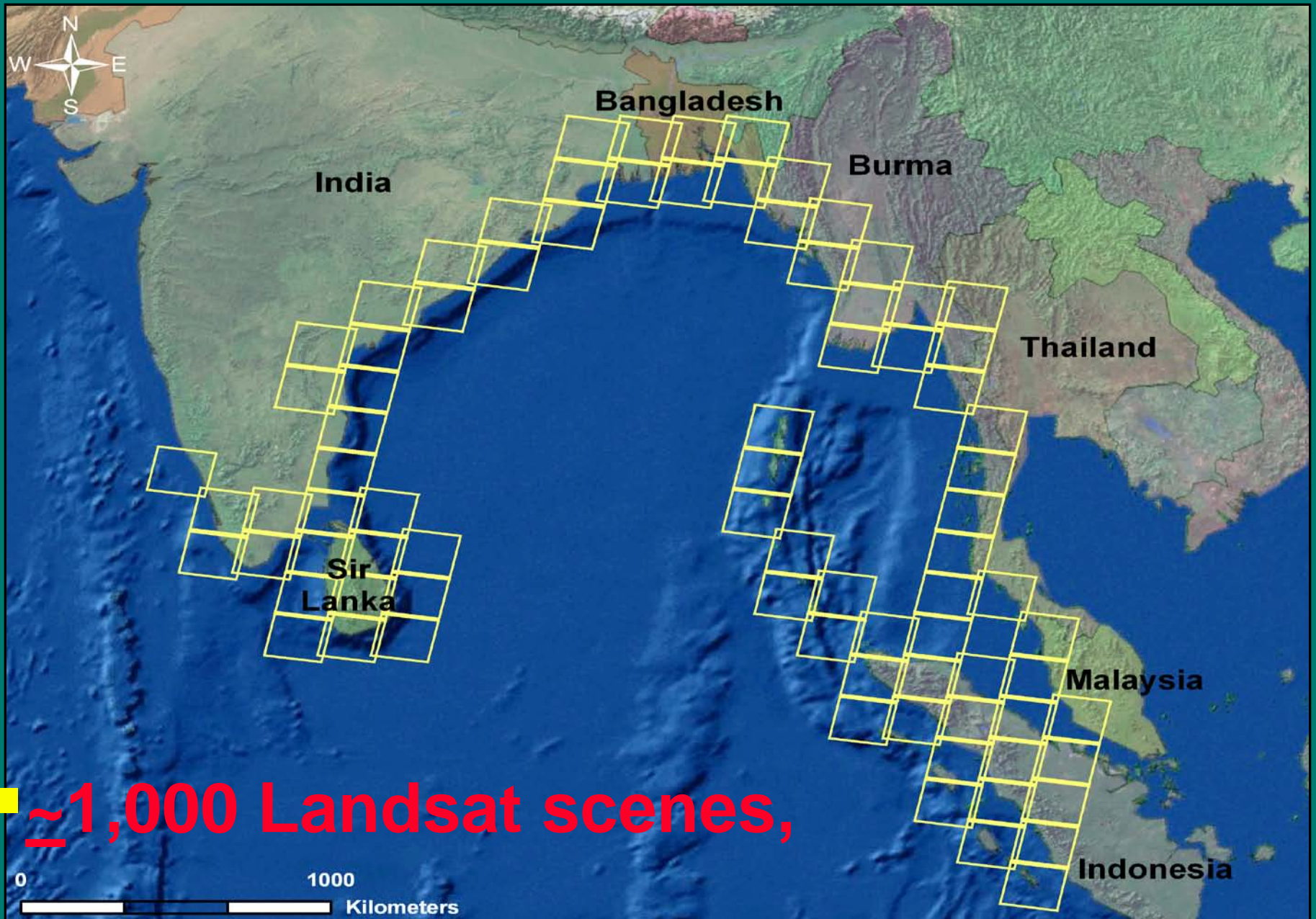


110,000 -240,000 square kilometers

1. GLS

2. Distinct Signature!!

- 
- **GLS plus other data e.g. Aster**
 - **Converted digital numbers to the top of the atmosphere reflectance**
 - **Ground truth data and existing maps and databases were used to select training samples and also for iterative labeling.**
 - **“true mangroves”.**

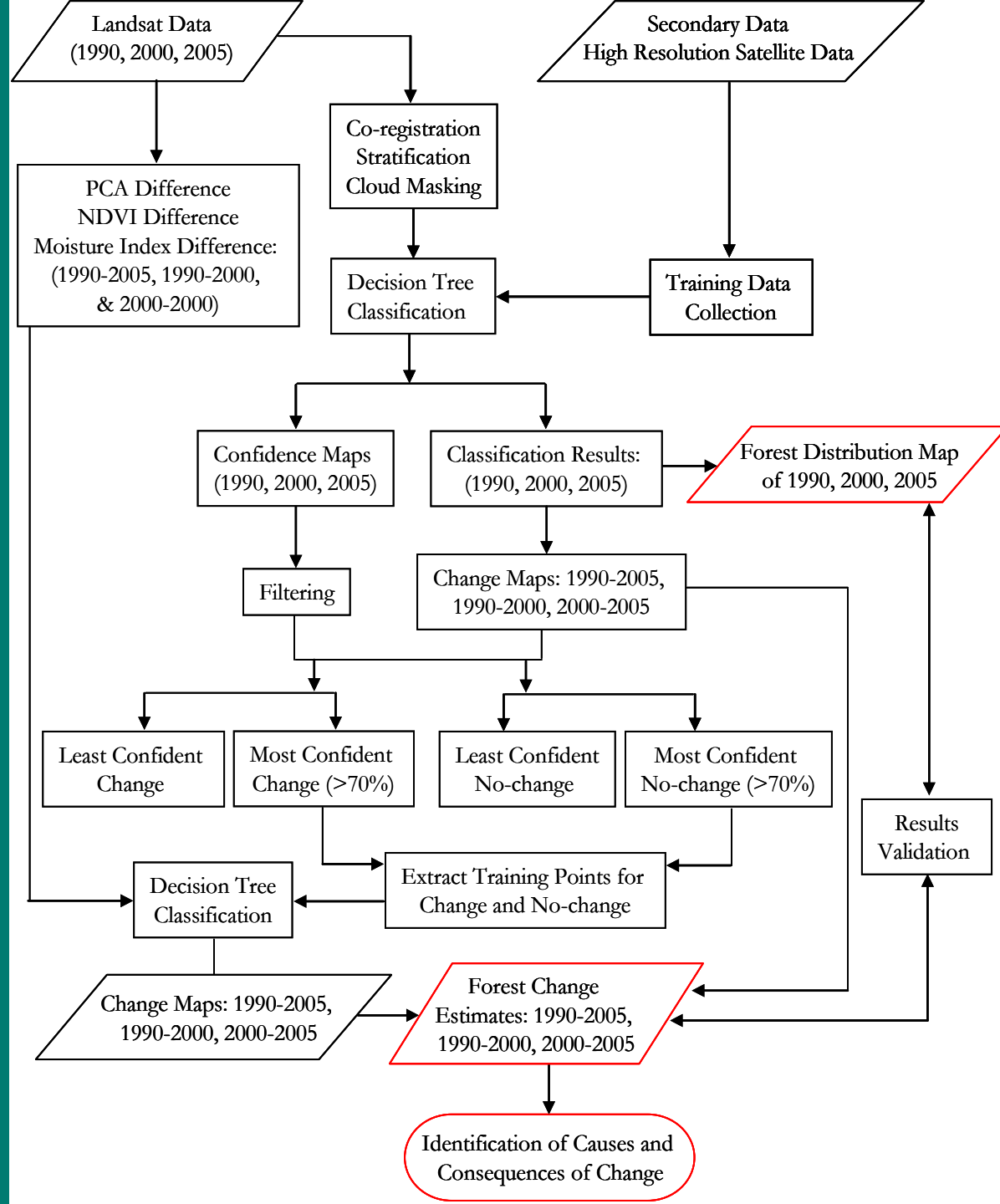


■ $\approx 1,000$ Landsat scenes,

Methodology

AMCTool: Automated Mangrove Classification Tool (IDL 6.3 Envi 4.3)

