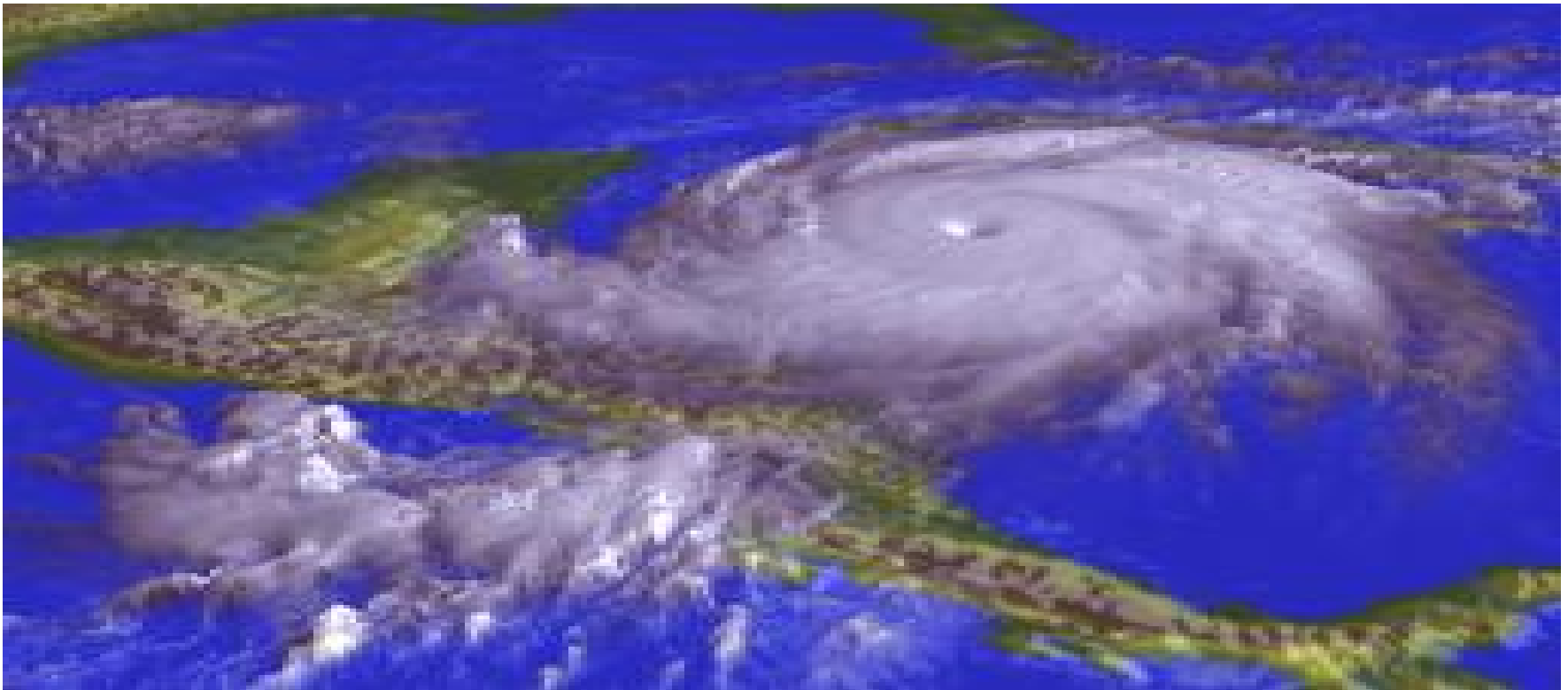


CRN-2050

Paleotempestology of the Caribbean region:

A multi-proxy, multi-site study of the spatial and temporal variability of Caribbean hurricane activity

Kam-biu Liu



Project Overview

- **PI:** Kam-biu Liu
- **12 co-PIs** from 10 inst. & 4 nations (U.S., Canada, Mexico, Costa Rica)
- **Objective:** to study the spatial and temporal variability of Caribbean hurricanes across **multiple timescales** and at **multiple sites**
- **Methodology:** by employing the principles and methods of *paleotempestology* – a **multi-proxy** approach



PI:

Kam-biu Liu (LSU)

Co-PIs:

Nina Lam (LSU)

Sam Bentley (Memorial)

Jeff Donnelly (Woods Hole)

Tom Webb III (Brown)

Claudia Mora (Tennessee)

Amy Frappier (Boston Col.)

