Hurricane Risk and Societal Vulnerability in the Caribbean Region

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- Background: Caribbean hurricane activity and climate change
- Socio-economic factors in vulnerability assessment
- The role of the IAI in international collaboration
- Research needs and priorities in vulnerability and adaptation planning

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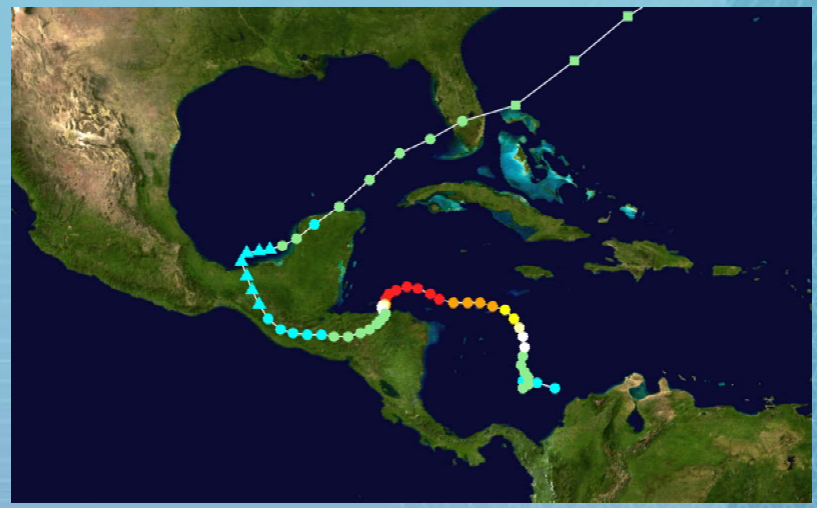
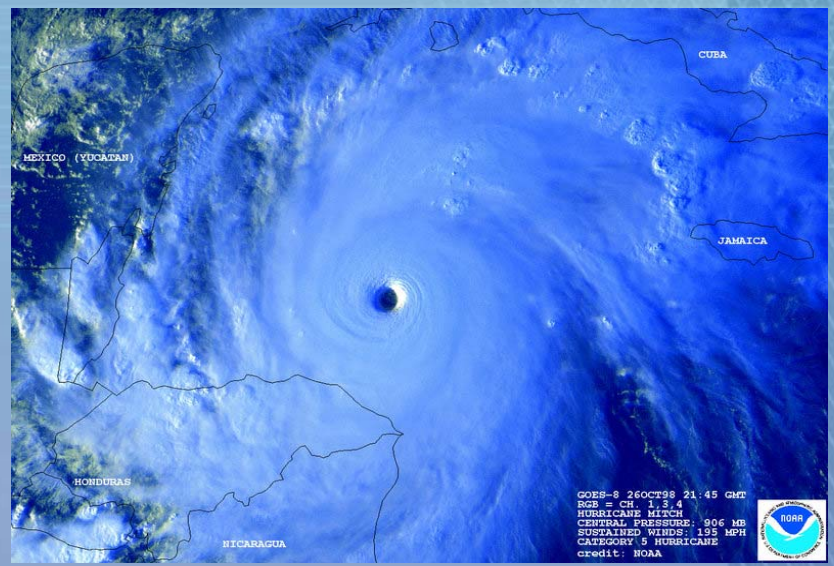
Caribbean Societies are Highly Vulnerable to Catastrophic Destruction by Hurricane Strikes

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?