- Landsat 6 bands
- Elevation
- NDVI
- NDMI



;NDVI expression

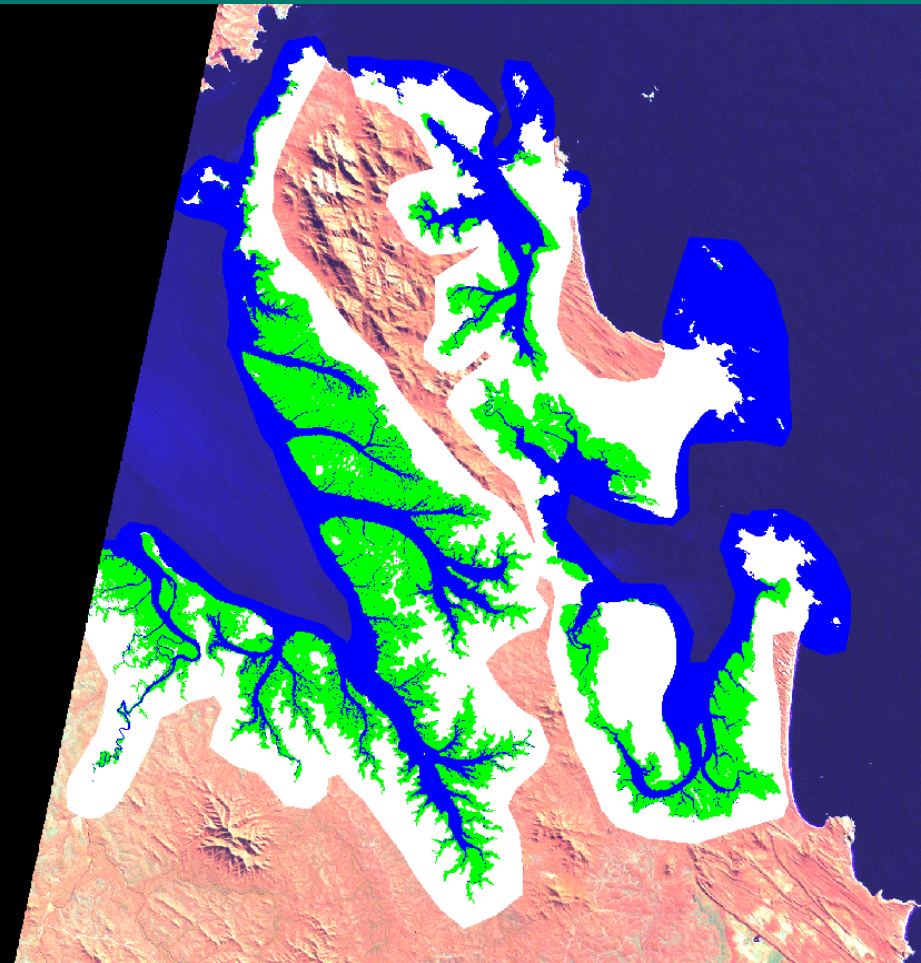
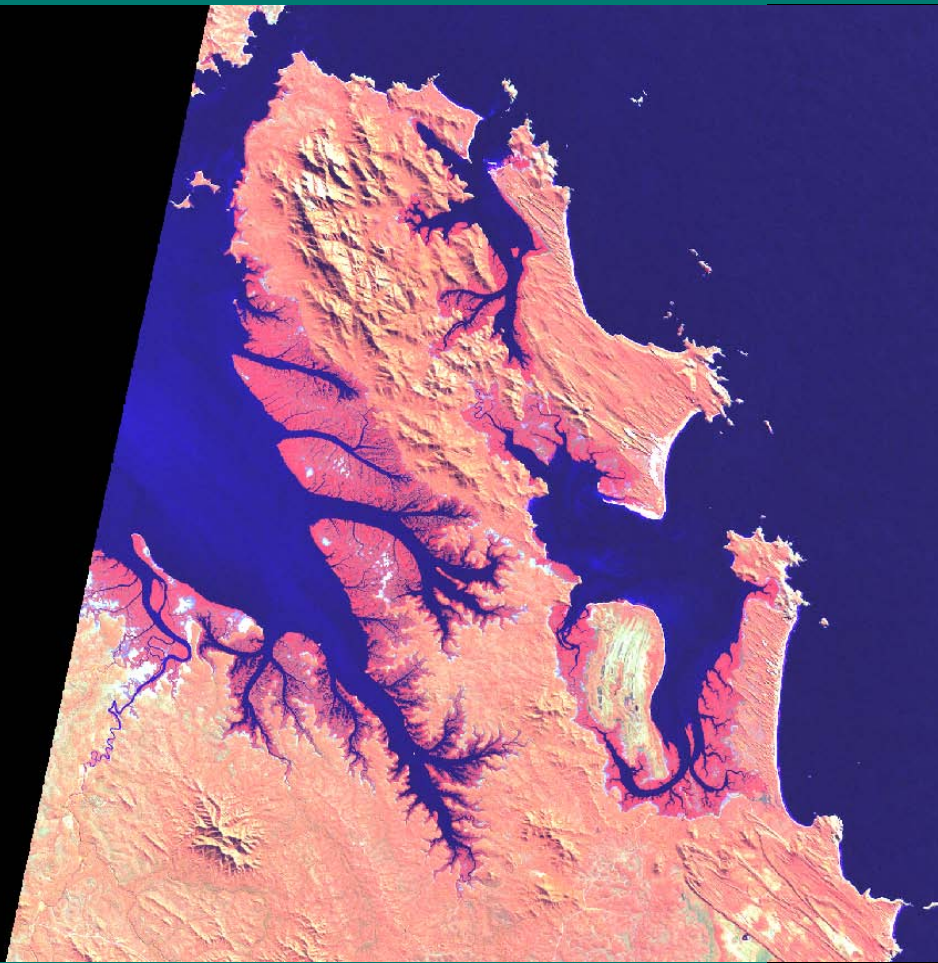
exp_ndvi= '(b1) gt 0.10 '

;NDMI Threshold expression

exp_gt265='((b1) gt -0.21) and ((b1) lt 0.10)'

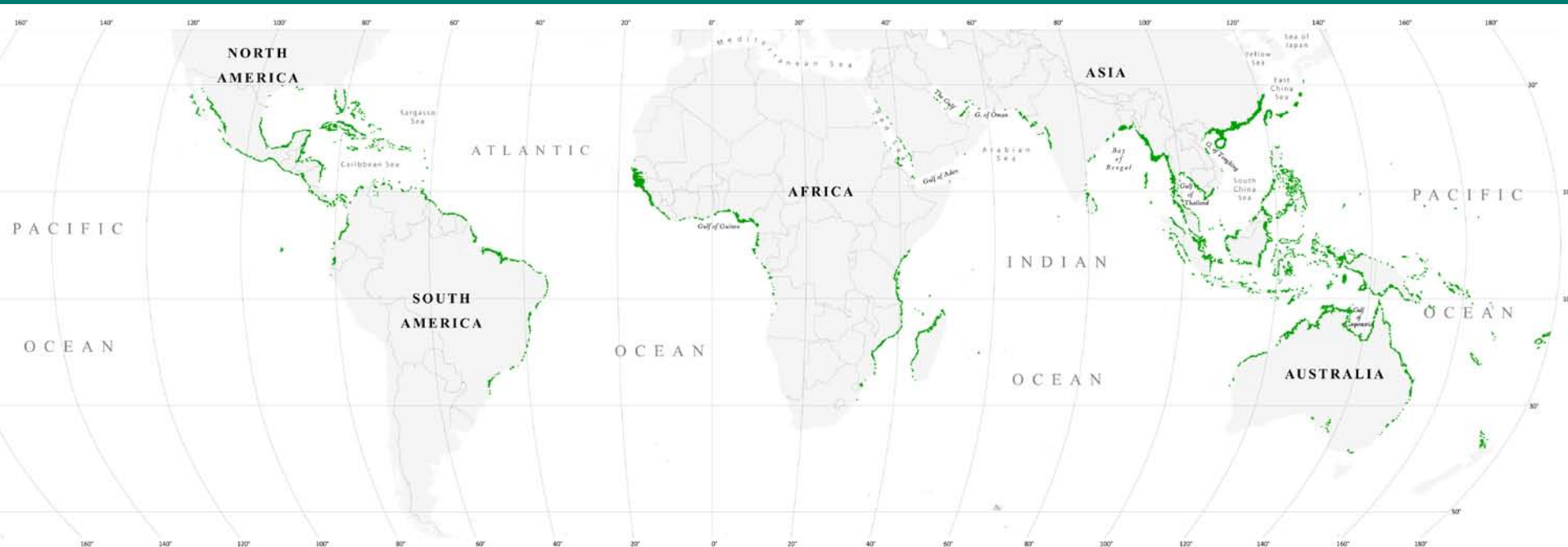
;DEM elevation parameter

exp_dem='((b1) lt 35),



Mangroves & Swamp Forest





- First wall-to-wall map
 - Most comprehensive,
 - globally consistent
 - Very small areas
- 42% in Asia
 - 20% in Africa
 - 15% in North and Central America
 - 12% in Oceania
 - 11% in South America