Anne Cohen (Woods Hole)

Matthew Peros (Ottawa)

Joe Desloges (Toronto)

Jorge Sanchez (Mexico)

Jorge Amador (Costa Rica)

Eric Alfaro (Costa Rica)

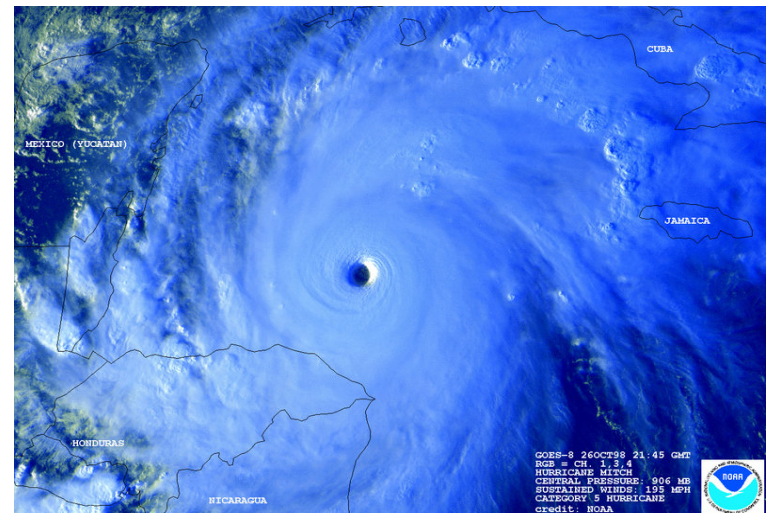
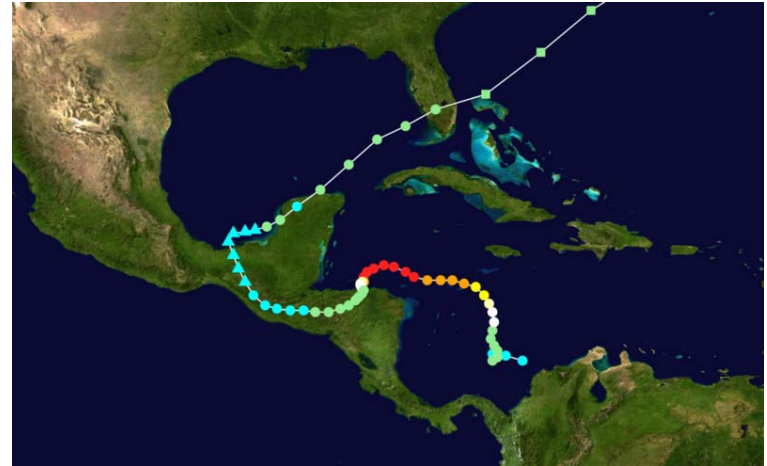
Why this project?

Caribbean Societies are Highly Vulnerable to Catastrophic Destruction by Hurricane Strikes

Hurricane Mitch

(October 27-29, 1998)

- Cat 5 at sea
- Cat 2 at landfall in Honduras
- Deadliest Atlantic hurricane since 1780
- > 10,000 deaths, mostly due to landslides & flooding
- \$8.5 billion in damage
- **Is Mitch the worst-case scenario for the Caribbean?**



- A better understanding of the climate mechanisms affecting Caribbean hurricane activity will help us better predict future hurricane activities under various global warming scenarios
- A long-term perspective is vital for such an understanding; hence *paleotempestology*