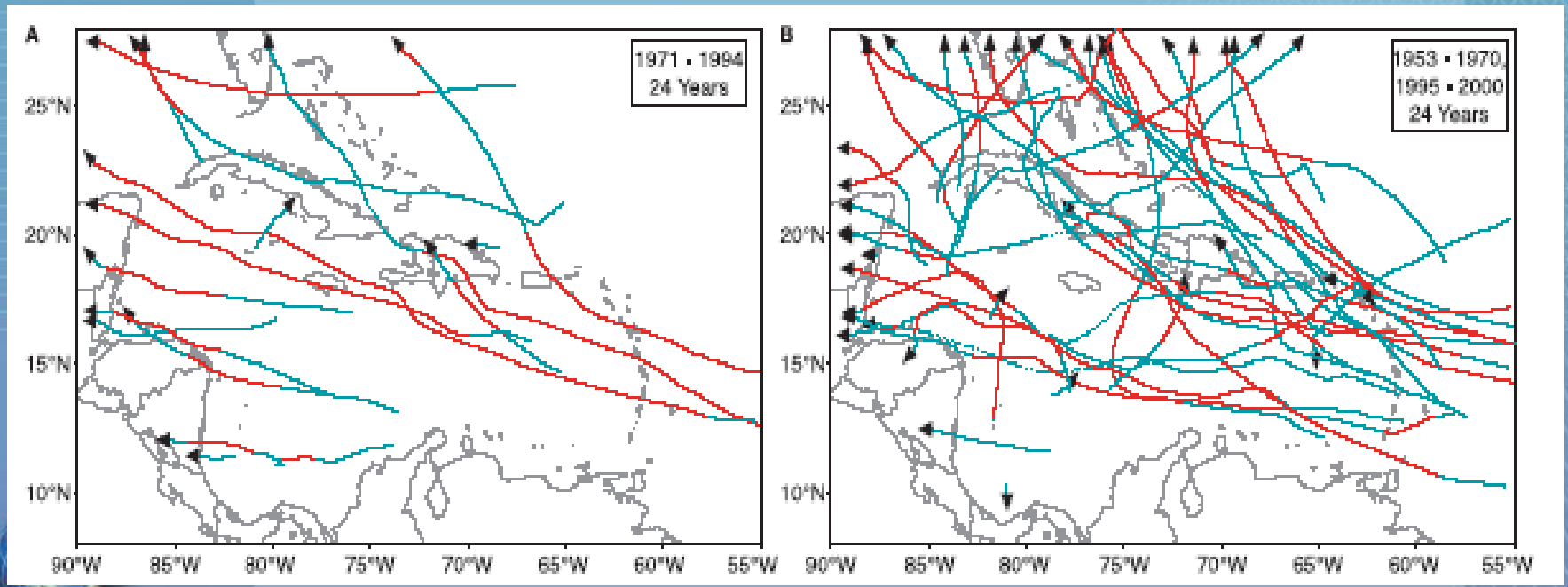




- **Caribbean hurricane activity exhibits both spatial and temporal variability on the multi-decadal timescale**
- **This variability is linked to large-scale climate patterns such as the Atlantic Multidecadal Oscillation (AMO) and El Nino-Southern Oscillation (ENSO)**

