

# Applications of the Regional Visualization & Monitoring System (SERVIR) for Coastal Zone Management

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Water Center for the Humid Tropics of  
Latin America & the Caribbean (CATHALAC)

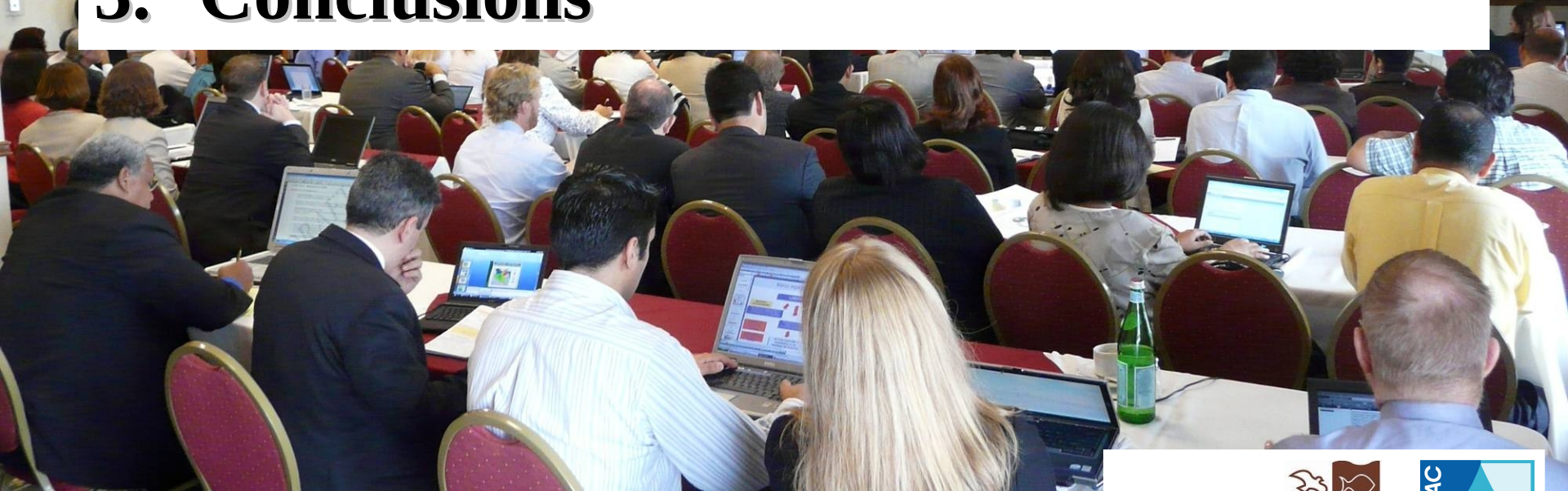
20.11.09

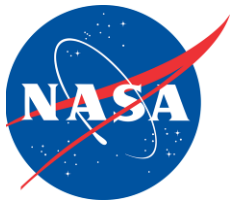




# Overview

- 1. SERVIR conceptual framework**
- 2. Applications to coastal zone mgt.**
- 3. Conclusions**



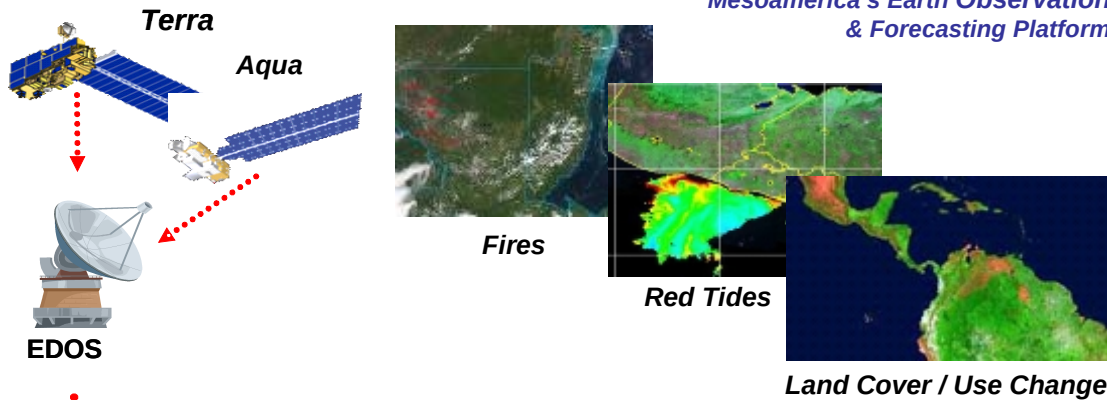


**USAID**  
FROM THE AMERICAN PEOPLE

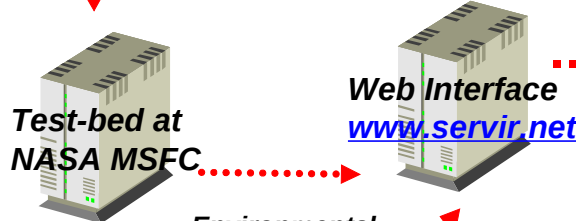


# the Regional Visualization & Monitoring System (SERVIR)

Mesoamerica's Earth Observation & Forecasting Platform



LandSat MODIS  
SRTM AMSR-E  
IKONOS ASTER



**Environmental Monitoring & Decision Support Products**



## Users

Central American Government agencies  
NGOs, researchers  
Educators, etc.

## Impacts

Emergency Response  
Policy Changes  
Corridor Preservation  
Species Preservation  
Sustained Development  
Improved livelihoods

## Thematic Areas

Agriculture  
Biodiversity  
Climate  
Ecosystems  
Energy  
Disasters  
Health  
Water  
Weather



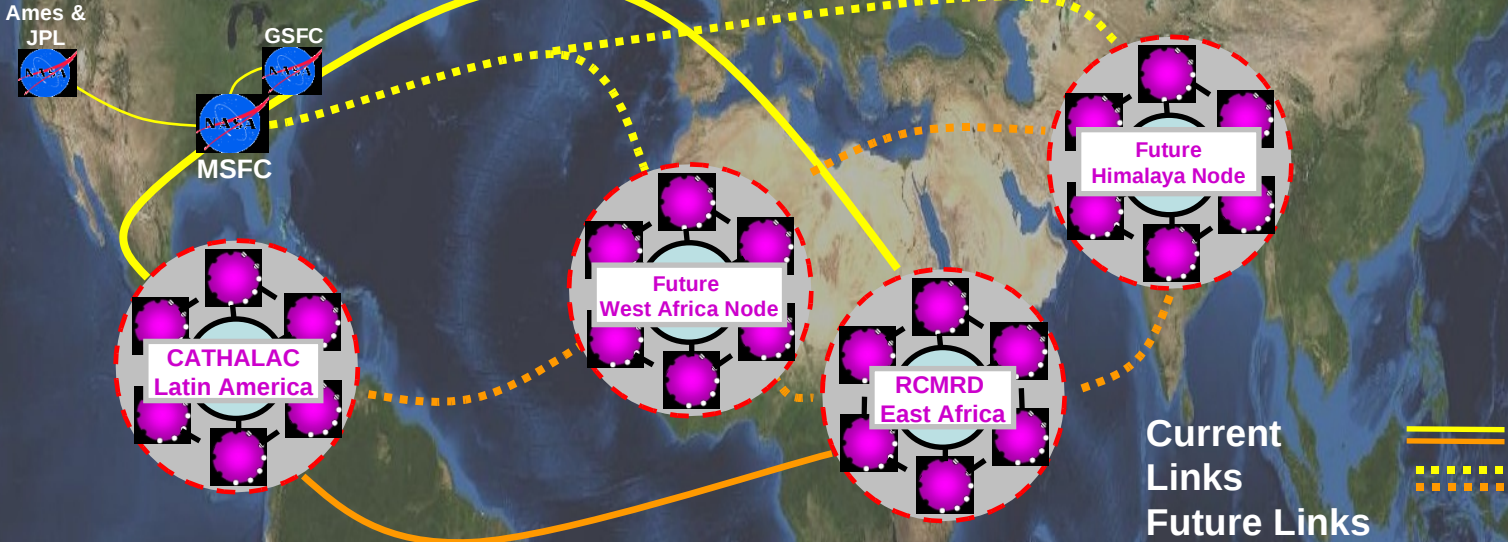
•Global Earth Observation System of Systems (GEOSS)

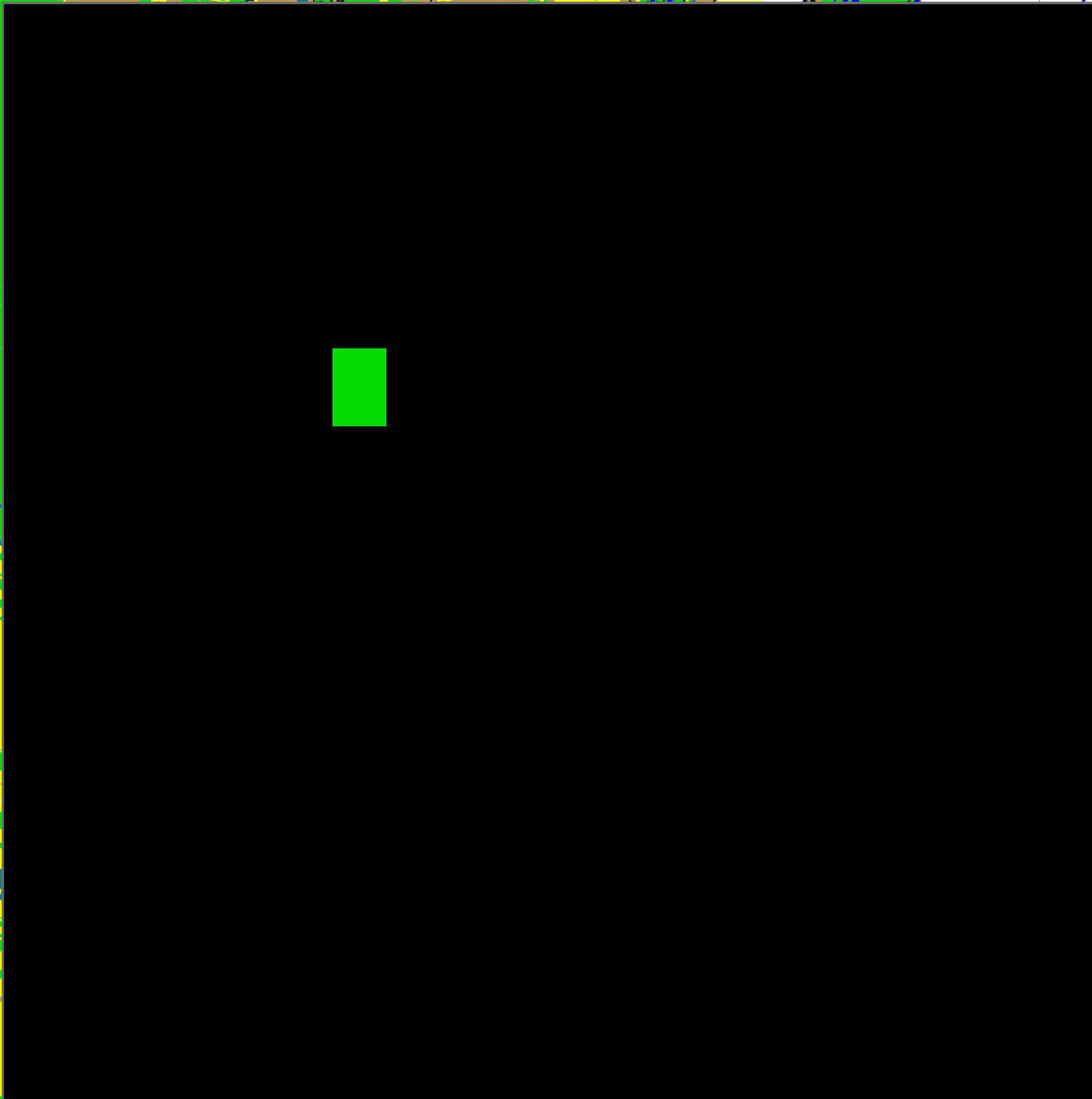


•International Charter on Space and Major Disasters

•Mesoamerican Environmental Information System (SIAM)

