Vulnerability of Disasters in Central America

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SUMMARY

- Vulnerability & Risk
- Natural Hazards in C-A
- Change of paradigm in C-A.
- Geomorphology, Tectonic Plates , Vulcanism.
- Types of Disasters in C-A & maps.
- Faults Map of Guatemala.
- Poisson probalility
- Logistic & Multicriteria Optimization

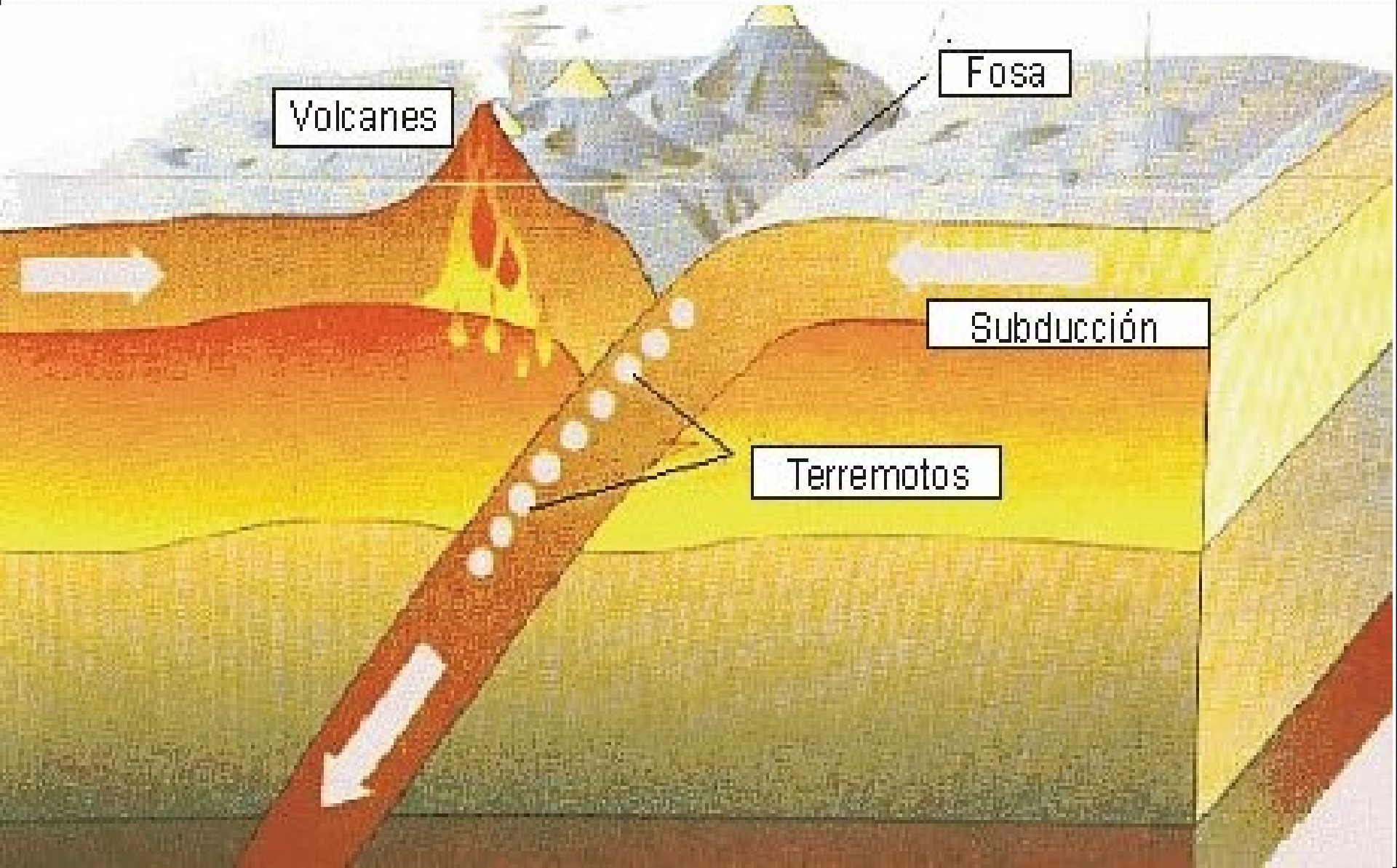
Causes of Vulnerability

- Human, Physical, Economical to Disasters
- People live in crowded conditions
- Physic or structure Engeeniring
- Traditional farming technology
- Natural environment in risk
- Socioeconomic (poverty)
- Hability to cope risk or loss

Natural Hazards in C-A

- Earthquakes
- Landsliding
- Volcanic activity
- Flooding
- Tzunamis (Pacific)
- Hurracanes
- Storms