1971-1994 (24 years)
- cold AMO

1953-1970; 1995-2000 (24 years)
- warm AMO

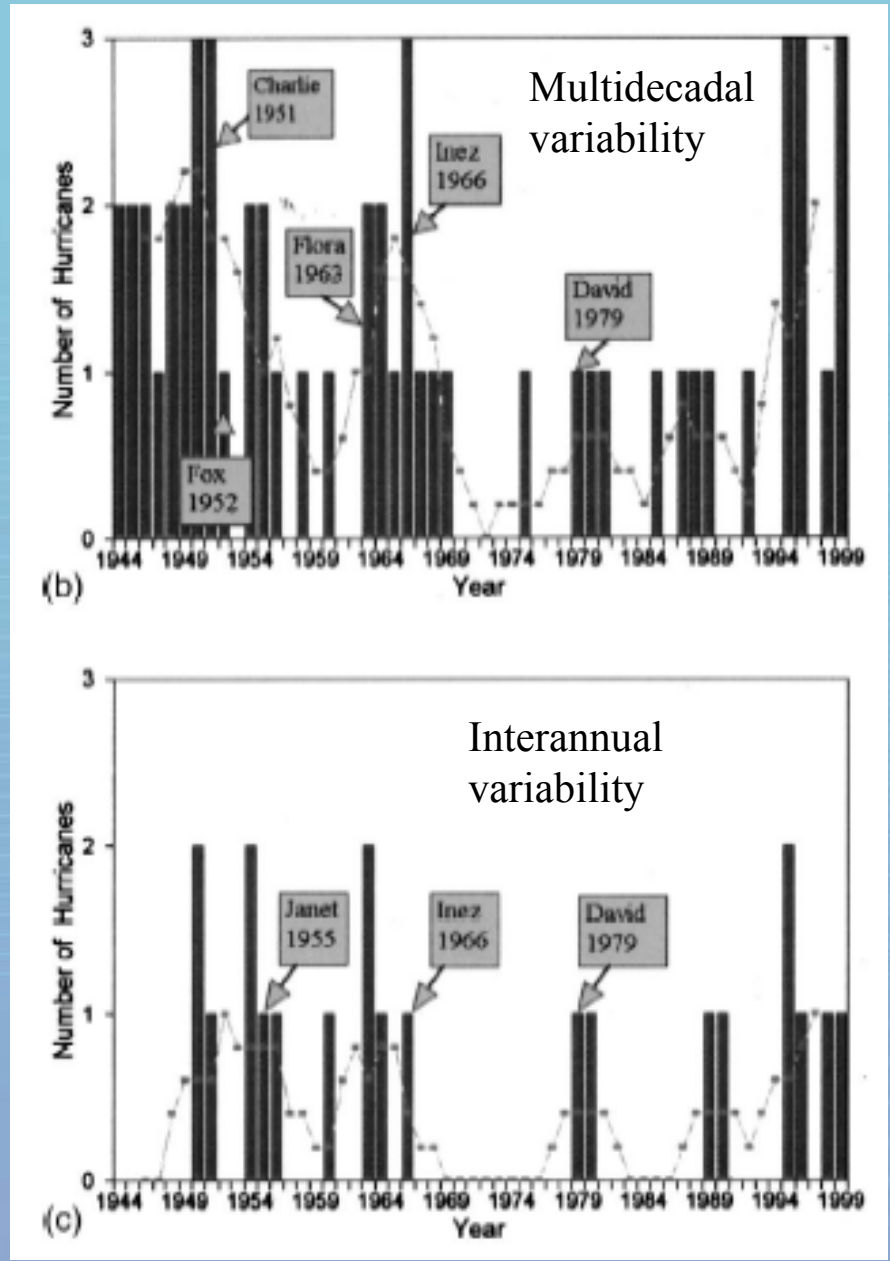


Goldenberg et al., 2001

Number of hurricane strikes per year (1944-1999)

Northern Caribbean → (1.0/yr)

Southern Caribbean → (0.4/yr)



Pielke et al., 2003

Economic loss due to hurricanes is a function of :

- Climate variability
- Societal vulnerability

Hurricane losses increase in proportion to increases in population, wealth, and inflation

Normalized losses *in year y*	=	Actual losses *in year x*	x	Inflation factor	x	Wealth factor	x	Population factor

Socio-economic factors resulting in increased societal vulnerability to natural disasters such as Hurricane Mitch

- Rapidly increasing population
- Widespread poverty
- Lack of access to adequate land
- Urbanization
- Deforestation (→ soil erosion, landslides, flooding)

** Many of these socio-economic factors also apply to SIDS.

"As populations rapidly grow, the proportion of people living in disaster-prone areas such as flash-flood zones, mudslide-prone valleys, and storm surge-threatened lowlands goes up even faster" (Pielke et al., 2003)

Accurate risk assessment and effective adaptation planning depends on sound scientific information …….

Research questions and uncertainties:

- How will future hurricane activity (intensity, frequency, tracks) change in the Caribbean region, and at what timescales, in the light of global climate changes *(cf. IPCC Report 2007)?*
- What would be the "worst-case scenario" for Caribbean SIDS? Is Mitch the worst-case scenario in terms of hurricane risk?
- What lessons do we learn from Mitch? How did the natural and human systems respond to Mitch?
- How can we prevent (or reduce the chance of) the Mitch disaster from happening in SIDS? (Implications for adaptation planning and vulnerability reduction).

a regional intergovernmental organization supported by 19 countries in the Americas dedicated to global change research and its socio-economic implications

Objectives: to promote

* scientific excellence
* international cooperation
* open exchange of information

Through:

* multinational + multidisciplinary collaboration
* contribution to capacity building
* policy-relevant research useful to decision-makers

Argentina•Peru•Bolivia•Brazil •Canada • Chile•Colombia•Costa Rica•Cuba•Dominican Republic•Ecuador
Guatemala•Jamaica•Mexico•Panama•Paraguay•Uruguay
USA • Venezuela

The role of the IAI and

examples of successful international collaboration ……

Decision 2/11 - Program of Work

one of the expected outcomes is an enhanced cooperation among Parties, **relevant organizations** and decision makers to enhance their ability to manage climate change risks.