# Potential Future SERVIR Network



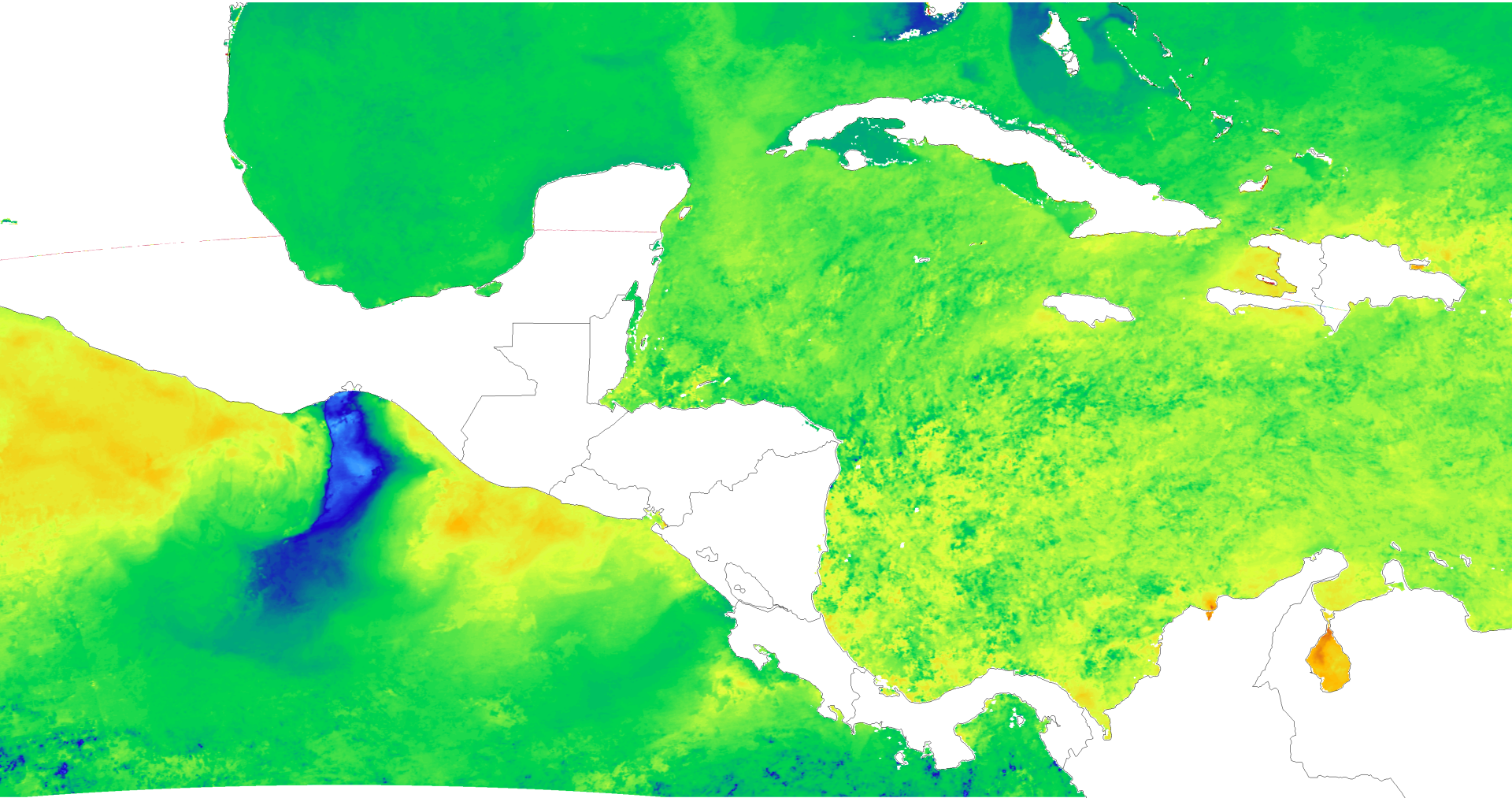




## Legend

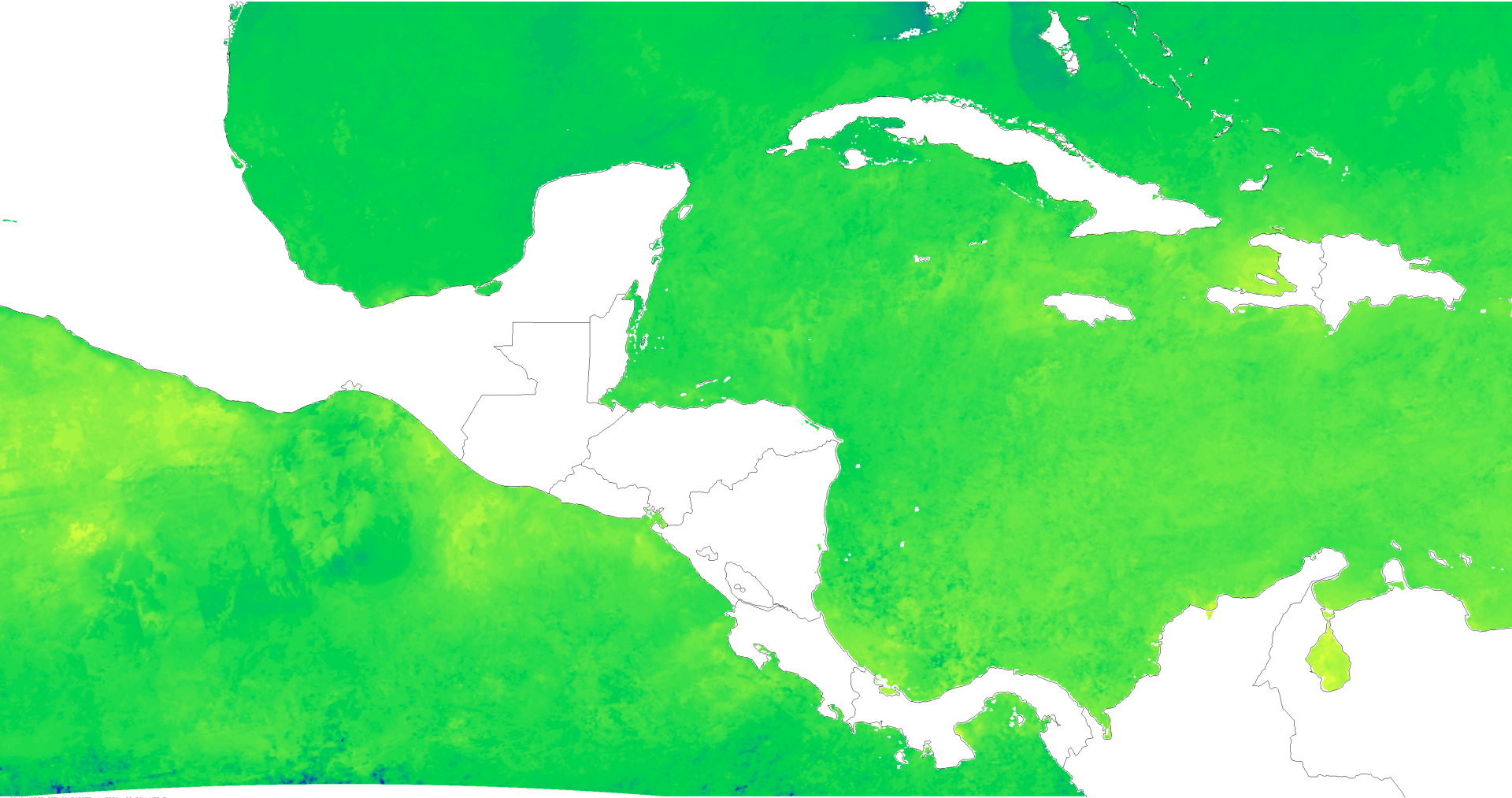
-  Coral reef
-  Agriculture
-  Aquaculture
-  Broadleaf forest
-  Littoral vegetation
-  Mangrove
-  Mixed forest
-  Pine forest
-  Savanna
-  Scrub/shrub
-  Urban
-  Water body
-  Wetlands