120°

100°

80°

60°

40°

**NORTH
AMERICA**

Gulf
of
Mexico

Sargasso
Sea

Caribbean Sea

ATLANTIC

Cape Verde

Basin

Cocos Ridge

Orinoco

Japura

Negro

Purus

Madeira

Xingu

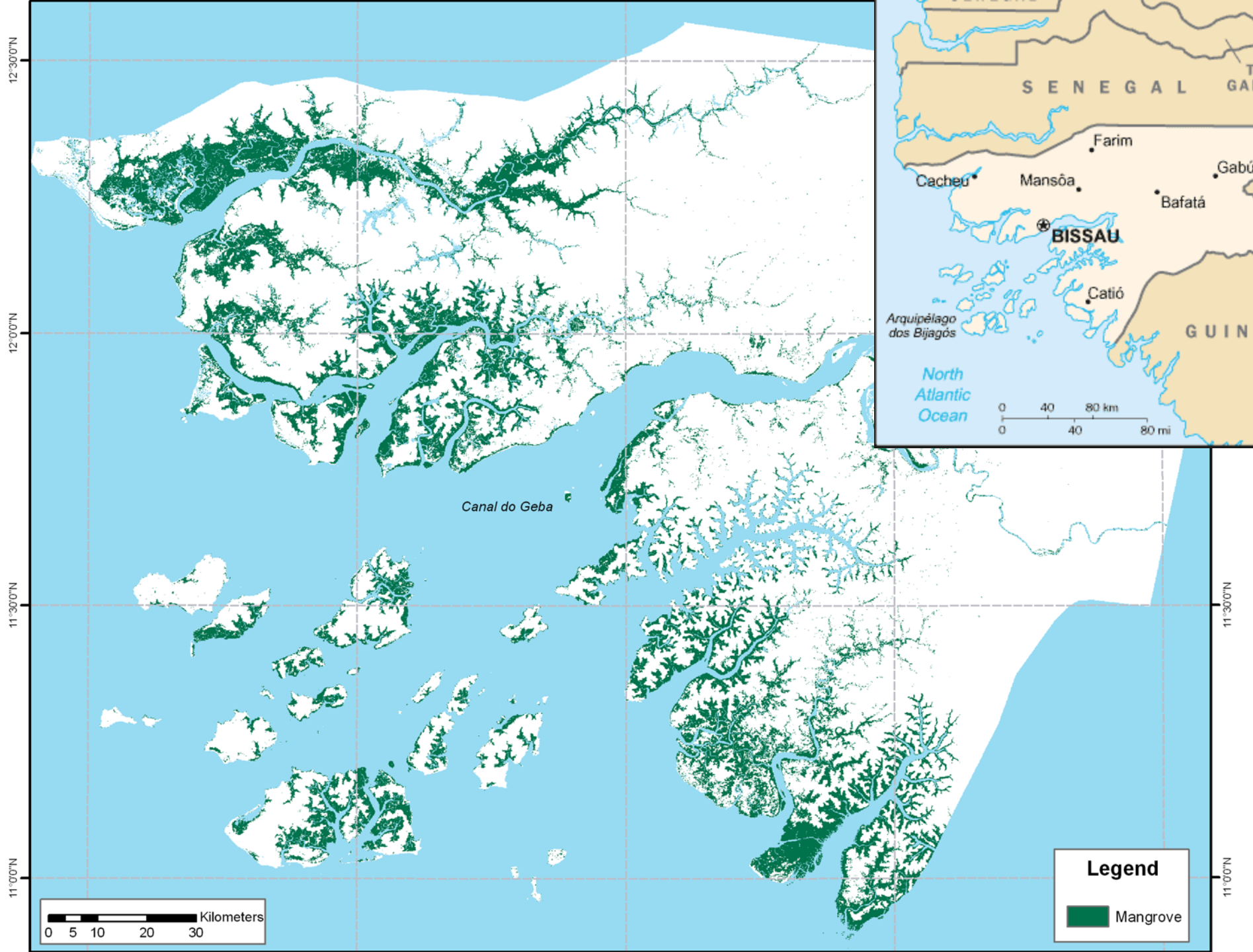
SOUTH

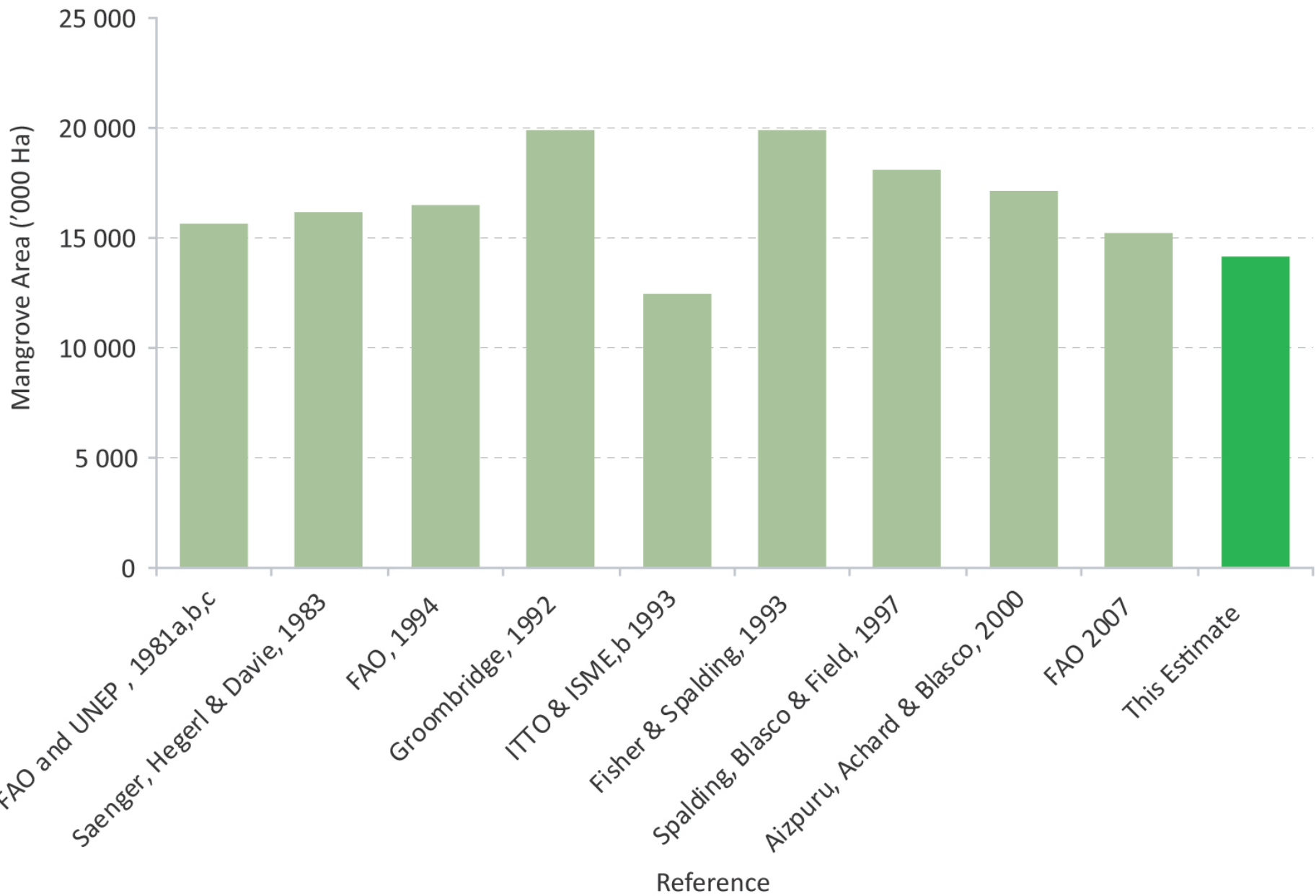
Rise

Atlantic Ridge

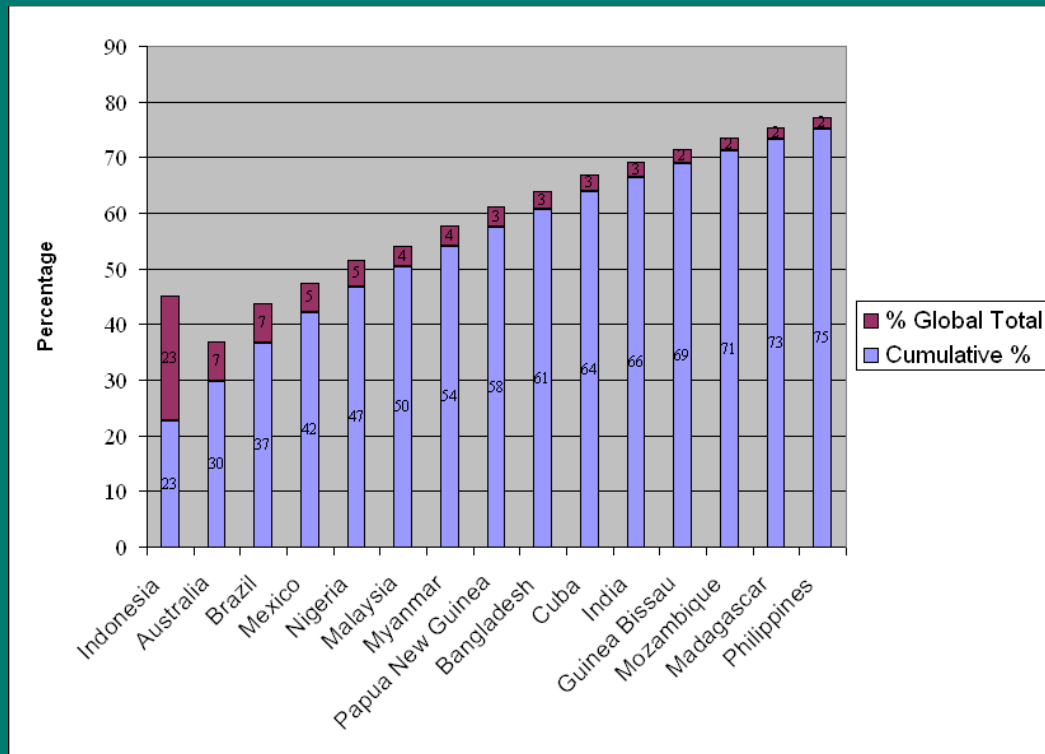
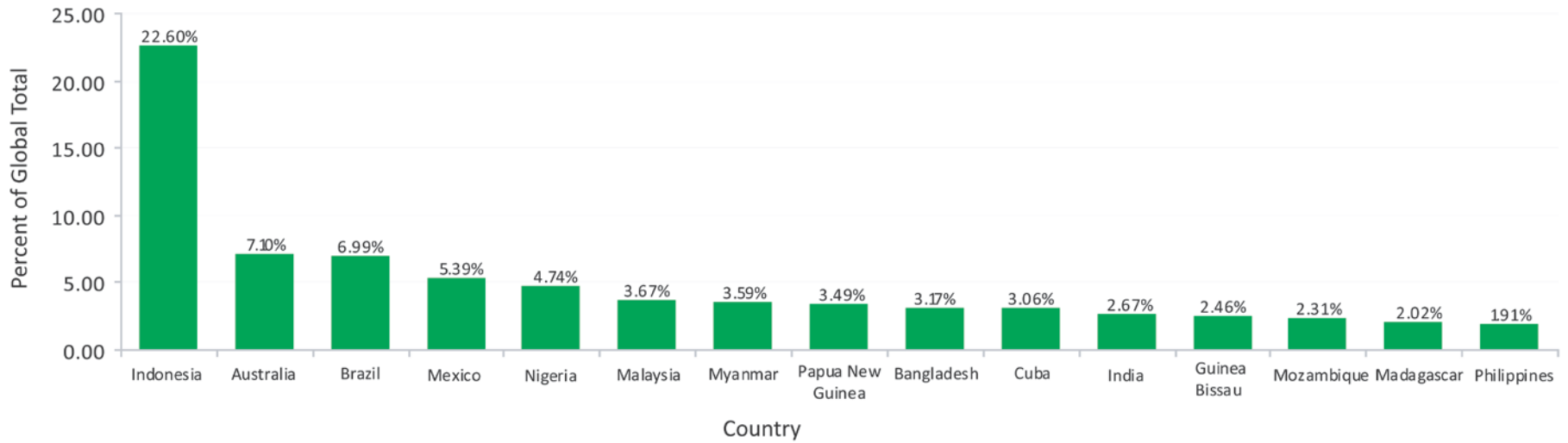