IAI Collaborative Network Program (CRN) addresses, among others, climate change and seeks to enhance regional capacity to understand climate vulnerability, extreme events and their impacts.

IAI Caribbean Initiative

Impact, vulnerability, and adaptation are complex issues that cannot be tackled by one research project alone.

Caribbean Initiative is a Collaborative Research Program involving 3 projects that combine drivers and extreme events that will provide sound and valuable information for SIDS:

1. land use change + impact of sedimentology in coastal areas
2. modeling of tropical cyclones +
3. hurricane history (paleotempestology research)

1. Caribbean Coastal Scenarios seeks to support sustainable development and coastal resource conservation in the Greater Antilles by:

- improving understanding (through research) of the relationships between island-scale inland development and coastal ecosystems (freshwater and pollution inputs)

- stimulating and supporting national and regional dialogues on the consequences of current and plausible future development and management activities (awareness building and institutional/ stakeholder cooperation)

- building capacity to continue analytical and cooperative approaches into the future

2. Tropical Cyclones: Current Characteristics and Potential Changes under a Changing Climate to:

- better understand the factors and processes that influence the intensification of tropical cyclones, through observations and model simulations (will large scale environmental conditions associated with the intensification of tropical cyclones in the region be more frequent in a future warmer climate?)

- evaluate which of these factors could be more important under global warming scenarios

- evaluate the impact of coastal waves induced by tropical cyclones under global warming scenarios

3. Paleotempestology of the Caribbean region

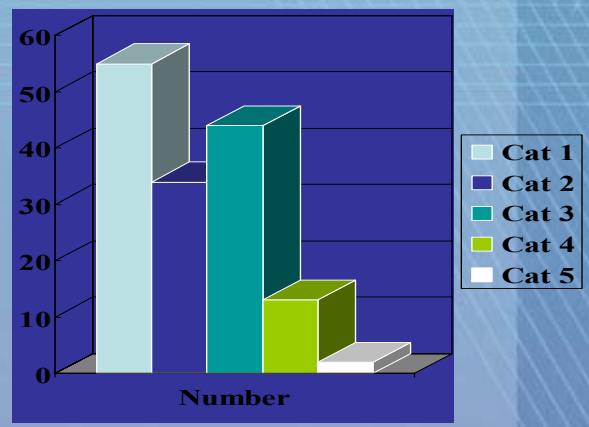
- PI: Kam-biu Liu
- 12 co-PIs from 4 nations (U.S., Canada, Mexico, Costa Rica)
- Objective: to study the spatial and temporal variability of Caribbean hurricane across multiple timescales and at multiple sites
- Methodology: by employing the principles and methods of paleotempestology

What is paleotempestology ?