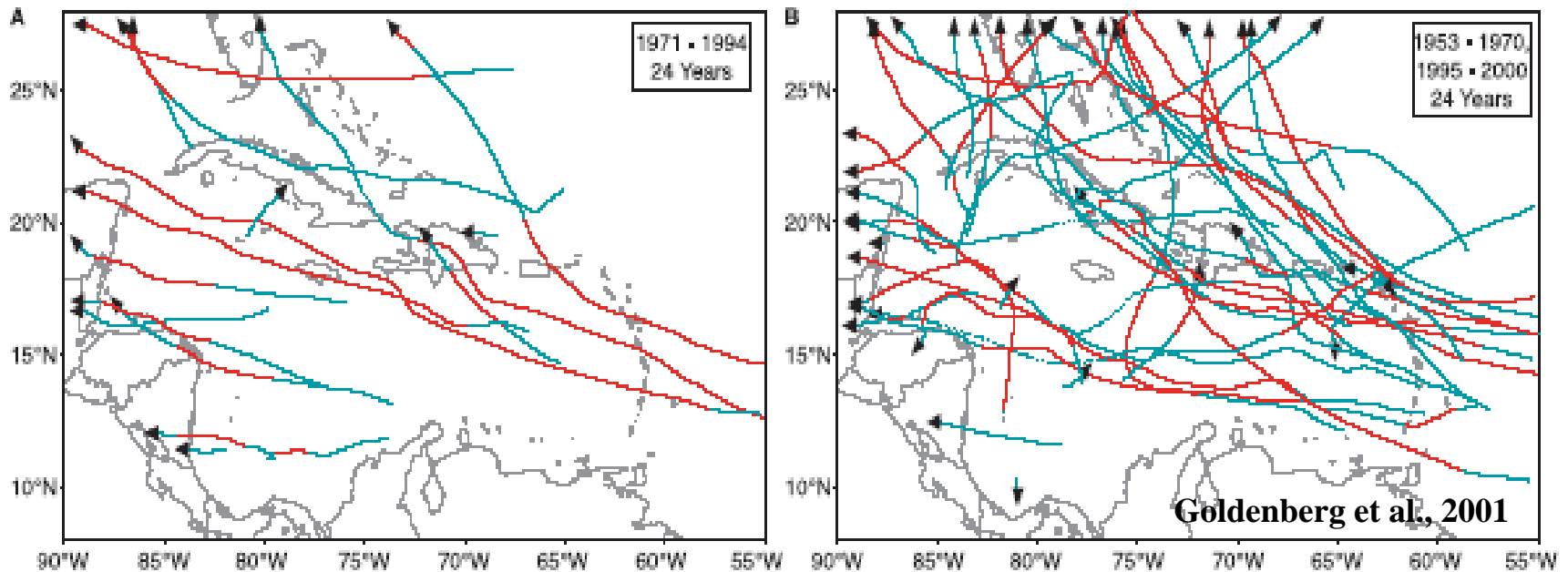
- Caribbean hurricane activity exhibits both spatial and temporal variability on the multi-decadal timescale
- This variability is linked to large-scale climate patterns such as the Atlantic Multidecadal Oscillation (AMO) and El Niño-Southern Oscillation (ENSO)

1971-1994 (24 years)

- cold AMO

1953-1970; 1995-2000 (24 years)