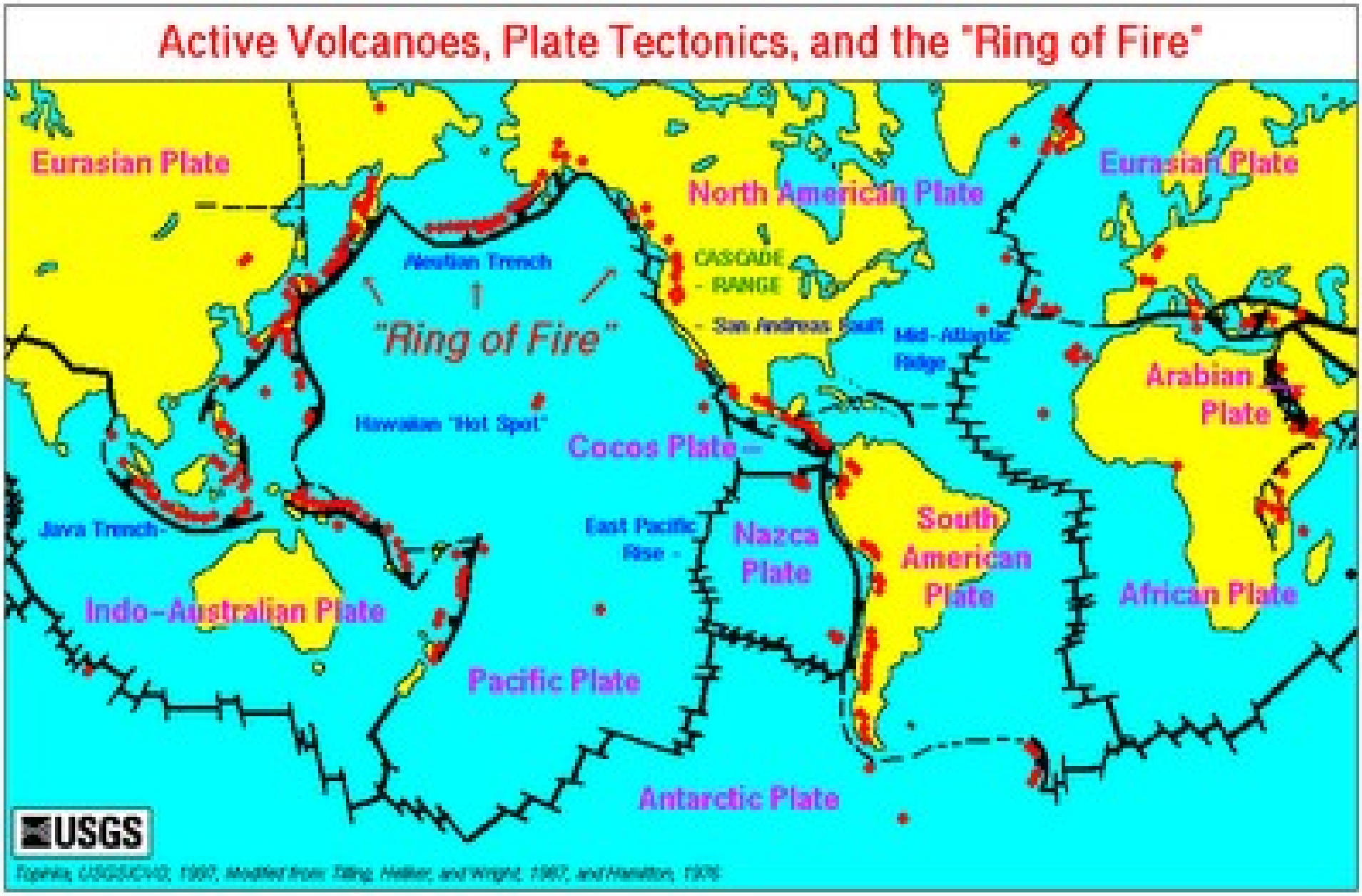
Vulcanism



Geology of Disasters

- C-A is part of Pacífic Volcanic Belt & location of tectónic plates)