# Satellite-Based Sea Surface Temperature (SST): 2 years ago at 2:40pm EST (November 20, 2007)



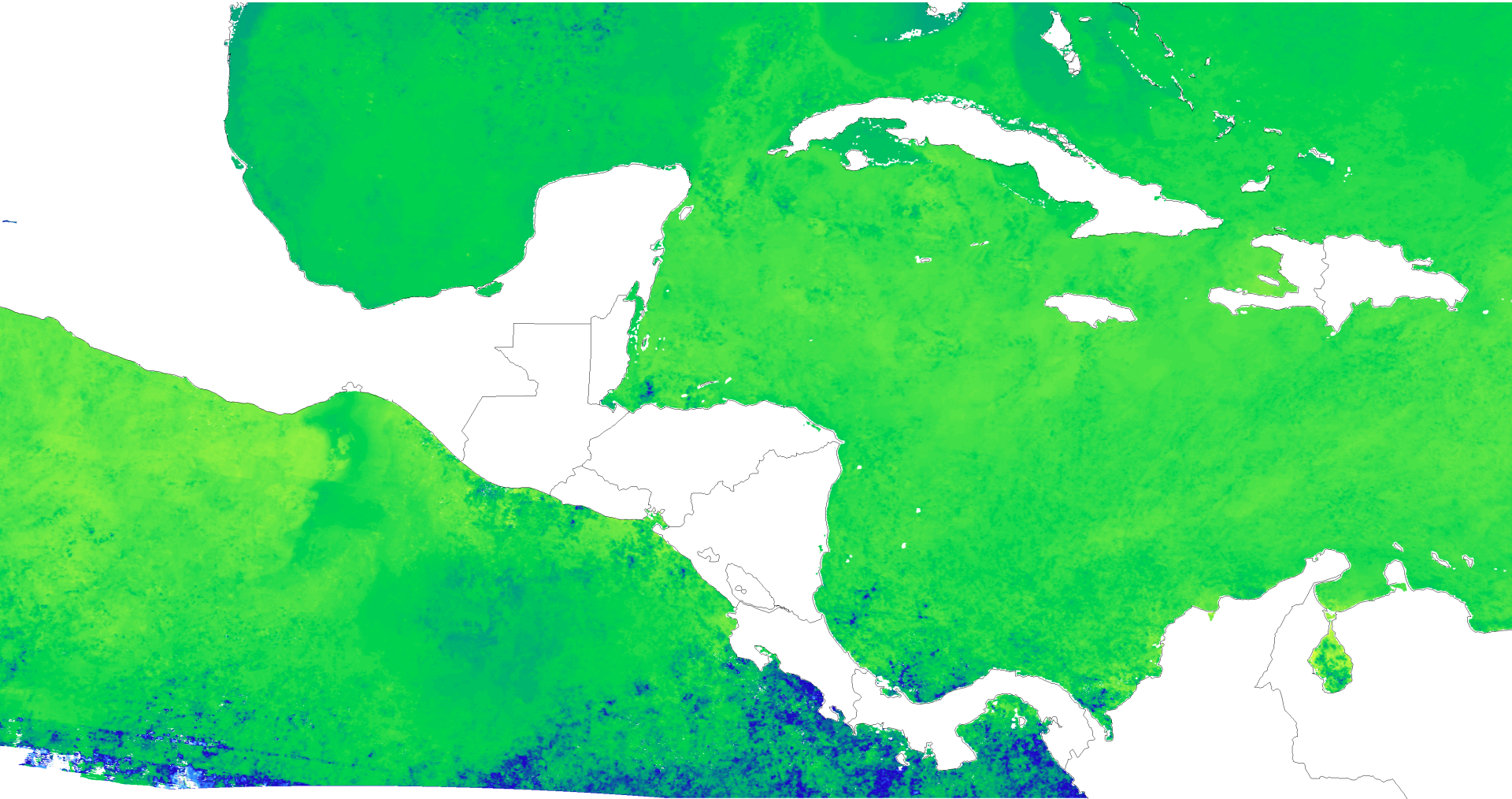
Source: MODIS Aqua

# Satellite-Based Sea Surface Temperature (SST): 1 years ago at 2:56pm EST (November 20, 2008)



Source: MODIS Aqua

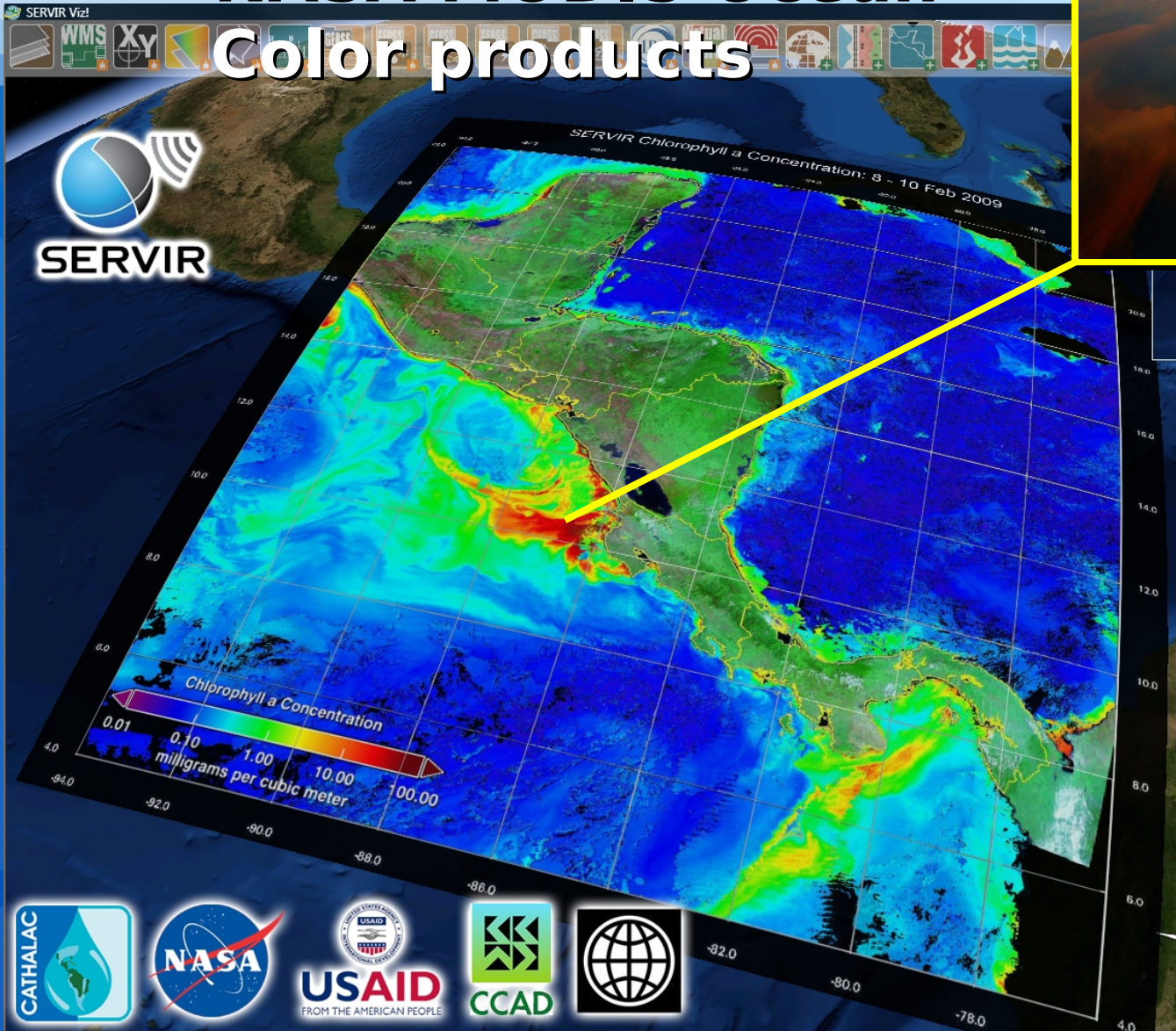
# Satellite-Based Sea Surface Temperature (SST): TODAY at 3:44am EST (November 20, 2009)