137,760 square kilometers



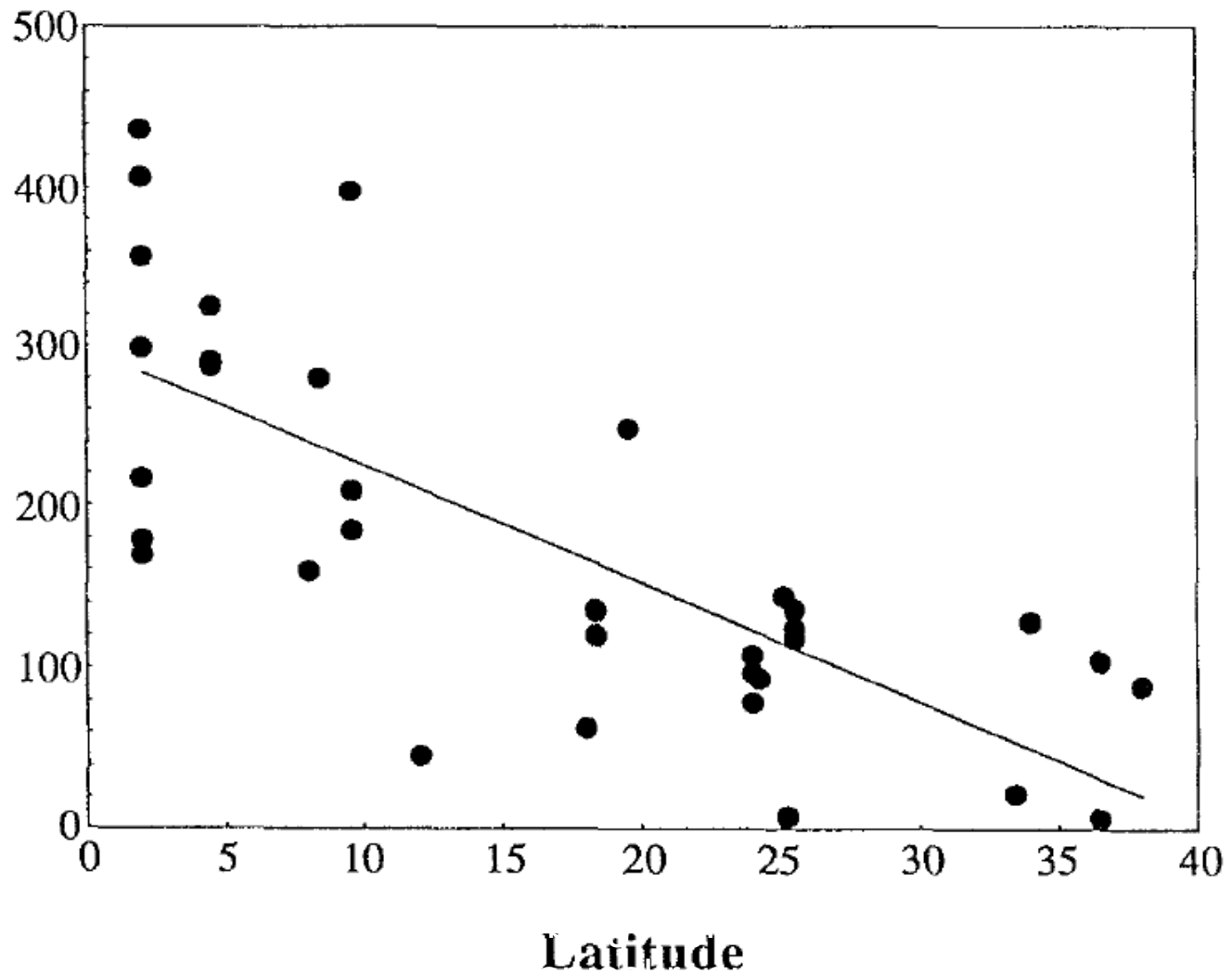
Biomass, Mg ha⁻¹

Figure 3. Distribution of aboveground biomass of mangroves with latitude.

Major Conclusions

Most comprehensive, globally consistent, and first highest resolution global map of mangrove distributions with better spatial and thematic details

Area in 2000 was 137,760 square kilometers in 118 countries and territories,

~12.3% smaller than the most recent estimate by FAO

75% of world's mangroves are found in just 15 countries,

Largest % are between 5° N and 5° S latitude

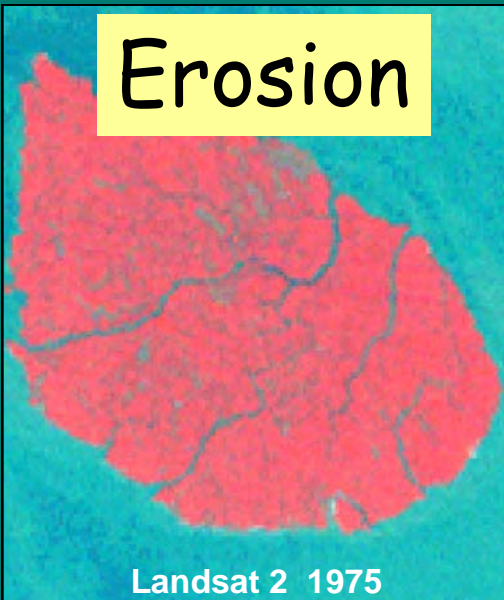
~6.9% is protected under the existing protected areas network (IUCN I-IV).

Change analysis from 1990 to 2005

- **Natural**
- **Anthropogenic**

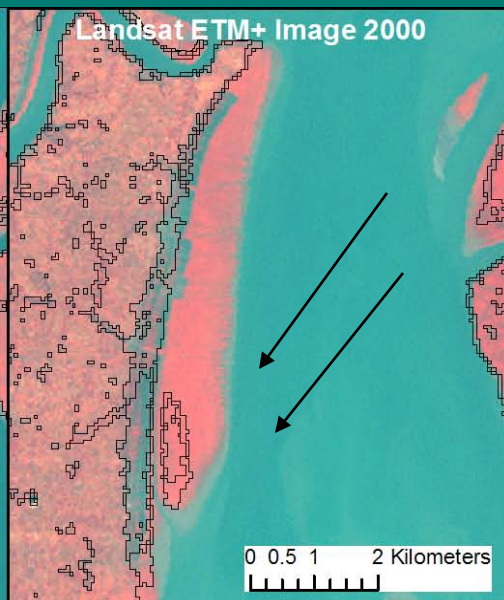
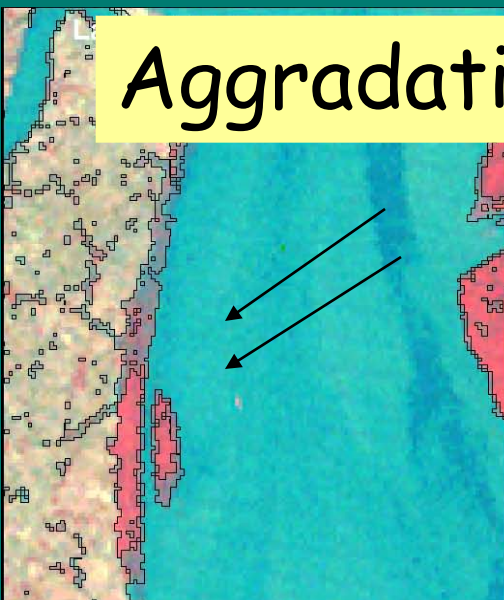
Erosion

Bhangaduni Island



Aggradation

Landsat TM Image 1989



0 0.5 1 2 Kilometers

Aquaculture



Agriculture



Exploitation



Resort





2000

Shrimp farms replacing mangroves in Gulf of Fonseca, Honduras



1987-1999: shrimp farms and ponds have mushroomed, carpeting the landscape around the Gulf of Fonseca, in blocks of blue and black shapes

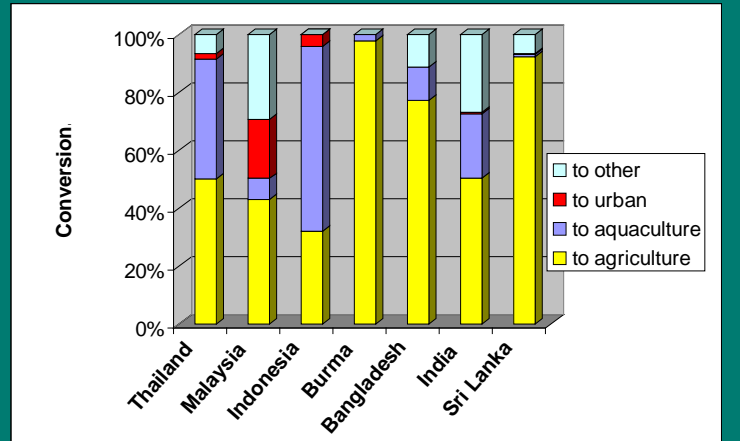
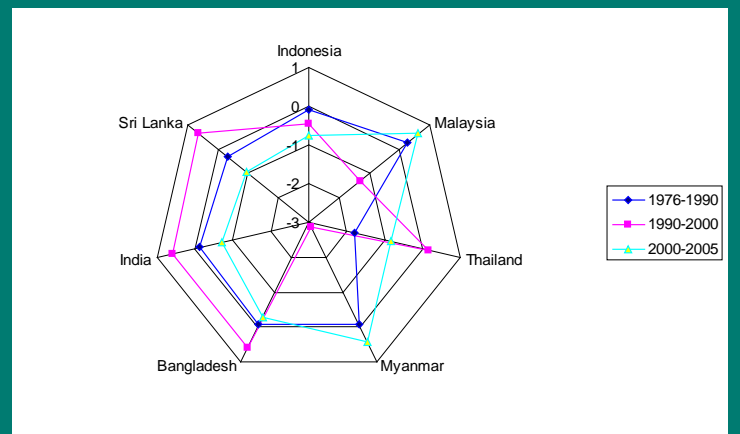
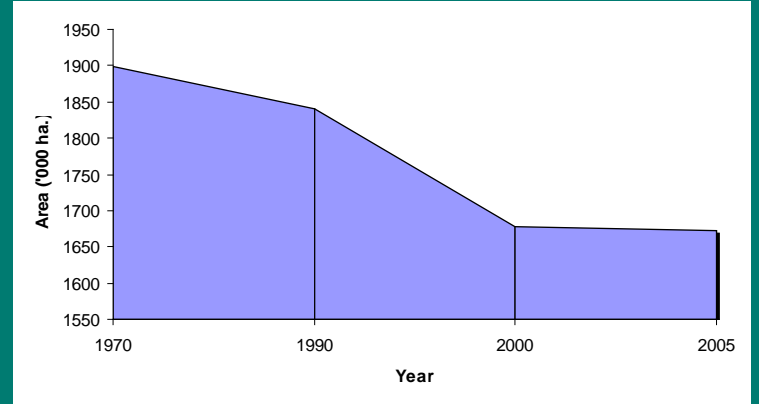
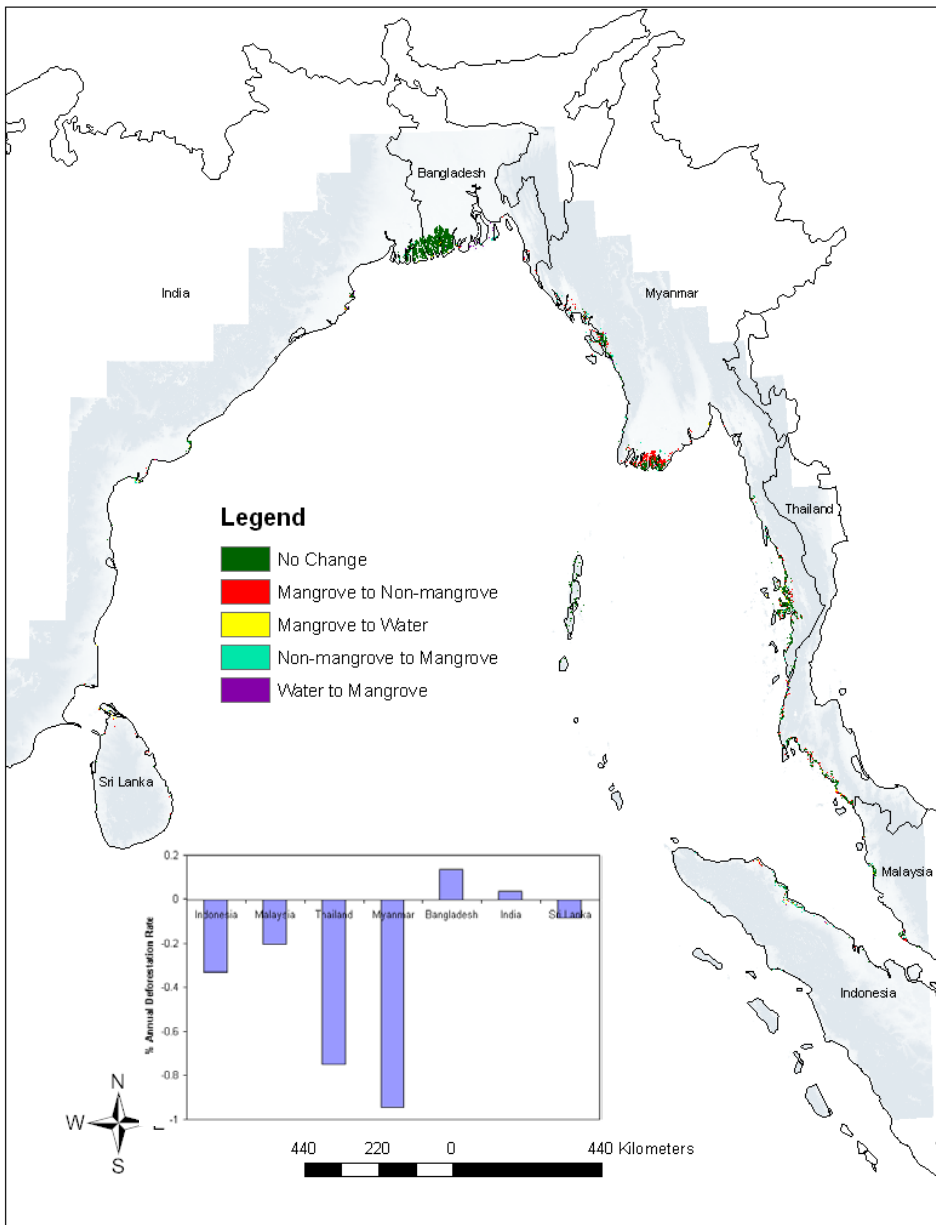
Urban expansion near Kuala Lumpur Malaysia