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

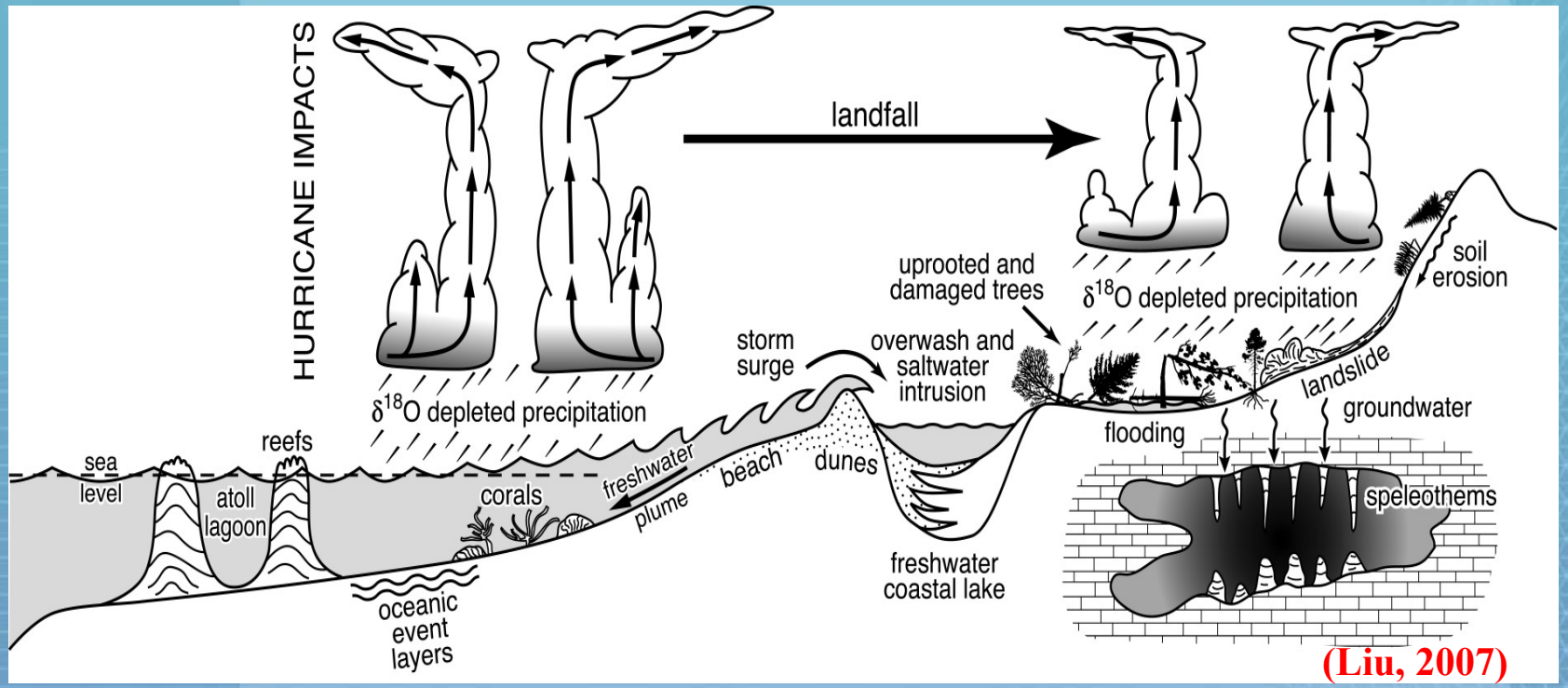
Why Study the Past?

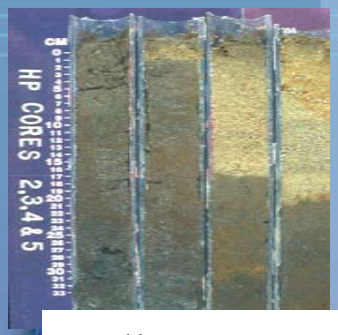
- **A long-term perspective is vital for accurate risk assessment.**
- Observational record of hurricanes only span the last 150 years.
- Category 4 & 5 hurricanes are extremely rare.
- A long-term perspective is vital to forecasting the return period of the "Big Ones".
- e.g., Is Hurricane Katrina's direct hit at New Orleans a 50-yr, 100-yr, or 500-yr event ?
- What is the probability for a Katrina-like hurricane to hit the Caribbean region?



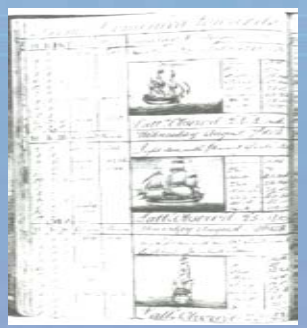
Paleotempestology of the Caribbean Region:

Multi-proxy Reconstruction of Prehistoric Hurricane Activities





sediments



documents

Tree rings

speleothems

corals

Vulnerability and Adaptation Planning for SIDS must be based on:

- Sound scientific information
  - Climate variability
  - Societal vulnerability
- Accurate risk assessment
  - Needs a long-term perspective
  - A systems approach including feedbacks & linkages
- International collaboration
  - Capacity building and sustainable development
  - Stakeholder involvement & information dissemination
  - Building regional databases
  - The role of the IAI as example