Source: MODIS Aqua



# Operational red tide monitoring using NASA MODIS Ocean Color products



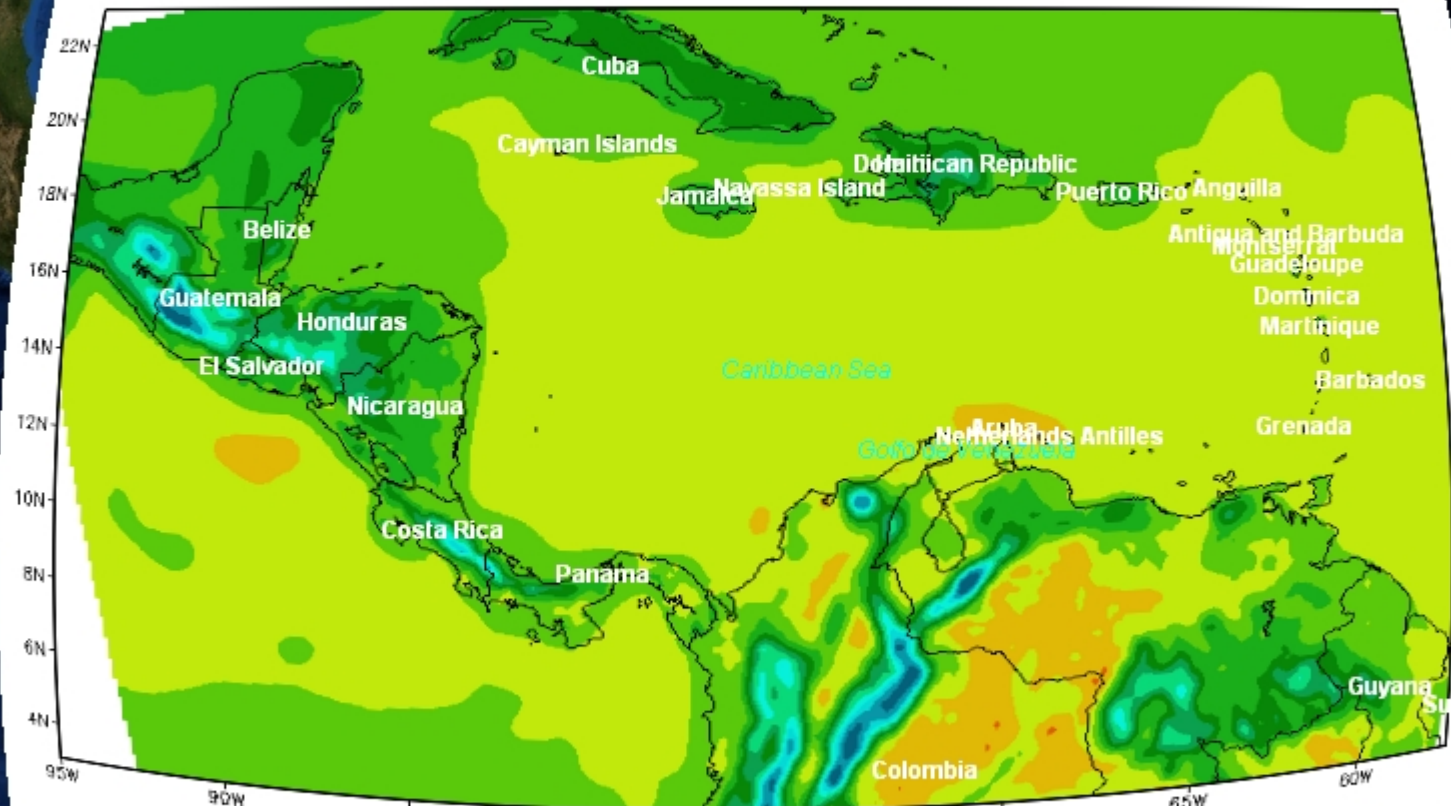


Gulf of Mexico

Straits of Florida

### Temperatura del suelo ei 21/NOV/2009, 05

Mexico



22N  
20N  
18N  
16N  
14N  
12N  
10N  
8N  
6N  
4N

95W

90W

85W

80W

75W

70W

65W

60W

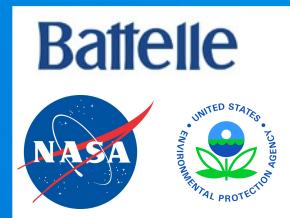
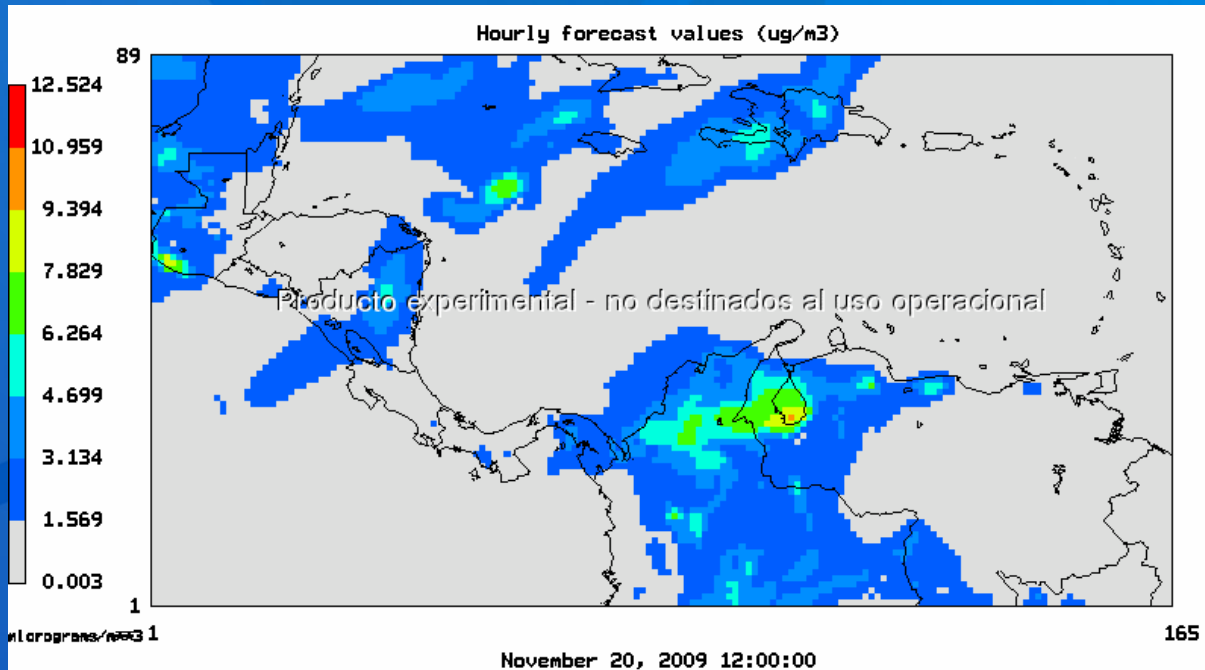
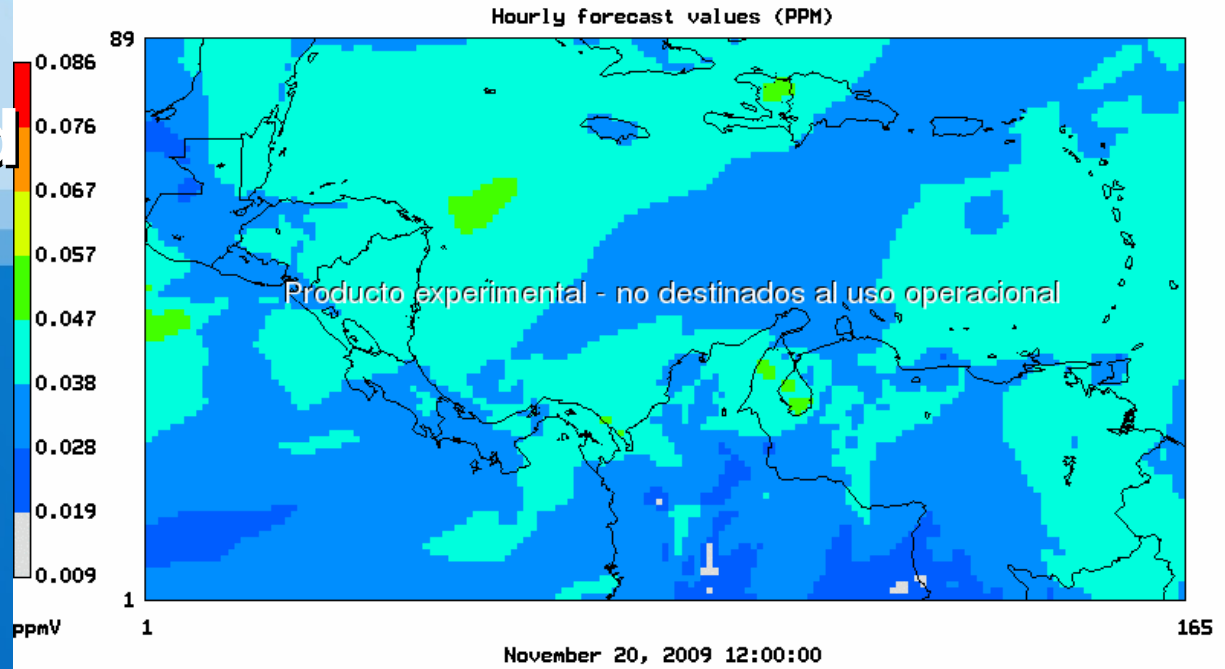


MM5v3  
CATHALAC

Ecuador



# Satellite-based and modeled air quality products



# SERVIR Data Portal

**SERVIR**  
Sistema Regional de Visualización y monitoreo

BIENVENIDO / WELCOME Su portal de datos mesoamericano / your

**Metadata Portal**

- Home
- Launch Map Viewer
- Advanced Search
- Login

Search Results

Records Found: 15

Search for:

What: Landsat  
Who: Any Publisher

Visor de Mapas Dinámicos - CATHALAC - Windows Internet Explorer

http://maps.cathalac.org/website/landsatfootprints/viewer.htm

Visor de Mapas Dinámicos - CATHALAC

**Landsat 7 Imagery Footprints**

255475103 Bytes 243911225 Bytes  
2792085658 Bytes 248598076 Bytes  
253625883 Bytes 265 Mb 260160067 Bytes  
308381635 Bytes 254 Mb 243 Mb 262 Mb 15 Mb  
275 Mb 321 Mb  
275 Mb 281 Mb 247 Mb 228 Mb 230 Mb 170 Mb 18 Mb  
270554967 Bytes 20 Mb 266 Mb  
544 Mb 269 Mb 282 Mb 305 Mb 228 Mb 244 Mb  
255011242 Bytes 5 Mb  
192 Mb 218 Mb 279 Mb 275 Mb 263 Mb  
232901917 Bytes  
197 Mb 255 Mb 279 Mb  
11 Mb 285 Mb 22 Mb  
320884256 B  
230 Mb 215 Mb 250 Mb  
273136074 Bytes 19 Mb  
254 Mb 247 Mb  
24959827 Bytes 176 Mb 106 Mb

Rec	URL para Descargar LandSat	Tamaño Archivo
1	http://mesosior2.cathalac.org/native/Imagen_Landsat_2005/17050200D0216.zip	306Mb
		170

LandSat 2006  
No Features Found

if you click, map will: ID Visible Features

Map: -75.49 , 7.51 -- Image: 662 , 447 -- ScaleFactor: 0.03275087336244553

Content type: downloadable Data

**SERVIR**  
Sistema Regional de Visualización y monitoreo

DATA PORTAL

BIENVENIDO / WELCOME Su portal de datos mesoamericano / your regional mesoamerican data portal

**Metadata Portal**

- Home
- Launch Map Viewer
- Advanced Search
- Login

Details

Content Citation

Content Title: [Áreas de Cobertura de las Imágenes LandSat disponibles en SERVIR](#)

Content Type: ArcIMS Image Service

Provider Level: Organization

Publication Date: 2006-06-01

Content Description

Content Summary: Este servicio de mapas de ArcIMS muestra la cobertura de imágenes LandSat que están disponibles para descargar del sitio de SERVIR. El servicio tiene varias capas desde el año 1972 hasta la fecha. Cada capa o "layer" contiene campos con la descripción, año y URL para descarga como archivo ZIP. El archivo ZIP contiene una los datos "raw" de las imágenes LandSat con las 6 bandas.

Content Purpose: Propagar la disponibilidad de las imágenes LandSat en Mesoamérica y el resto de países.

Content Themes: Imagery and Base Maps

Time Period of Content

Beginning Date: 1972-01-01

Content Status

Progress: On-going

Spatial Domain

West Coordinate: -106.071263  
East Coordinate: -44.736620  
North Coordinate: 31.202152  
South Coordinate: -6.606874

Content Keywords

Theme Keywords: imageryBaseMapsEarthCover , landsat , imágenes

1980

1989

1998

## **Using SERVIR's image archive to track development**

2000

2002

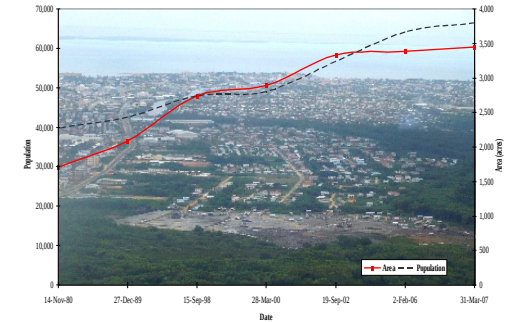
2007

### ***Then: Belize City in 1980***

- ~39,771 inhabitants
- 1,706 acres (6.9 km<sup>2</sup>)
- Density of 5,756 people / km<sup>2</sup>
- Nat'l density of 6 people / km<sup>2</sup>

### ***Now: Belize City in 2007***

- ~66,422 inhabitants
- 3,449 acres (14 km<sup>2</sup>)
- Density of 4,758 people / km<sup>2</sup>
- Nat'l density of 13 people / km<sup>2</sup>



- Belize City's area has about doubled between 1980 and 2007
- The annual growth rate has been ~106 acres (43 ha.) per year
- The 1,700+ acres (705 ha) cleared has largely been mangrove & other wetlands

# Baselines

1992

3.69 M ha (49.3%)

2000

3.34 M ha (44.9%)

2008

3.20 M ha (43.0%)

## Land cover types

-  Agriculture - general
-  Agriculture - subsistence
-  Bare land
-  Coastal vegetation
-  Forest - mangrove
-  Forest - plantations
-  Forest - primary
-  Forest - secondary
-  Other uses
-  Scrub