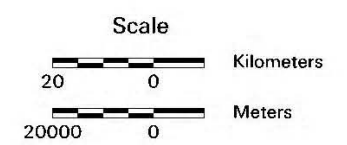
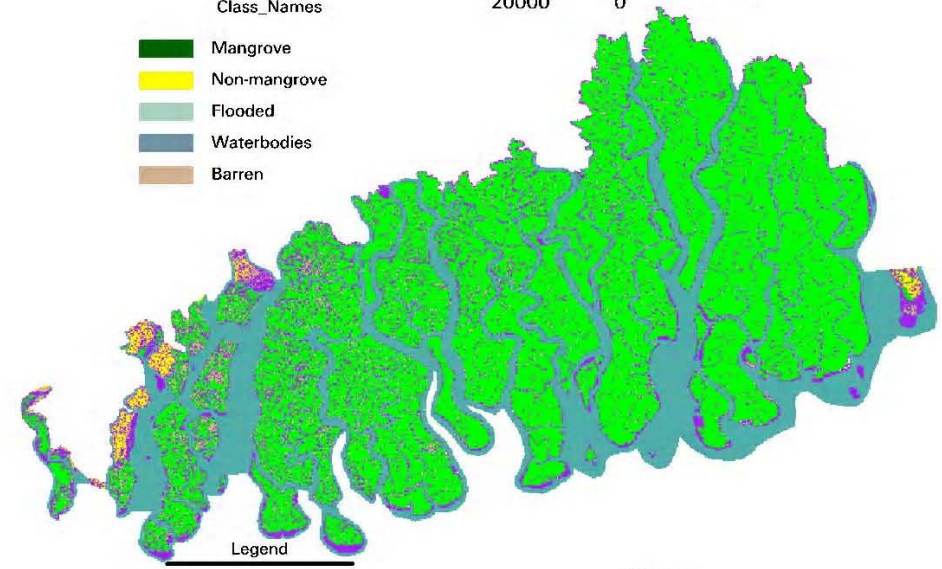
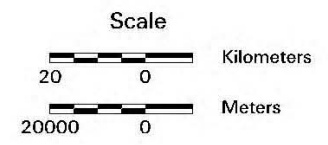
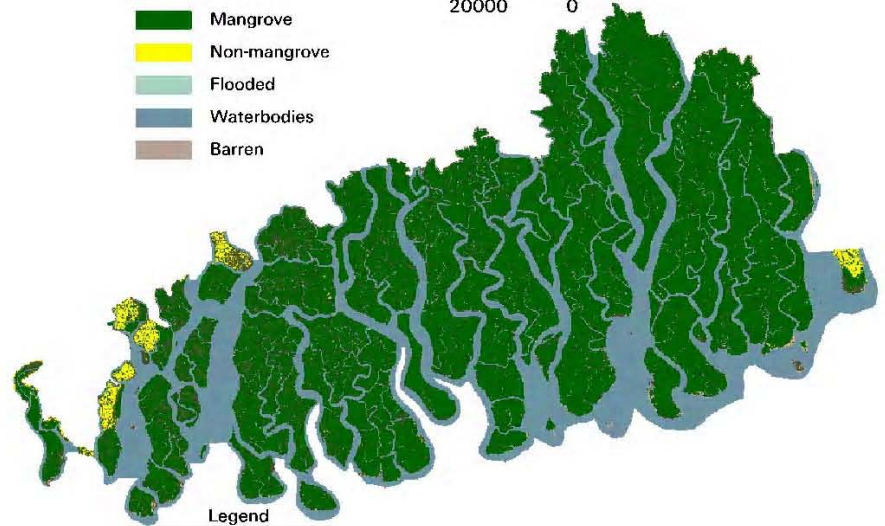
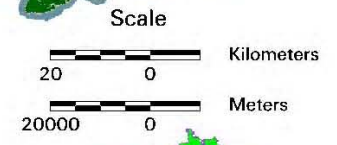
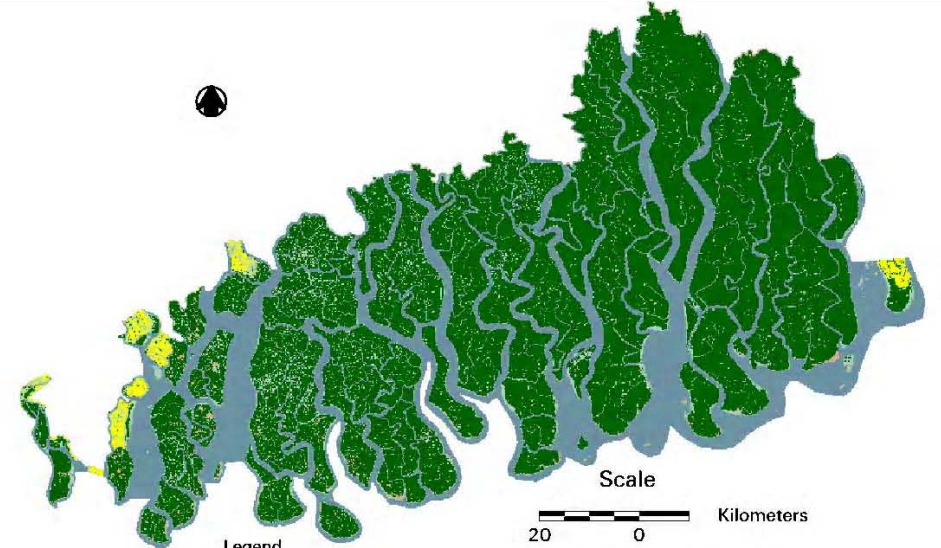
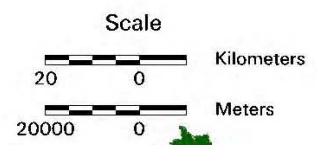
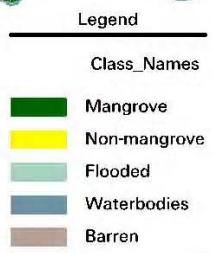
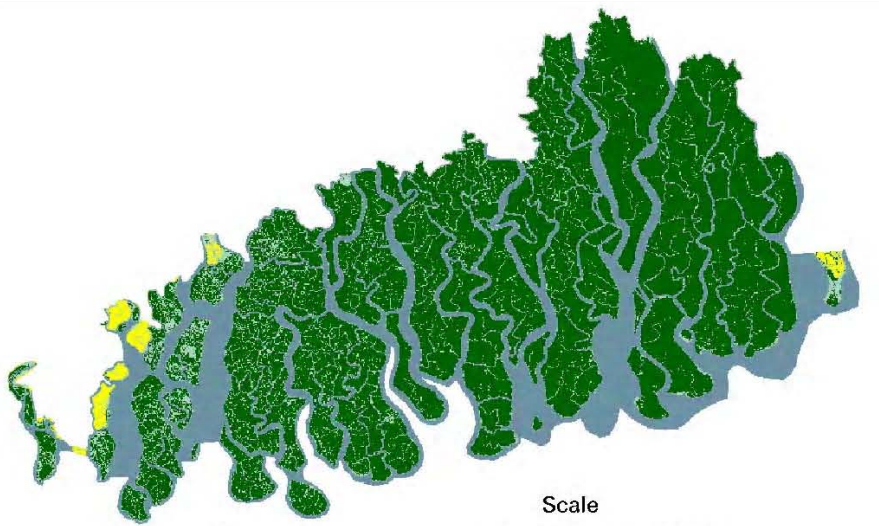
Landsat 1975