- **Seismic Hazard + vulnerabilities = RISK.**

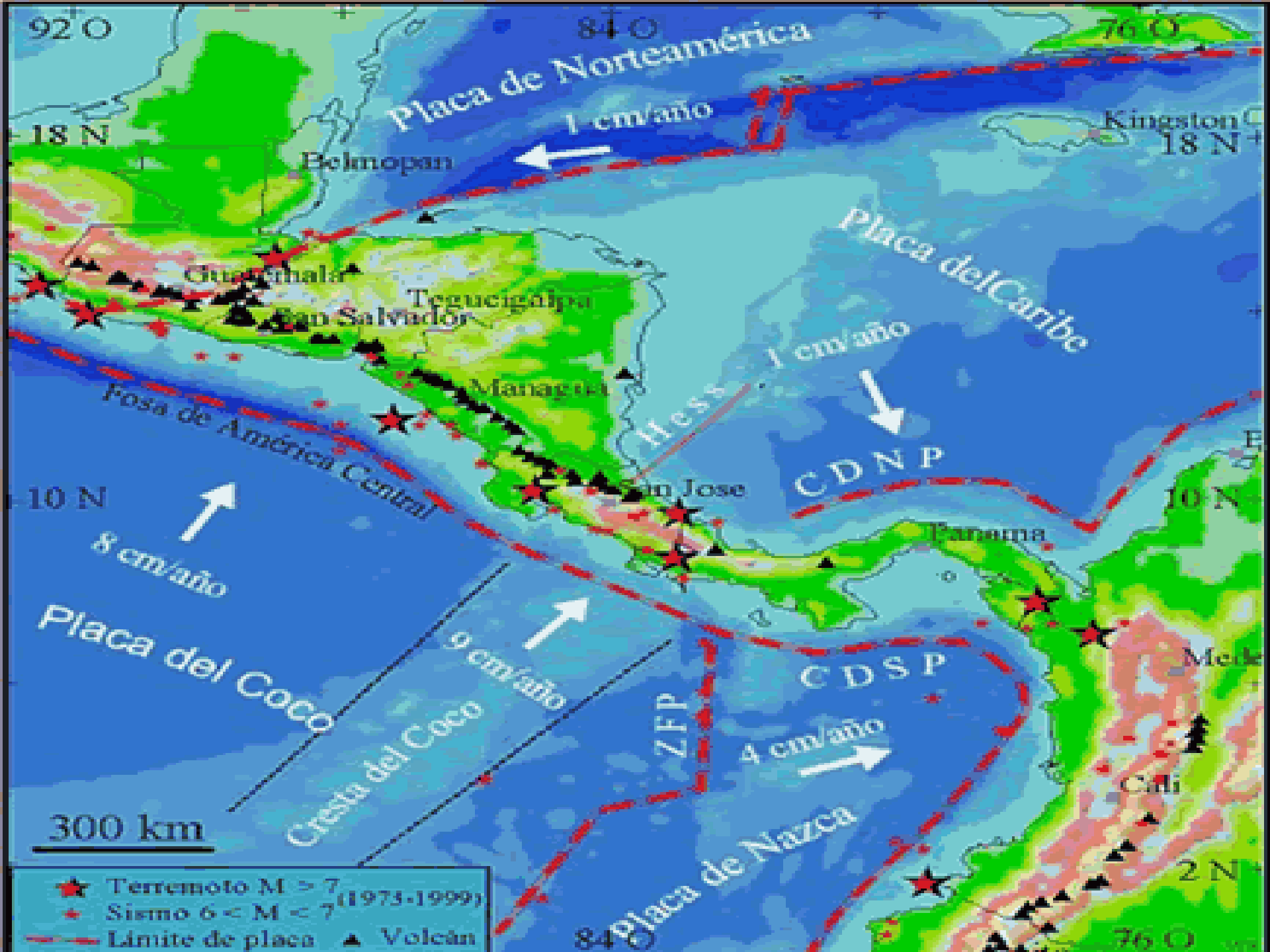

Active Volcanoes, Plate Tectonics, and the "Ring of Fire"
Eurasian Plate
North American Plate
Eurasian Plate
Aleutian Trench
CASCADE
- RANGE
"Ring of Fire"
Mid-Atlantic
Ridge
Arabian
Plate
Hawaiian "Hot Spot"
Cocos Plate
Java Trench
East Pacific
Rise
Nazca
Plate
South
American
Plate
African Plate
Indo-Australian Plate
Pacific Plate
Antarctic Plate
USGS

Change of Paradigm in C-A

- Disasters are not only natural
- Vulnerabilities are associated to Risk.
- Climatic Change has influenced disasters:
- Hurricanes, Storms, floods & landscapes.
- Fast urban growth in the Third World.
- Development & Vulnerability are in inverse relation.

Minimize Risk in C-A

- Several isthmus countries are classified at high risk
- Associated to Climate Change
- Risk Asessment & Management
- Seismic Hazard Maps
- Geology of faults.
- Tectonic Plates
- Strategies of prevention.
- Geological & Hidro-meteorological conception


92 O
84 O
76 O
Placa de Norteamérica
1 cm/año
18 N
Belmopan
Kingston
Guatemala
Tegucigalpa
San Salvador
Placa del Caribe
Managua
Fosa de América Central
1 cm/año
CDNP
San Jose
10 N
Panama
8 cm/año
Placa del Coco
9 cm/año
CDSP
ZFP
4 cm/año
Cresta del Coco
Cali
300 km
Placa de Nazca
2 N
Terremoto M > 7
Sismo 6 < M < 7 (1973-1999)
Límite de placa
Volcán

Disasters in Central America!

- Earthquake devastates all the country. 4/2/76
- Highest Mortality.
- Permanent disasters (Hewitt, 1983).
- Collision of Cocos, North American & Pacific plates.
- Mitch Hurricane with flooding , Oct. 28, 1998.
- (Guatemala, Honduras, Nicaragua)
- Stan Storm, October 2005 (Santiago,lake Atitlán).