# Regional Context

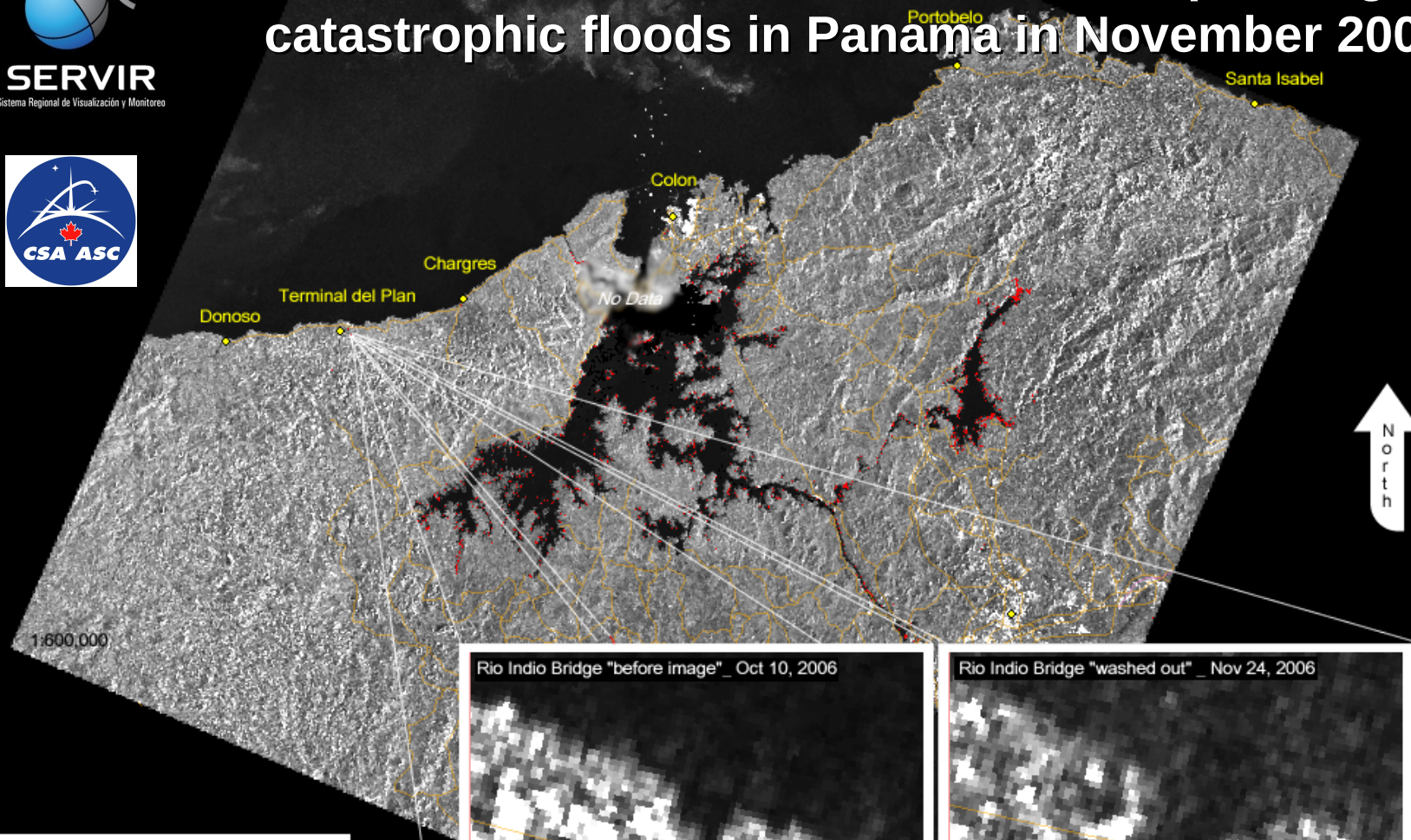




**SERVIR**  
Sistema Regional de Visualización y Monitoreo



# Utilization of RADARSAT data for responding to catastrophic floods in Panama in November 2006

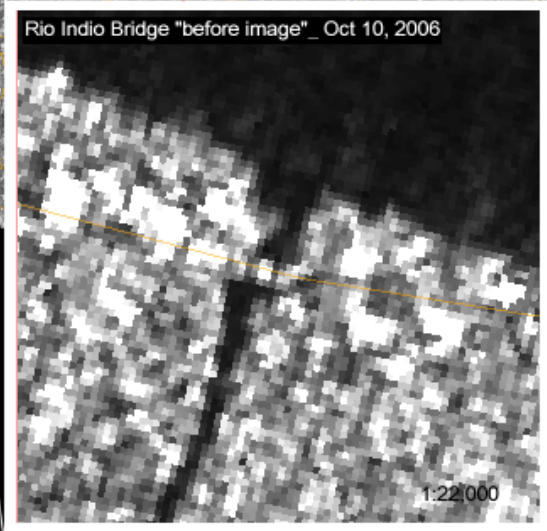


Panama Flooding: CATHALAC/SERVIR

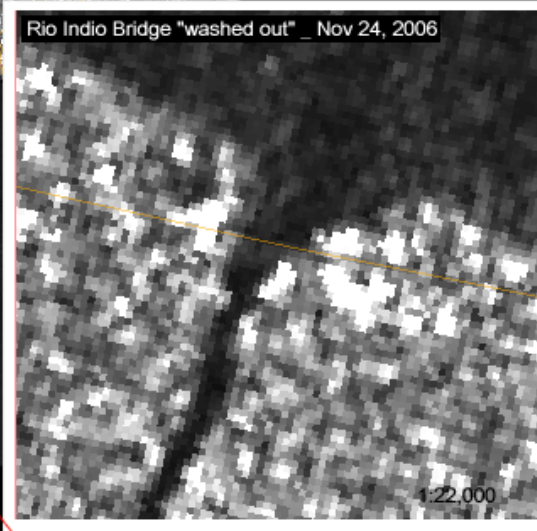
- Ciudades
- Flood Areas
- Paved Roads



Rio Indio Bridge "before image" \_ Oct 10, 2006



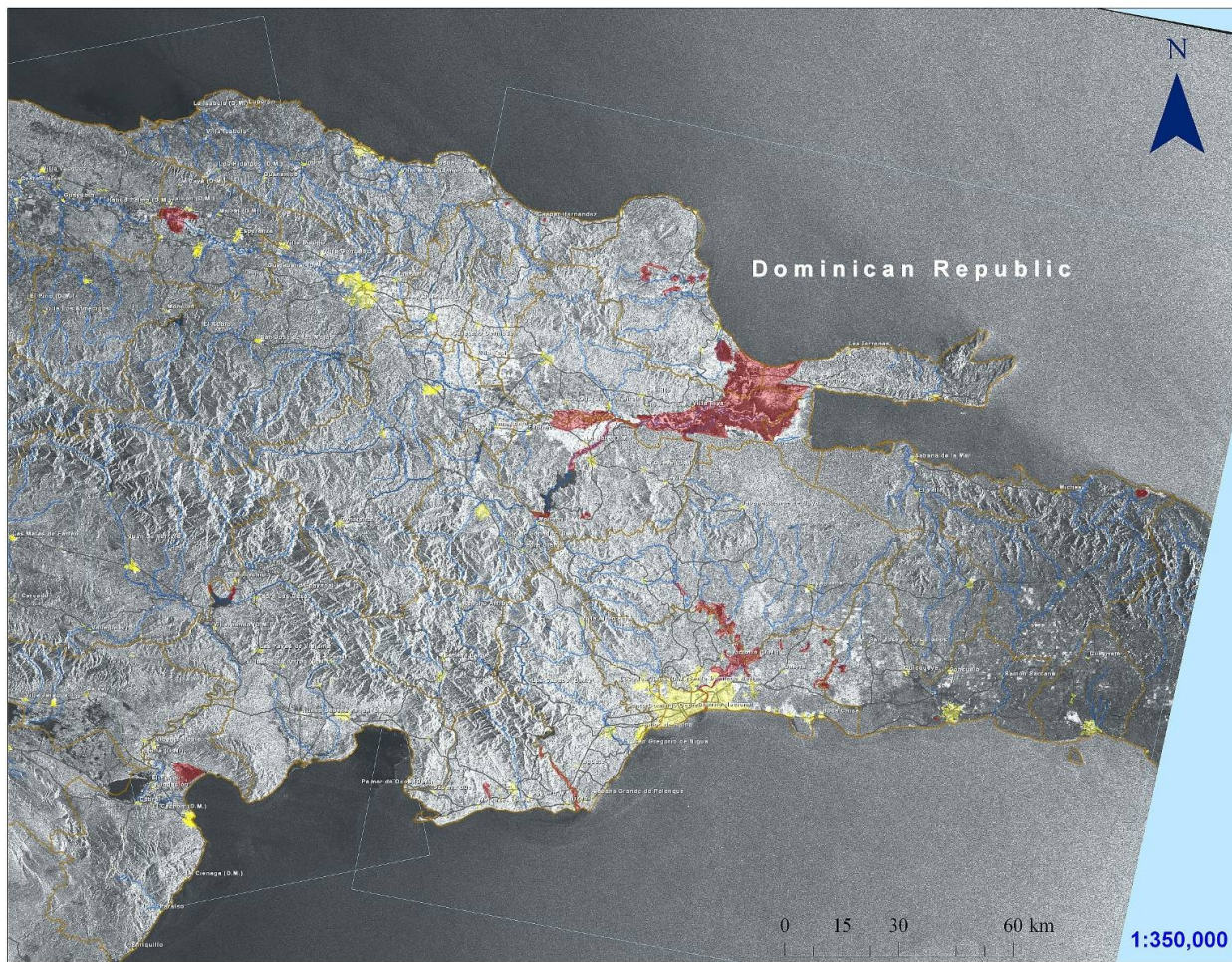
Rio Indio Bridge "washed out" \_ Nov 24, 2006





# 2007: Flooding in Dominican Republic after TS Noel

## Areas de Inundaciones Substanciales de Tormenta Tropical Noel



- Legend**
- Provincias
  - Areas de Inundacion
  - Areas de Imagenes de Satelite
  - Areas Pobladas
  - Rios
  - Calles Principales

Este es un análisis preliminar de las inundaciones substanciales de la Tormenta Tropical Noel. Se realizó el mapa usando datos de radar del satélite Japonés ALOS, sensor PALSAR. La resolución de las imágenes es de aproximadamente 100 metros. Se realizó el análisis por digitalización en pantalla (heads up digitizing) basado en una imágenes antes de la tormenta (19 septiembre 2007, 03:21UTC y 27 de octubre de 2007, 15:01UTC) y una después de la tormenta (1 Noviembre 2007, 15:08UTC). Las imágenes fueron proporcionadas por medio de la Carta Internacional del Espacio y las Grandes Catástrofes ([www.disasterscharter.org](http://www.disasterscharter.org)), Activación 183. Nuevamente, esto es un análisis preliminar y no tiene verificación del campo.