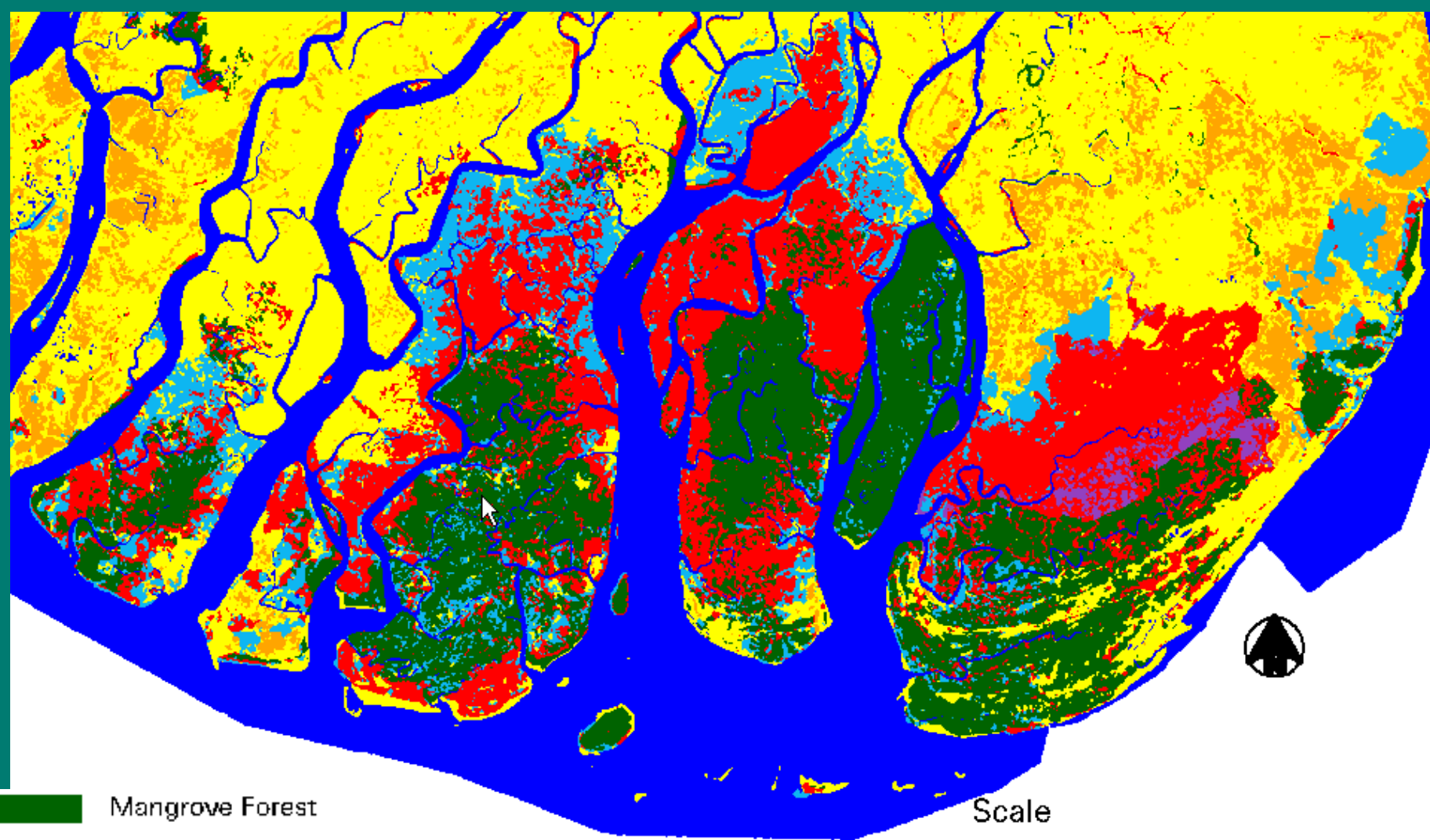


Landsat 2005



Mangrove forest cover change from 1973-2005





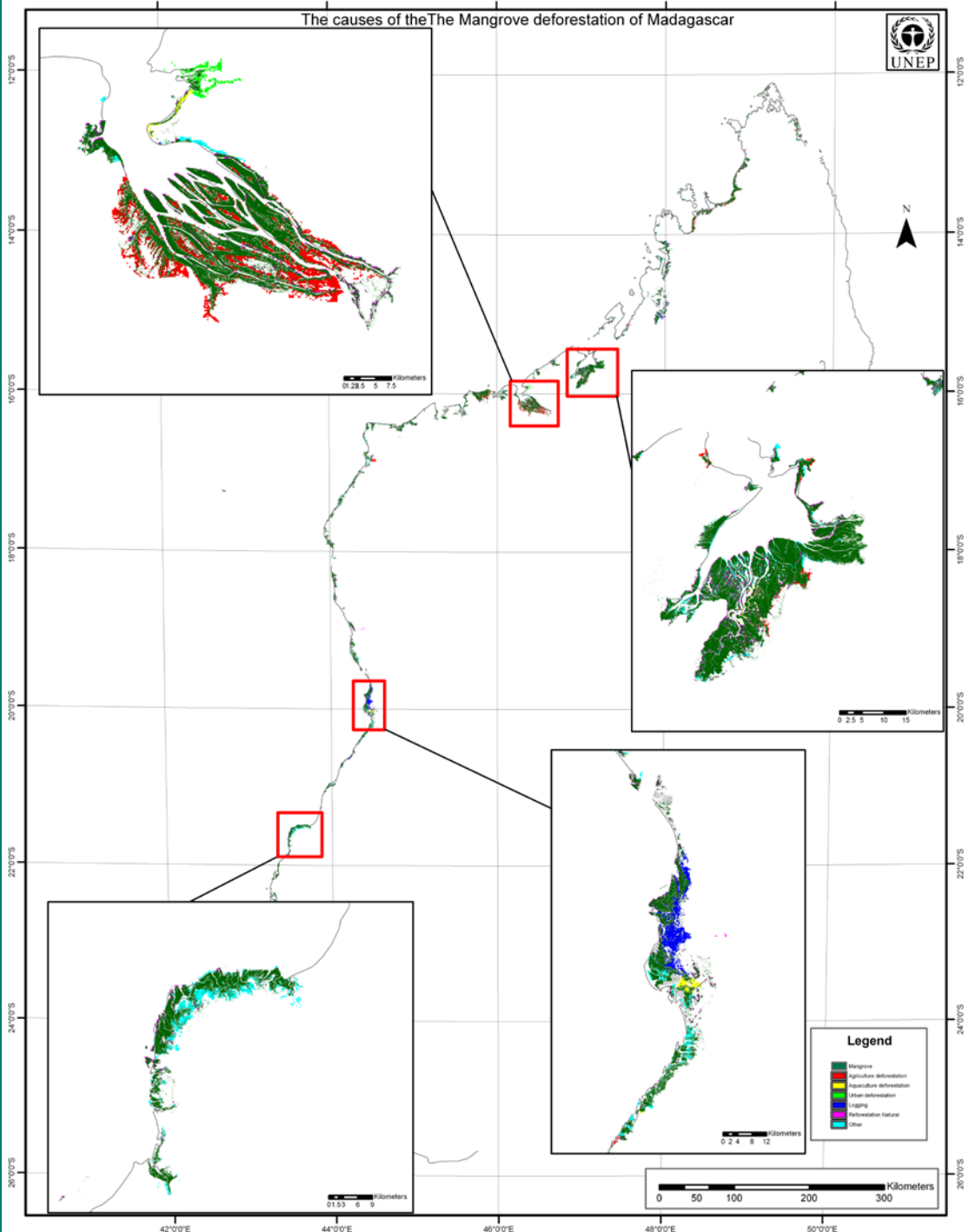
Scale



Kilometers

-  Mangrove Forest
-  Non-mangrove
-  Barrcnlands
-  Waterbodies
-  1975-1990 Deforestation
-  1990-2000 Deforestation
-  2000 - 2005 Deforestation

The causes of the mangrove deforestation of Madagascar



Present status

- Africa & some part of Asia is complete

Outreach



Imaging NOTES



Winter 2010
Volume 25 Number 1

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Cover Story

At the Tipping Point

How DigitalGlobe's Latest Satellite Launch is Breaking Down Barriers

Features

A New Era in Elevation Models

3D with LIDAR, Optical and Radar

Forests of the Sea

Global Distributions and Dynamics of Mangroves

Forests of the Sea Global Distributions and Dynamics of Mangroves



1 of 6

Figure 1. Mangrove forests destroyed during Asian Tsunami of 2004, Southern Thailand.



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Open story tools

ALL STORIES

MORE ABOUT THIS STORY



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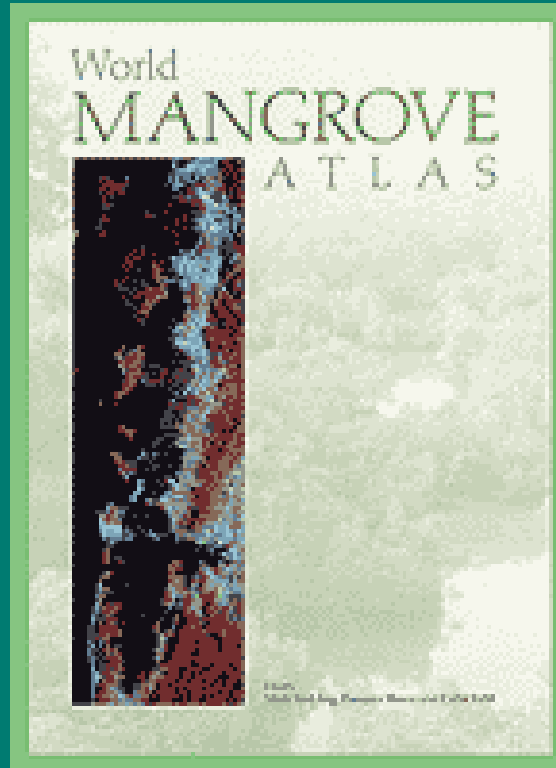
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Contribution to International Programs