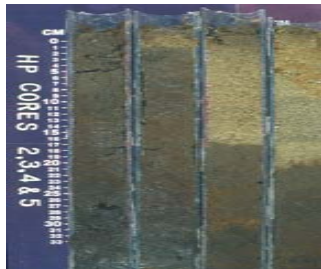
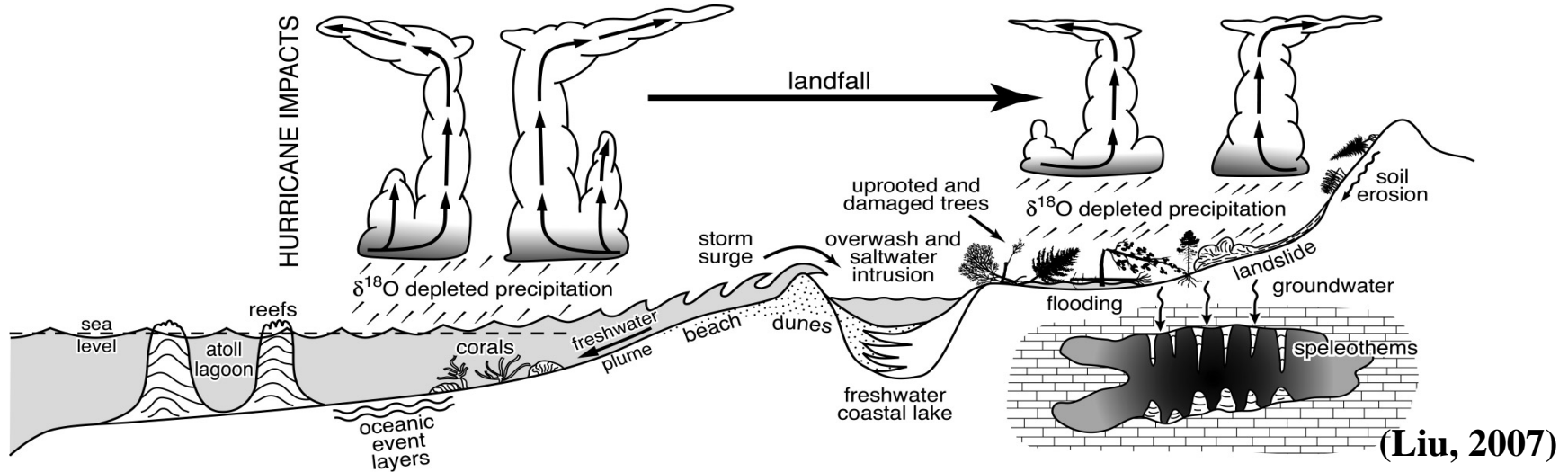
- warm AMO



Paleotempestology is a new field of science that studies *past* hurricane activities by means of geological and archival techniques.

Our CRN2050 project spearheads the expanding frontiers of Paleotempestology....

Multi-proxy Reconstruction of Prehistoric Hurricane Activities



sediments



documents



tree rings



speleothems



corals

Goals & Objectives

- Produces the first comprehensive paleotempestological record from the entire Caribbean region based on multiple proxies;
 - Lake-coring fieldwork to produce sedimentary record of paleohurricane strikes
 - Compiling historical record of hurricane strikes and societal impacts
- Contributes to the expanding frontiers of paleotempestology by developing new proxies;
 - $\delta^{18}\text{O}$ record of speleothems (cave deposits)
 - $\delta^{18}\text{O}$ record of tree rings
 - $\delta^{18}\text{O}$ record of corals
- Provides insight into climate mechanisms controlling Caribbean hurricane activity—vital for long-term forecasting;
- Integrates paleotempestological data with socio-economic data into web-based GIS tool; research results available to stakeholders and vital for risk management & vulnerability reduction;
- Communicates results and findings to stakeholders & decision-makers.

Brief Progress Report

- Team consists of paleoclimatologists, paleoecologists, meteorologists, coastal geologists, isotope geochemists, social scientists, & GI scientists
- Fieldwork has been conducted in 5 Caribbean countries: **Mexico, Belize, Nicaragua, Dominican Republic, Cuba**
- Lab work already in progress:
 - Tree-ring isotopic analysis (Mora), Yucatan speleothems (Frappier), Coral XRF analysis (Cohen). Sediment analysis (Liu, Donnelly, Peros)
- GIS being developed; website already started at LSU:
 - Socio-economic data collection (Lam)