CATHALAC/SERVIR esta trabajando como "Project Manager" para esta activación. Para más información, ver [www.servir.net](http://www.servir.net)



[www.servir.net](http://www.servir.net)





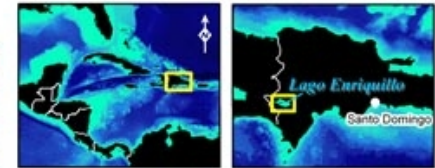
# Flooding in the Dominican Republic

March 2009

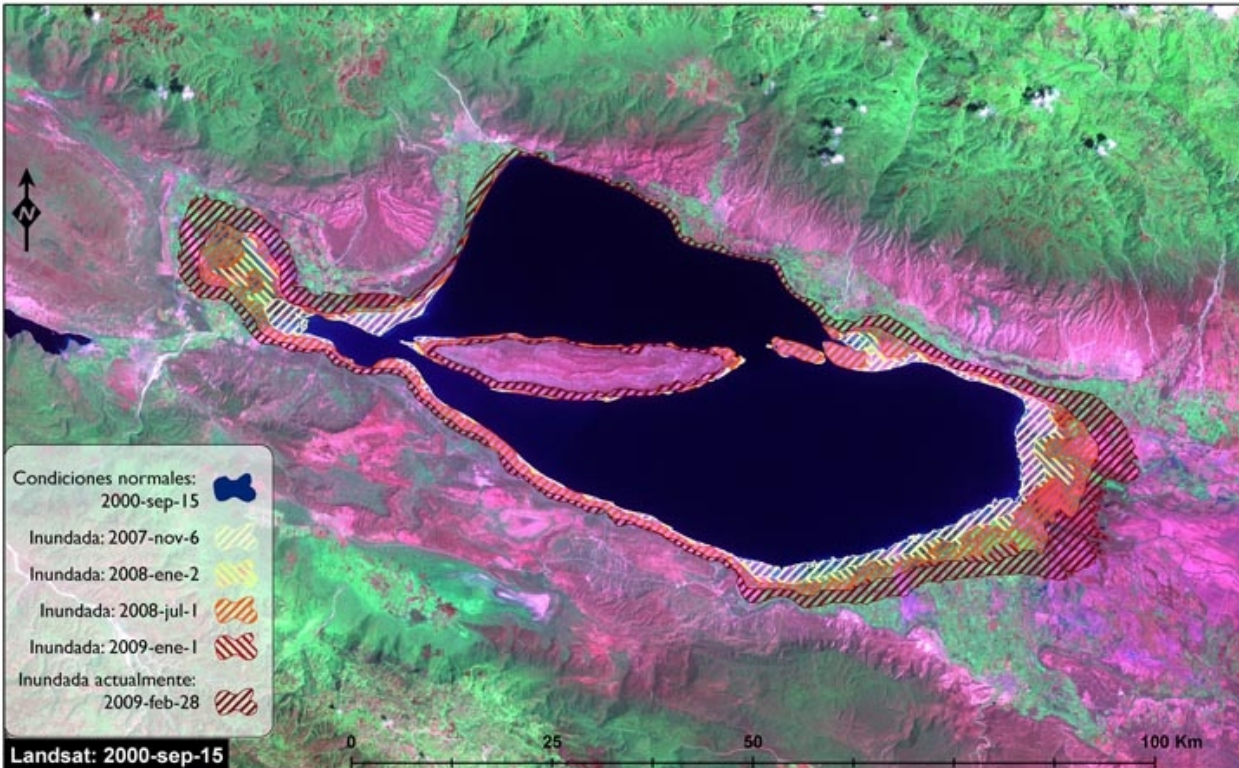
## Inundaciones en Lago Enriquillo, República Dominicana

Generado por CATHALAC el 4 de marzo de 2009

- MAPAS DE UBICACIÓN -



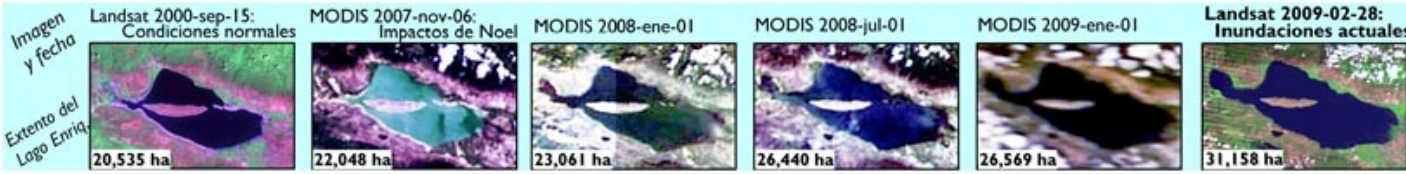
Según el uso del suelo de SEMARENA y la imagen más actual de Landsat, 2475 ha de agricultura mixta, 715 ha de cultivos intensivos y 25 ha de pastos, están inundadas actualmente.



- Agricultura Mixta
- Arroz
- Bosq. Conf. Abierto
- Bosq. Conf. Denso
- Bosq. Latifol. Inundado
- Bosq. Latifol. Semi Hum.
- Bosque Seco
- Café
- Cultivos Intensivos
- Escasa Vegetación
- Manglares
- Matorral Latifoliado
- Matorrales Seco
- Pasto
- Sabana Humedal
- Zona Poblada

CIRCUNSTANCIA	AREA DEL LAGO (HA)*
Condiciones normales: 2000 sept 15	20,535
Huracán Noel: 2007 nov 6	+ 1513
Inundación: 2008 ene 1	+ 1013
Inundación: 2008 jul 1	+ 3379
Inundación: 2009 ene 1	+ 129
Inundación: 2009 feb 28	+ 4590
<b>Condiciones actuales: 2009 feb 28</b>	<b>31,158</b>

\*Estos valores son aproximados, basados en MODIS y Landsat (abajo).





# 2009: Collaboration w/ the GEO AIP Flood Pilot





# 2009: Collaboration w/ the GEO AIP Flood Pilot



Imagen LANDSAT del Lago de Atitlán - Octubre 30 2009  
Departamento de Sololá, Guatemala

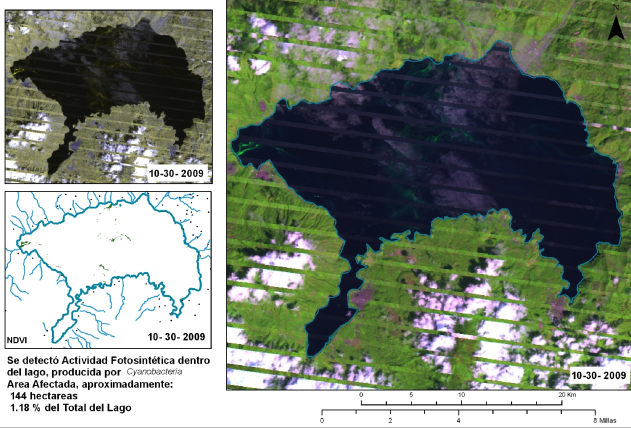
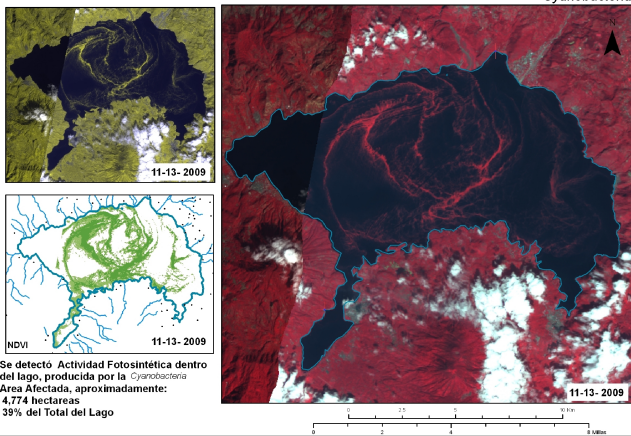


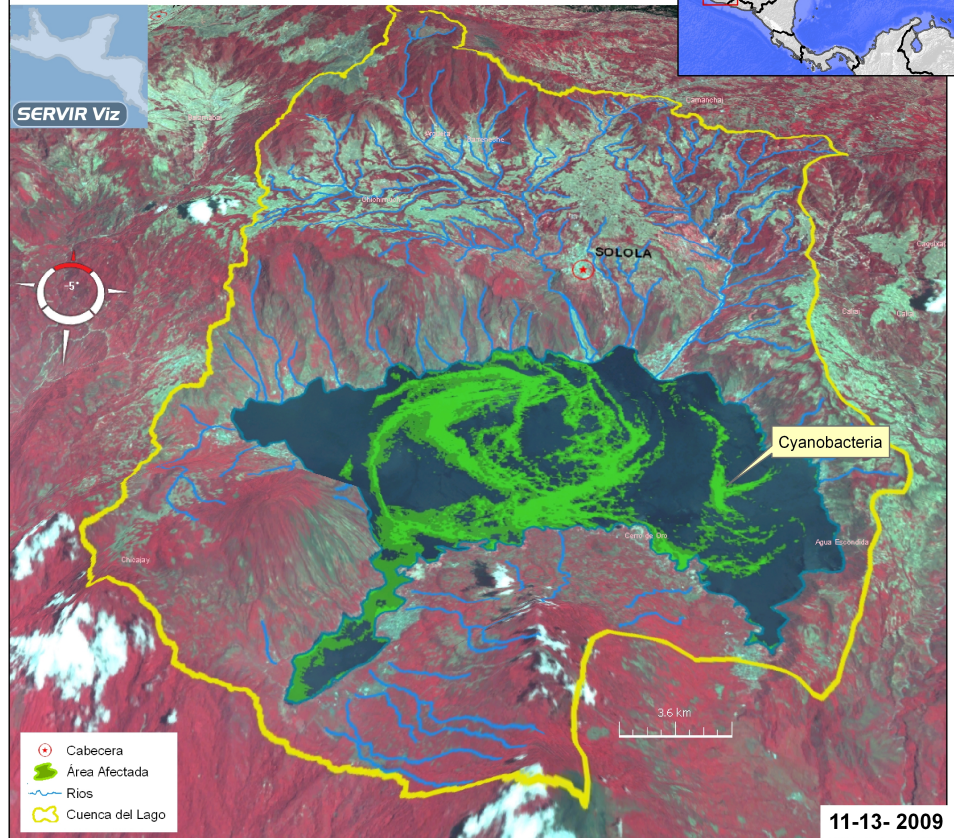
Imagen EO-1 del Lago de Atitlan - Noviembre 13 del 2009  
Departamento de Sololá, Guatemala