GLS Data Issues

- Cloud Cover
- Image Quality
- Data Gaps/Incomplete Coverage

Seamless data: excellent for mangrove mapping – GLS 2000

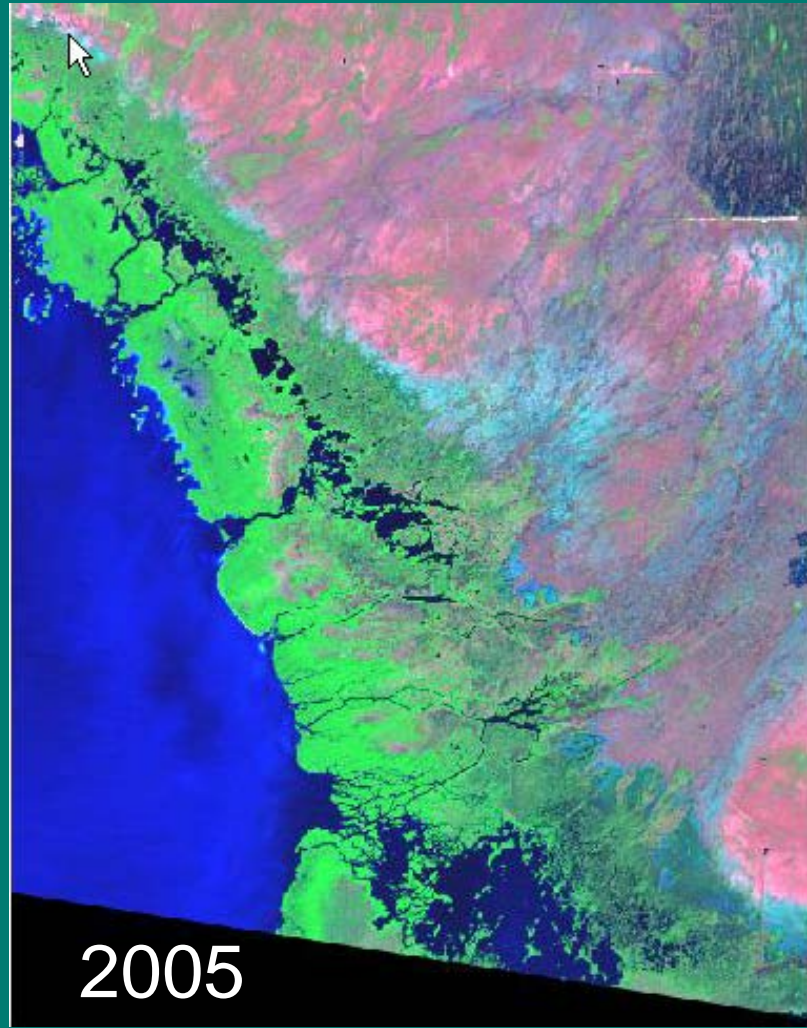
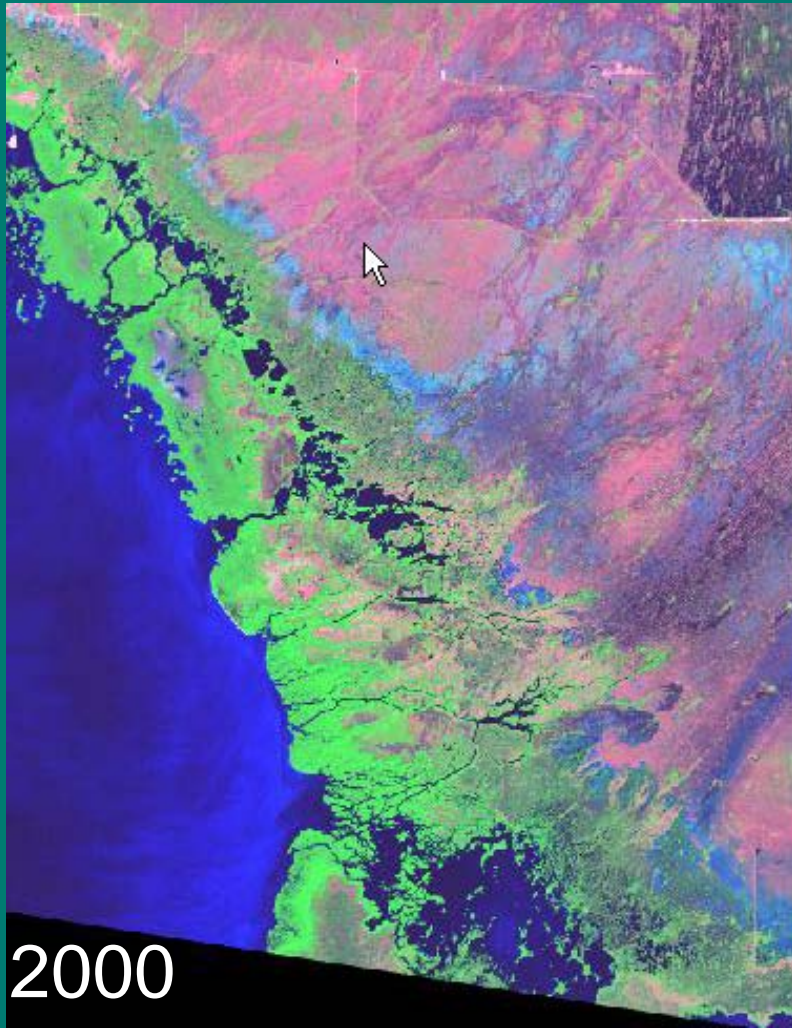