DR



Yucatan



Cuba

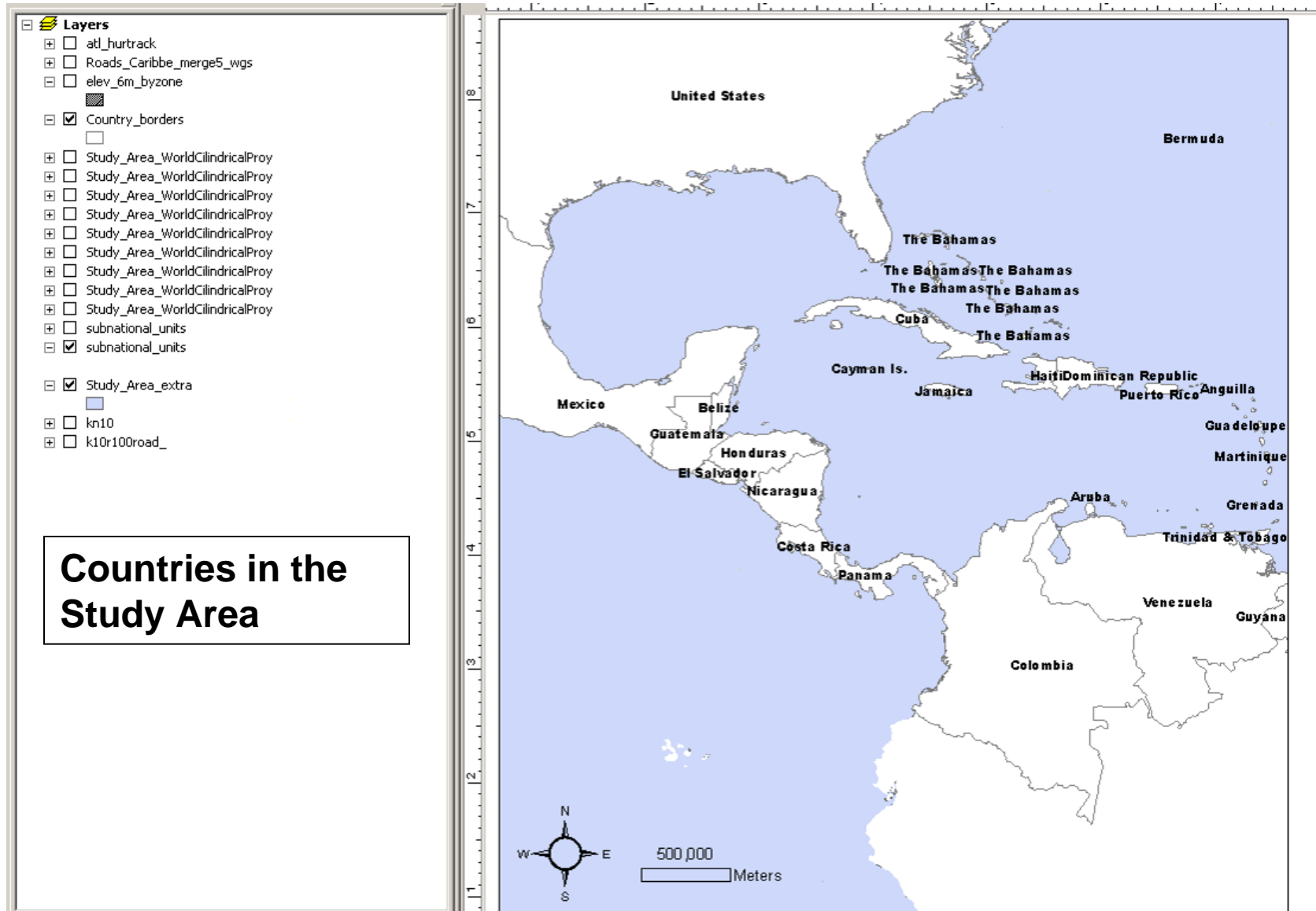


Nicaragua

Belize