## Lago de Atitlán, Departamento de Sololá , Guatemala Área Afectada por *Cyanobacteria*

### Sistema Hídrico de la Cuenca Endorreica del Lago de Atitlán

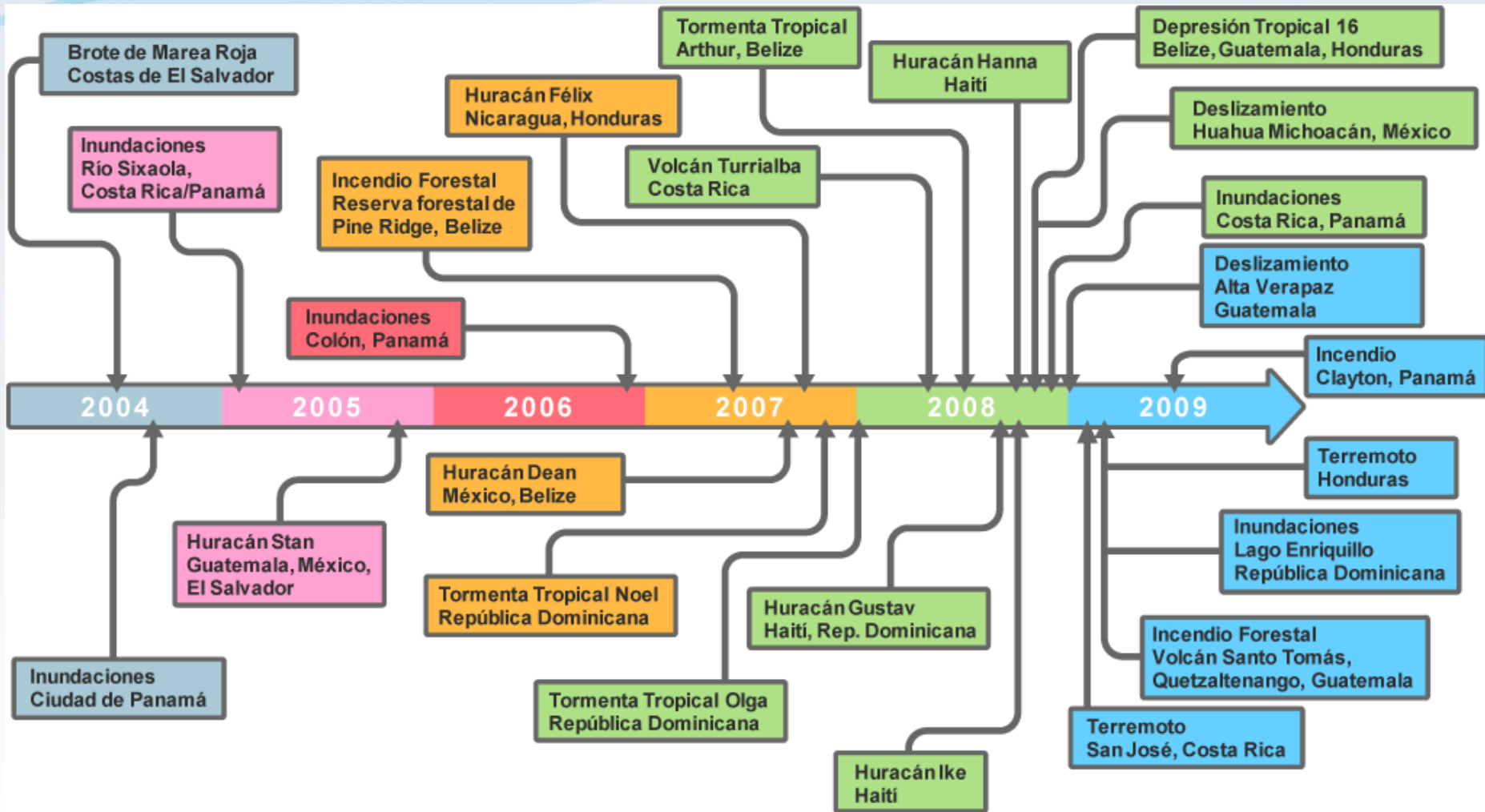
Visualizacion en SERVIR-VIZ



[www.servir.net](http://www.servir.net)

Elaborado por CATHALAC, 16 de Noviembre 2009

# SERVIR Support for Disaster Response



\* Generation of products for 33 events between June 2004 and November 2009

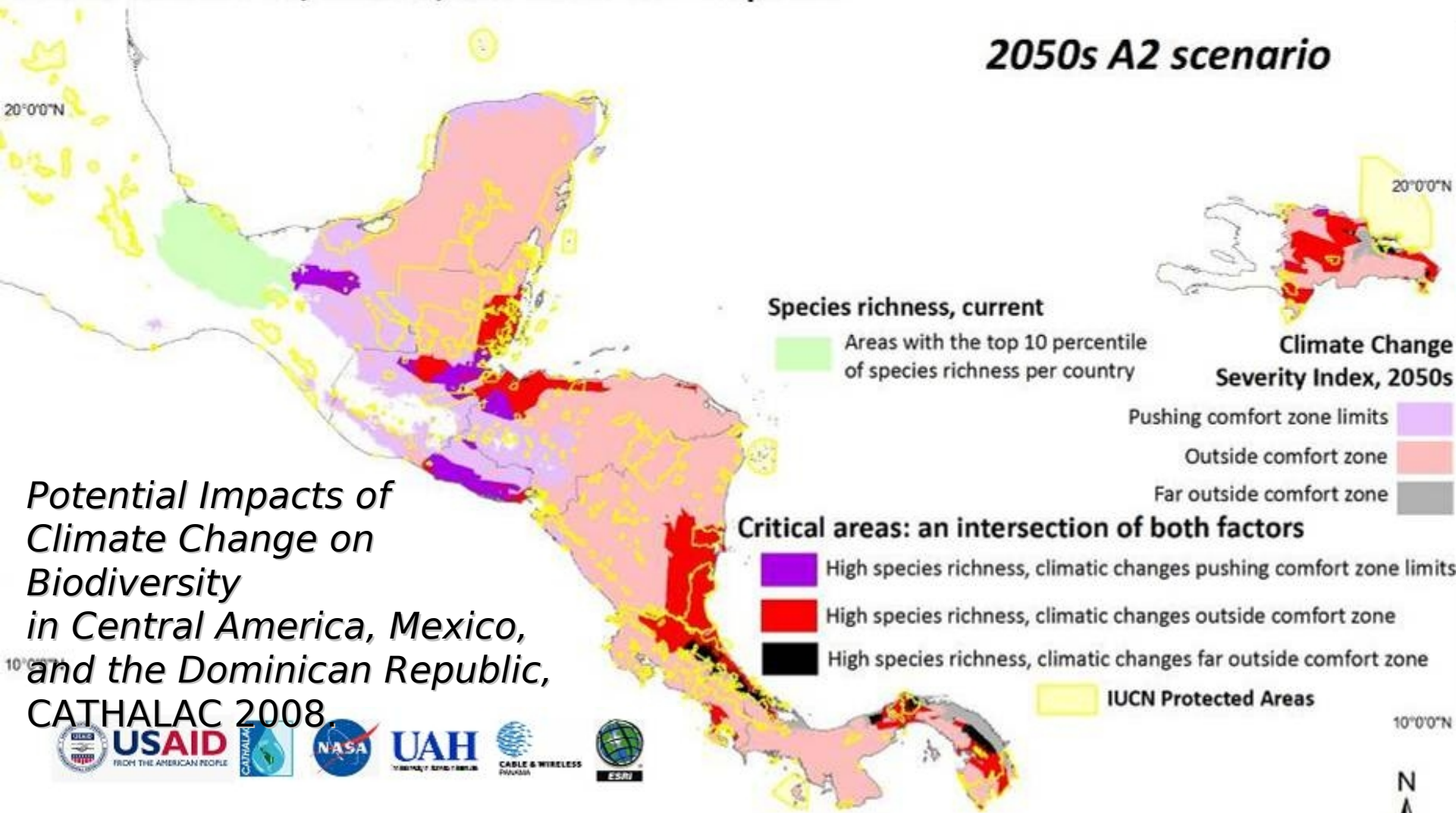
90°0'0"W

80°0'0"W

70°0'0"W

# Critical areas: high species richness and climate change severity in Central America, Mexico, and Dominican Republic

## 2050s A2 scenario



*Potential Impacts of Climate Change on Biodiversity in Central America, Mexico, and the Dominican Republic, CATHALAC 2008.*



Data derived from:  
Grids.

NatureServe InfoNatura Species Distribution

WorldClim Climate Grids: Current and Future Conditions.

70°0'0"W





## Potential Impacts of Climate Change on Biodiversity

in Central America, Mexico and the Dominican Republic



Executive Summary

2008

# Identifying Critical Areas for Conservation: Biodiversity and Climate Change in Central America, Mexico, and the Dominican Republic

Eric R. Anderson<sup>1</sup>, Emil A. Cherrington<sup>1</sup>, Laura Tremblay-Boyer<sup>2</sup>,  
Africa I. Flores<sup>1</sup>, Emilio Sempris<sup>1</sup>

**Abstract.** Given the rapidity and intensity of anthropogenic impacts on natural systems, assessing the effectiveness of current protected areas in preserving biodiversity is especially important in Mesoamerica and the Caribbean, which contain a wide array of species and ecosystems. In light of the growing need to consider climate change in policymaking, combining climate change projections with biodiversity maps allows scientists and decisionmakers to understand possible climate change impacts on biodiversity. In this study, we use GIS to identify spatial relationships between regional climate change models and species habitat ranges for Mesoamerica and the Caribbean. Evaluating possible effects of climate change in terms of temperature and precipitation involves three factors: historical averages, historical ranges, and future averages. Because different ecosystems and species exist at different temperature and precipitation ranges, we consider "comfort zones" of each area. We develop a quantitative, spatial measurement of climate change intensity of each area by calculating the difference between historical and future averages and dividing that difference by the area's comfort zone, at a spatial resolution of 1km<sup>2</sup>. The result is a normalized grid of projected climate change severity. According to the modeling results, should worst case scenario conditions prevail, by the 2030s, the Caribbean coasts of Costa Rica, Honduras, Nicaragua, Panama, and the Dominican Republic, will be significantly impacted by climate change. By the 2080s, all of the ecosystems and species of Central America and the Dominican Republic may be subjected to conditions well outside of their traditional comfort zone, while most of Mexico's ecosystems and species are at lower risk of severe climate change impacts. Integrating species richness data with the climate change severity analysis identifies critical areas that may require specific interventions to facilitate the adaptation of species to climate change. The information generated points not only to the utility of current protected areas, but is also useful in guiding the development of new protected areas and biological corridors, for the reduction of the potential impacts of future climate change.

### INTRODUCTION

Mesoamerica and the Caribbean are two of the world's top twenty-five biodiversity hotspots, teeming with globally significant biological diversity. In Mesoamerica alone, nearly 8% of the world's terrestrial species are found on less than 1% of earth's landmass (Mauri 2002). Yet, deforestation and uncontrolled human development have resulted in the loss of an estimated 70% of original habitat (Conservation International 2004). In response to this situation, the regions' governments have demonstrated their commitment to biodiversity conservation through the Mesoamerican Biological Corridor and Caribbean

Biological Corridor, networks of protected areas spanning the isthmus and Caribbean islands. These corridors are home to the globe's only preserves for sensitive species such as the jaguar and whale shark (respectively the largest cat in the Americas, and the world's largest fish), as well as over 250 threatened birds, mammals, and amphibians (InfoNatura 2007).

The richness of species and ecosystems in Mesoamerica and the Caribbean is constantly threatened by human-induced drivers of environmental change. The conversion of natural landscapes such as forests, grasslands and wetlands, into



**Address:**  
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[emilio.sempris@cathalac.org](mailto:emilio.sempris@cathalac.org)

<sup>2</sup>Sea Around Us Project  
Fisheries Centre  
Aquatic Ecosystems  
Research Laboratory  
(AERL)  
The University of  
British Columbia  
2020 Main Mall  
Vancouver, British  
Columbia V6T 1Z4  
Canada  
[LBoyer@fisheries.ubc.ca](mailto:LBoyer@fisheries.ubc.ca)

Figure 1.  
Mesoamerican and  
Caribbean biodiversity  
hotspots.