GLS 2000

Manila Bay, Philippines

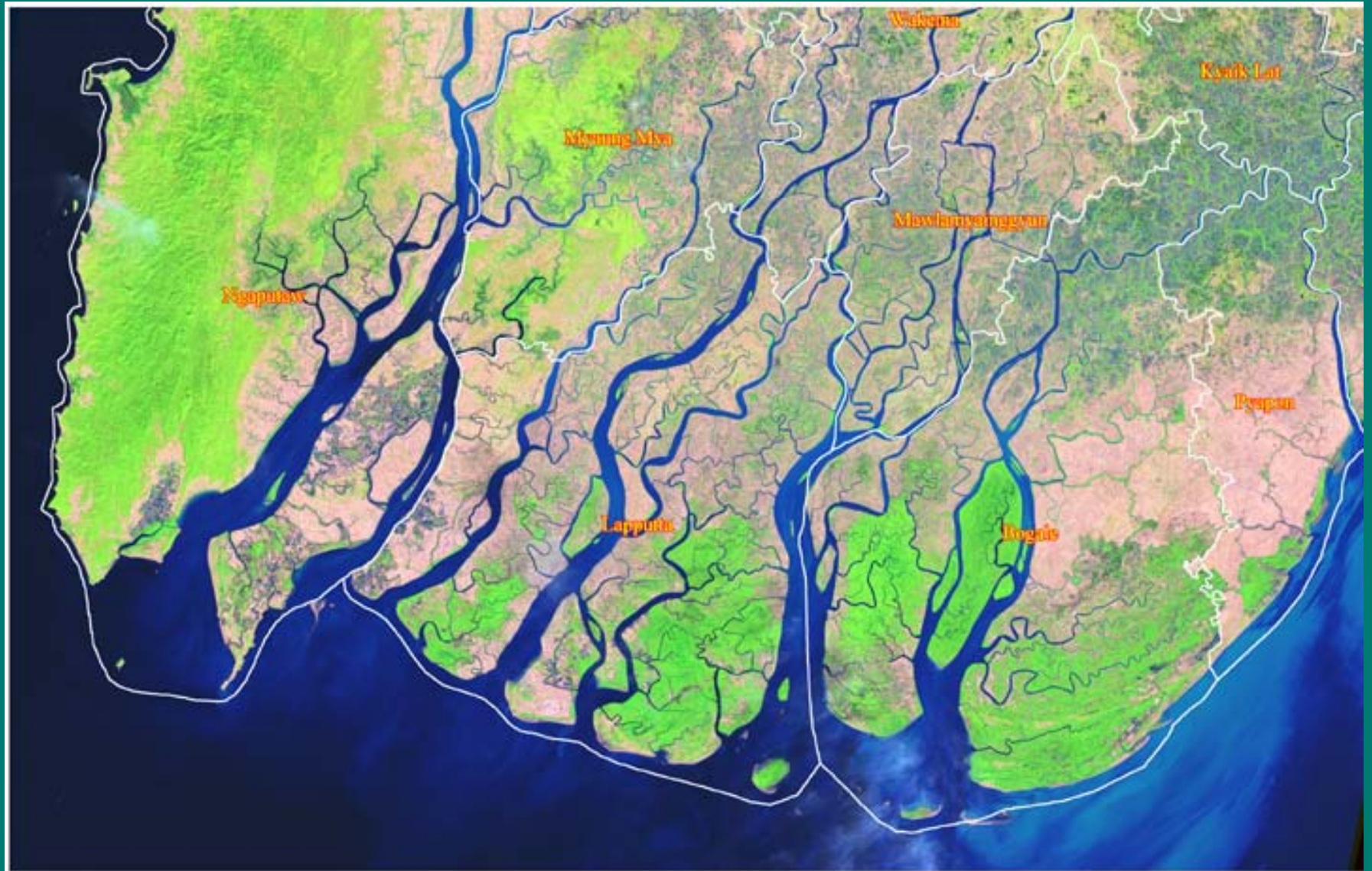
Stable GLS time series



1990 Landsat 5 TM



2001 Landsat 5 TM

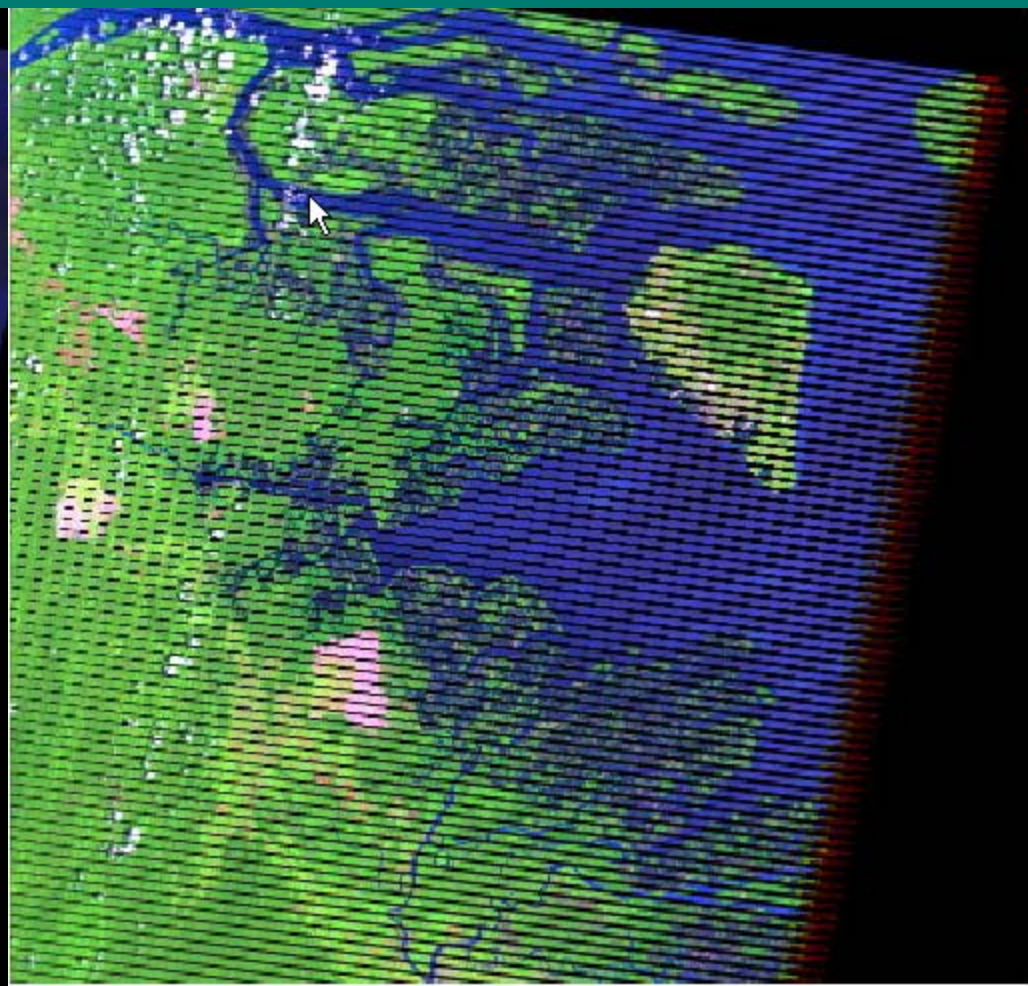


2005 Landsat 7 ETM+





GLS 2000



GLS 2005

GLS-2005

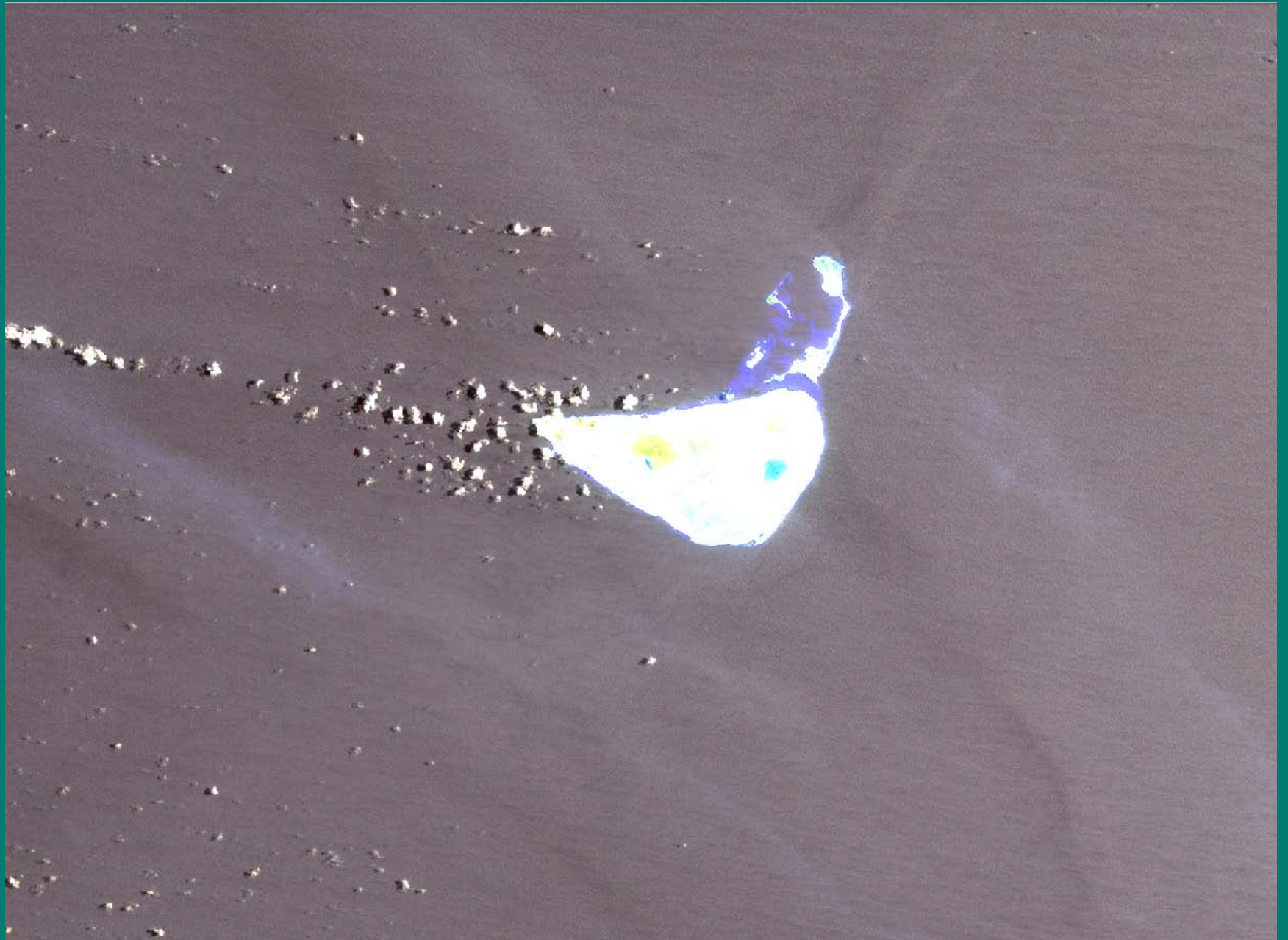




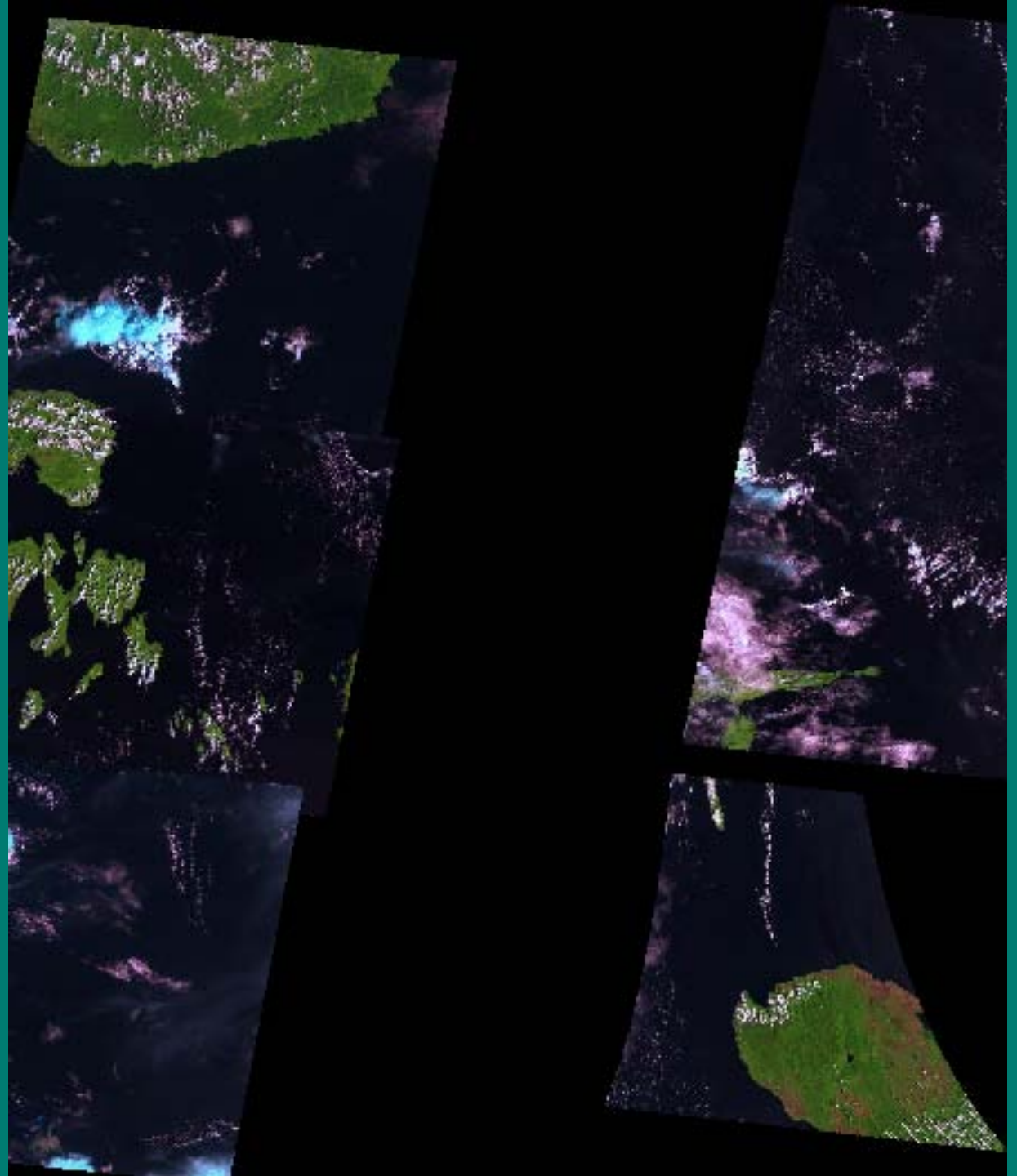
GLS 2000



GLS 2005



1990 data in Pacific Islands



Recommendations for improvement

- Cloud free
- Gap Filled, GLS 2005 in tropical areas
- Full coverage
- Additional images
- GLOVIS Issues
 - Data in hard disk
 - ~~Option of downloading multiple scenes~~
 - Option of downloading a subset of a scene/scenes or subset of bands

GLS data Supplemented by Landsat archive/other satellite data is needed

Mangroves in New Caledonia



- Where are data gaps in the GLS datasets?
 - ?How stable is the GLS time series?
 - ?How are we going to handle the 1990 calibration issue?
 - ?Are transitions between adjacent path/rows derived from L-5 and from L7 data seamless?
 - ?What is the proportion of data with poor gap-filled results? How is it controlled (QC)?
 - ?What is proportion of path/rows with no L-5 available and no good L-7 for interpolation (gap-filled)?
 - ?How consistent (in terms of season) has been scene selection?
 - ?What are we missing by having such infrequent time sampling with GLS in terms of disturbance history?
 - ?Do we still have issues with geodetic correction? How is it in high latitudes? Ideas for future improvements?
 - *How can we benefit from collaborations with our international partners on processing Landsat-like data?