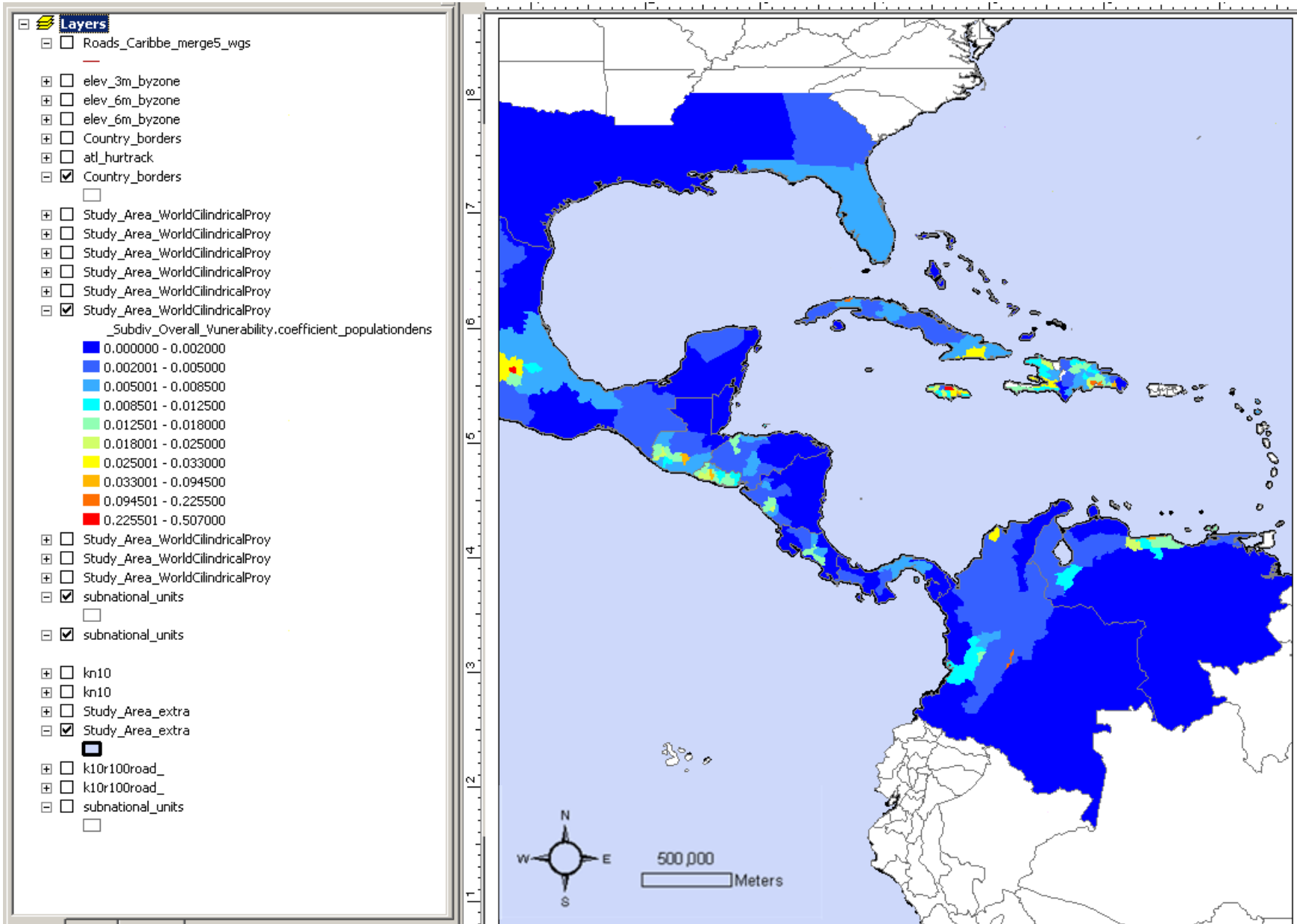
CRN2050: Integration of natural and social sciences