# Summer 2009: Building capacity for EO in disaster mgt in Central America



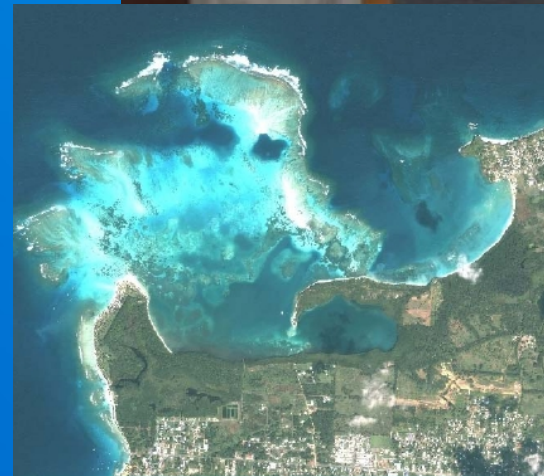
- Training for:
- Disaster mgt agencies
  - Meteorological services
  - Environmental ministries

National





# The Global Environment Facility-funded Integrating Watershed and Coastal Areas Management in Caribbean Small Island Developing States (GEF-IWCAM) Project



*IKONOS image of Buccoo Reef and adjacent land, Tobago (2004)*

**1km pixels**

e.g. AVHRR,  
GOES, MODIS

**500m pixels**

e.g. MODIS

**250m pixels**

e.g. MODIS

**30m pixels**

e.g. Landsat

**20m pixels**

e.g. IRS

**15m pixels**

**e.g. ASTER,  
Landsat ETM  
(sharpened)**

**10m pixels**

**e.g. SPOT**

**1m pixels**

**e.g. Ikonos / Quickbird**

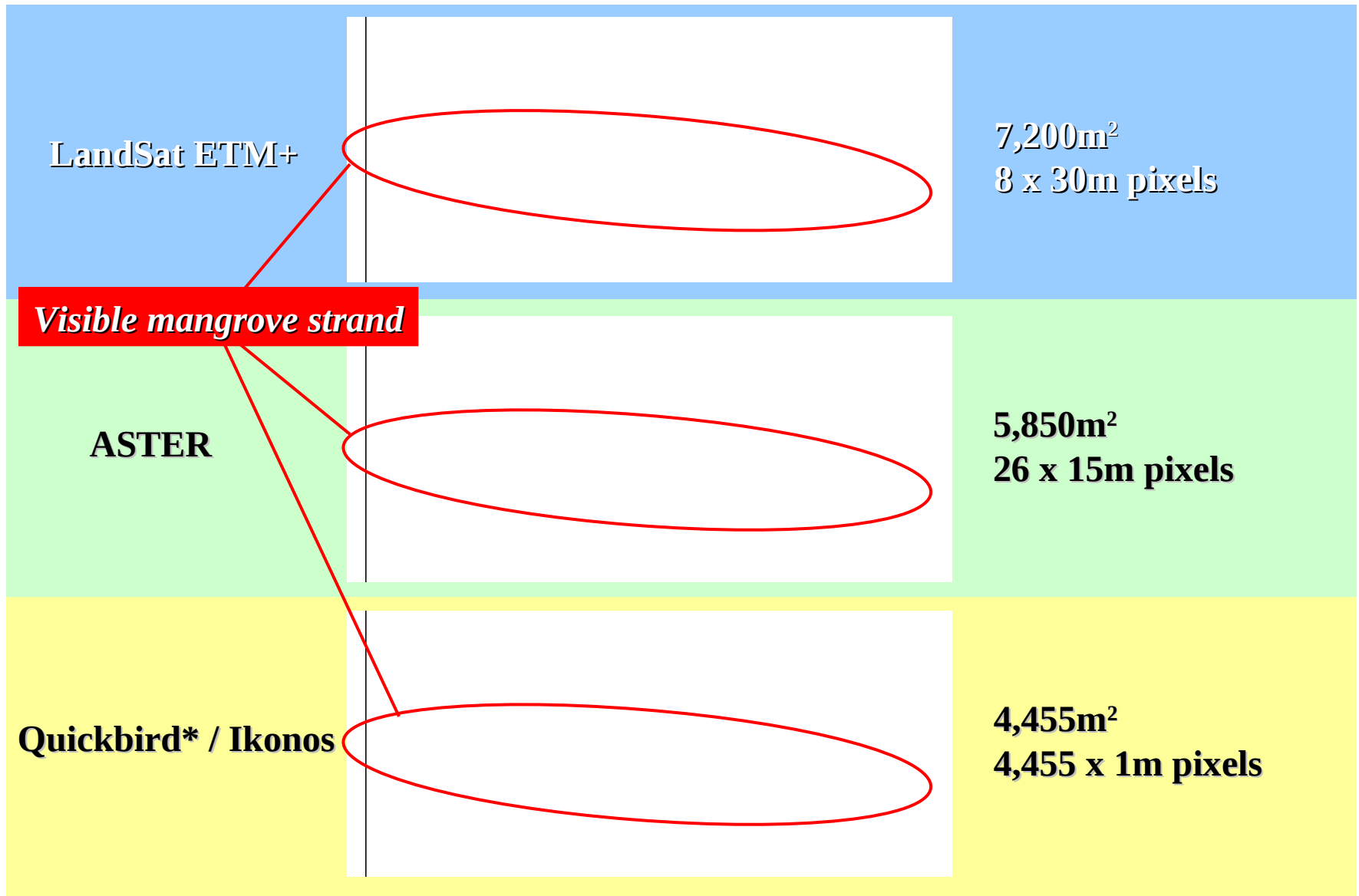
***Operational principle: IKONOS or  
Quickbird can be used to map small  
features a few m<sup>2</sup> large***

***Visible mangrove strand***



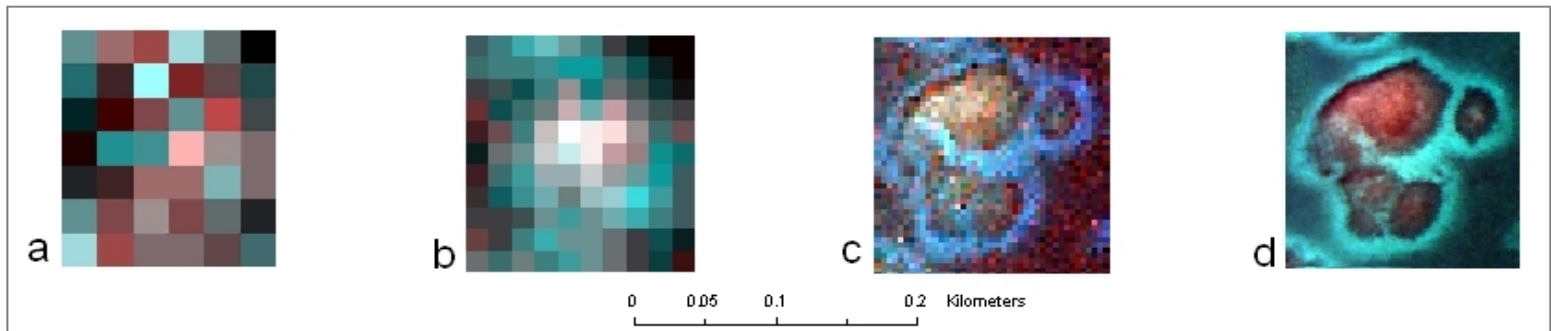
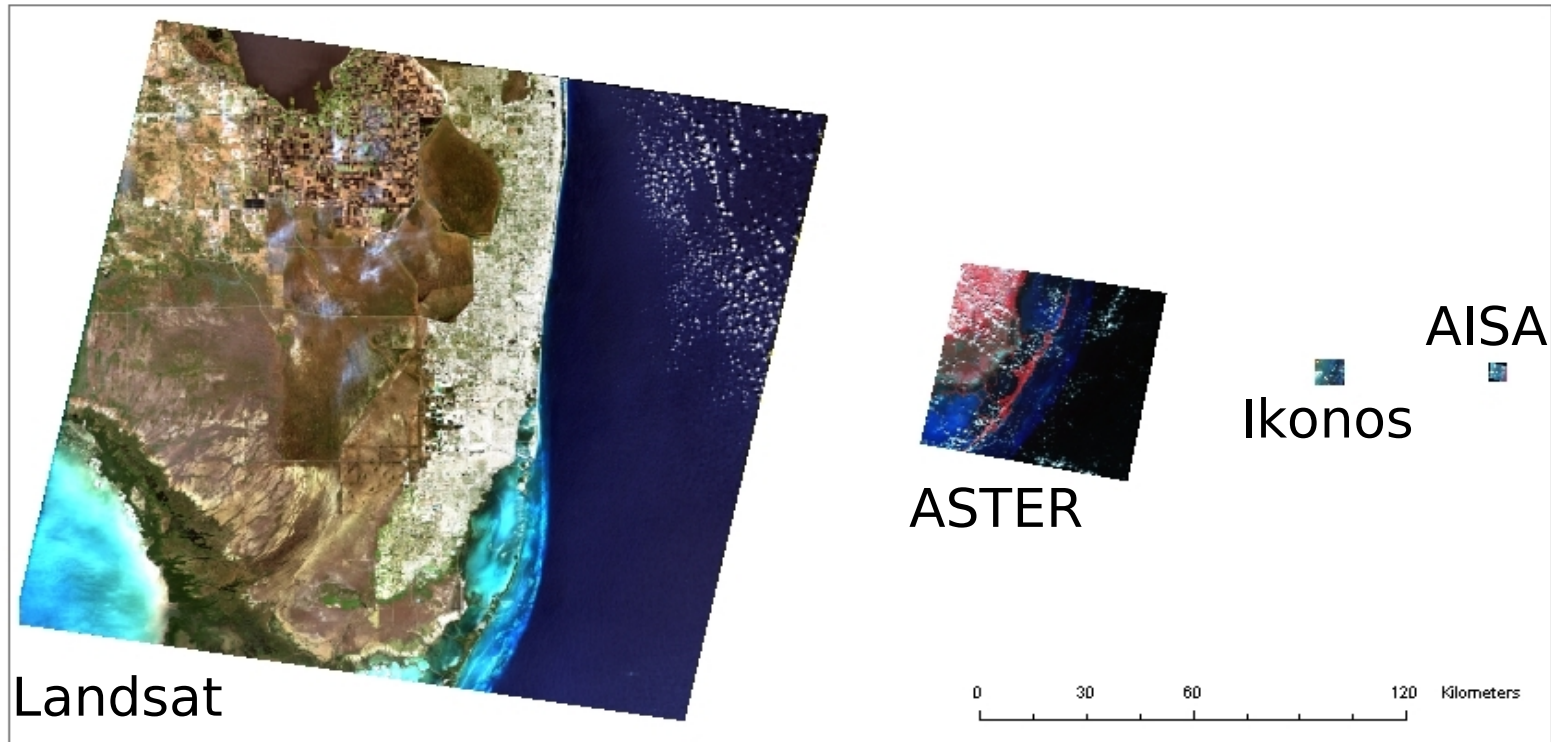
**1m pixels: resolution of IKONOS / Quickbird\***

# So what does this all mean for analyses?



\* The pan-sharpened Quickbird data used in this analysis was re-sampled to 1m resolution

# Pixel Size





# Conclusions

- **Capacities vary widely across ‘sub-regions’ (Mesoamerica / Caribbean / S. America)**
- **Spatial resolution considerations for CZM**
- **EO for disaster mgt. and envir. monitoring**
- **Understanding baseline conditions (terrestrial and marine)**
- **Access to satellite imagery (optical AND radar)**
- **Access to in-situ data**
- **Capacity to utilize EO data**
- **Need for ready-to-use operational products**
- **Much work to be done**