- Collection of socio-economic data and developing a GIS

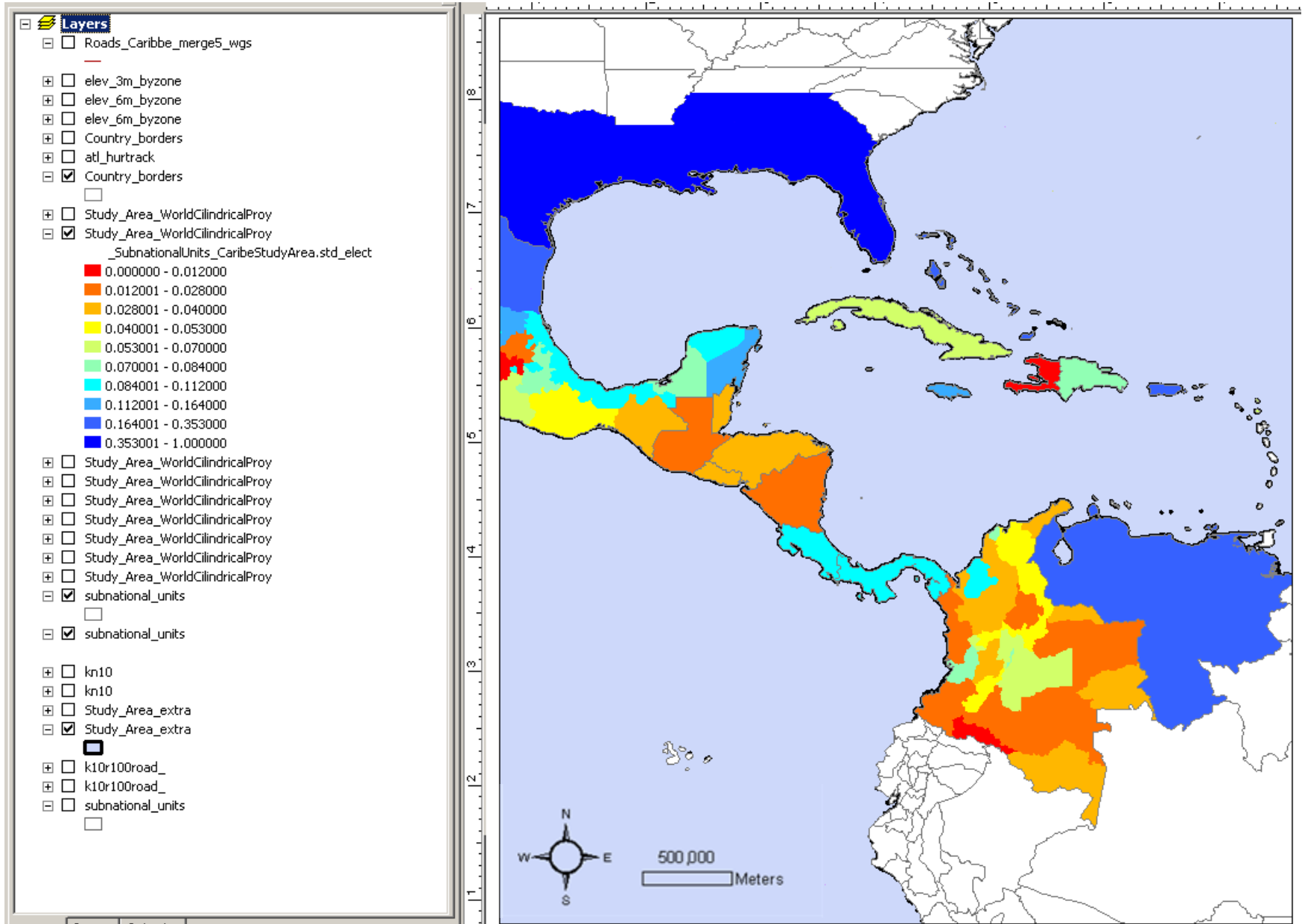


Population Density Coefficient

(Population density at area below 6m and population density at subdivision)

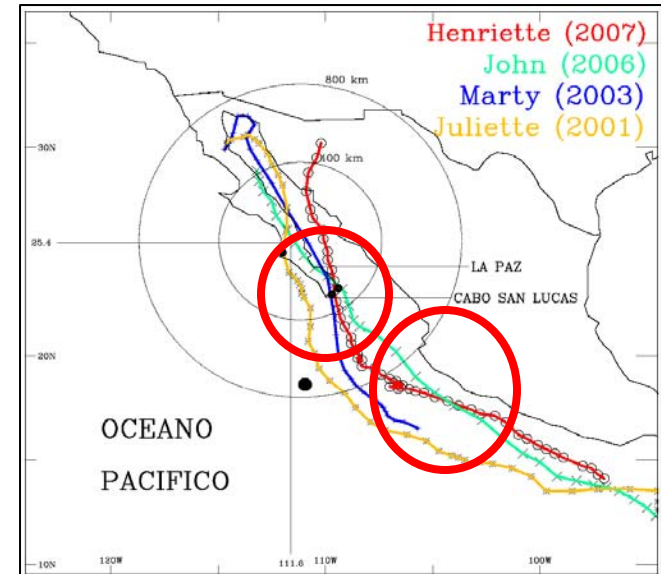


Technology Coefficient (electricity consumption)



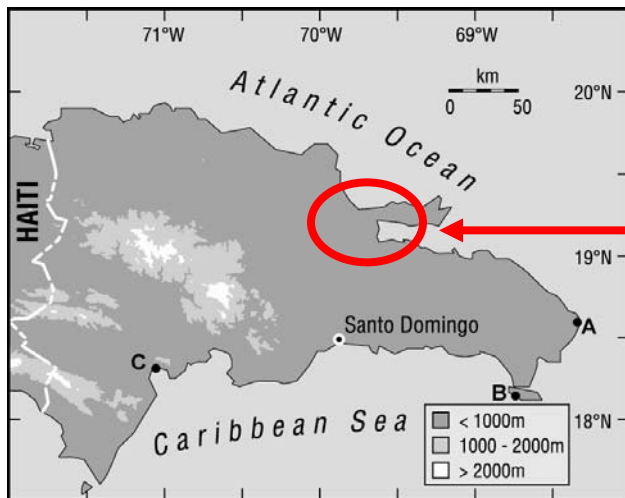
New collaboration with other CRNs

- With **CRN-2048** (Modeling E. Pacific hurricane dynamics)
 - Liu's participation in Raga's training courses in La Paz (2008) & Acapulco (2009)
 - Liu & Lam visit to UNAM (2008)
 - Farfan's visit to LSU (2009)
 - Reconnaissance fieldwork in Baja Sur (2008) & Guerrero (2009)
 - Planned fieldwork in Guerrero, Jalisco, & Baja Sur (2009-10)

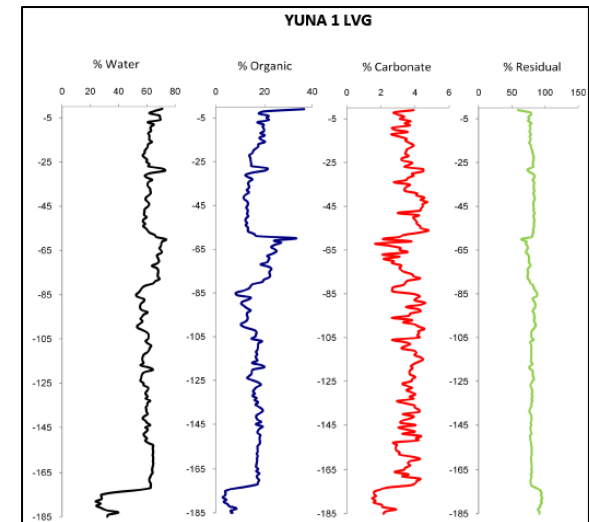


New collaboration with other CRNs

- **With CRN-2061 (Caribbean coastal scenarios)**
 - collaborative fieldwork in Dominican Republic (Yuna River basin)



Yuna watershed basin



Proposed cross-cutting theme for IAI:

“Reduction of societal vulnerability to natural hazards in the face of global climate change”

Key questions:

- How will future climate change affect natural hazards (e.g., hurricane activity) in the region?
 - Need to understand long-term dynamics and climate mechanisms
- How will enhanced hurricane activity affect biophysical systems (ecosystems, hydrology, biogeochemical cycles, soil erosion, fire regime, etc)?
- How will enhanced hurricane activity affect human systems?
 - Need to understand past societal impacts and current vulnerability
- What can society do to reduce our vulnerability and increase our resilience?