1976 Guatemala´s earthquake

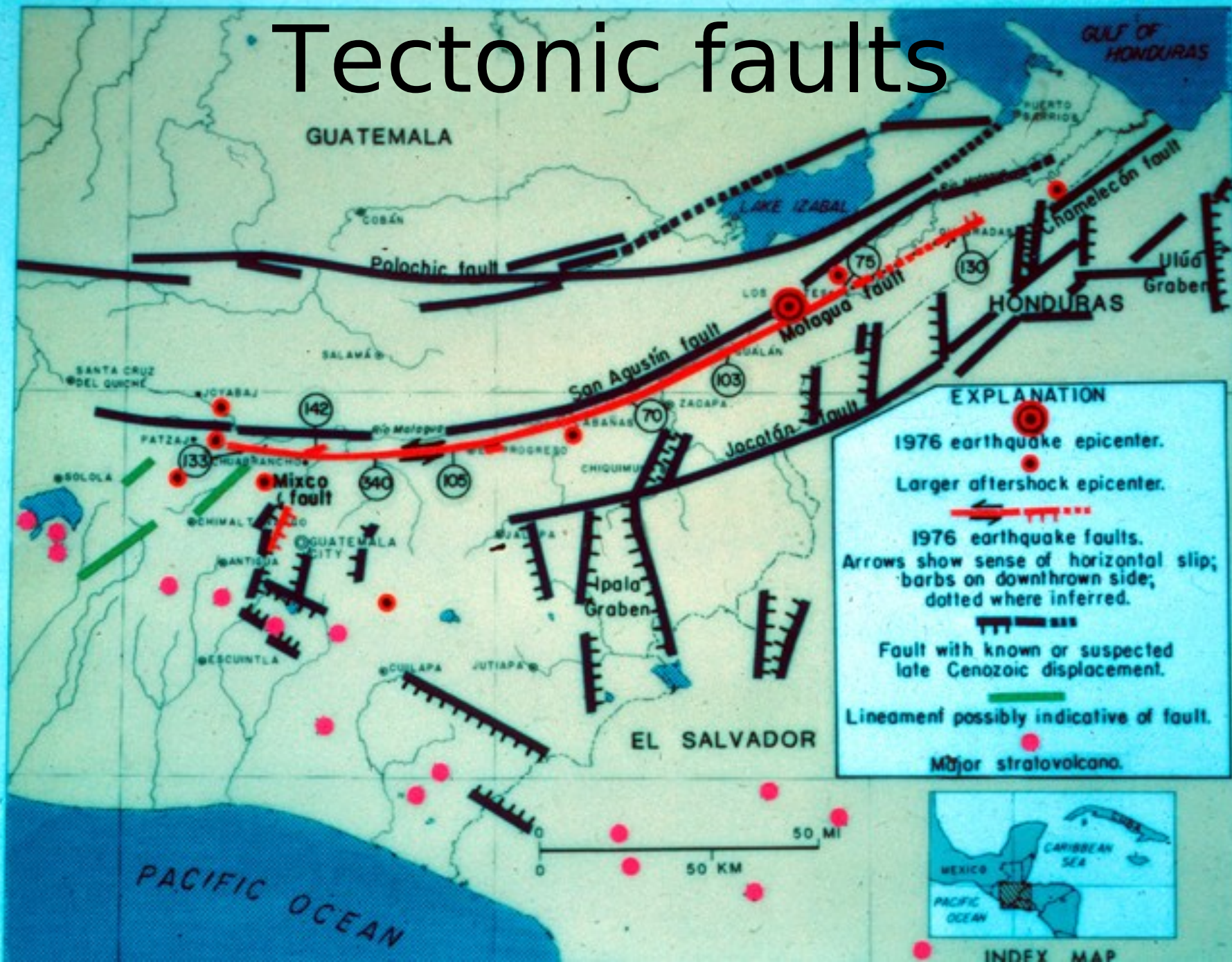
Poisson probabilistic Model

- Poisson distribution is applied to Seismic Hazard Maps (earthquake Guatemala, StanfordU).
- Number of events *n is large , small prob. p of earthquakes.*
- Calculus of probability of success *p* is efficient for seismic events.
- Poisson is: P (k, λt),
- λ is density of seismic activity in time axis.
- Magnitude & Frecuency, & Aftermath.

Poisson probabilistic Model

- P(X= 0,1,2,... n): events
- Fix M= 7.6 Richter magnitude (Guatemala 1976)
- We combine Binomial Conditional distribution with Poisson
- Prediction of probability for Guatemala´s earthquake is every 50 years
- Statistics: 1920, 1976, 2025?
- Reduce high vulnerability for future hazard events

Tectonic faults



Earthquakes in C-A

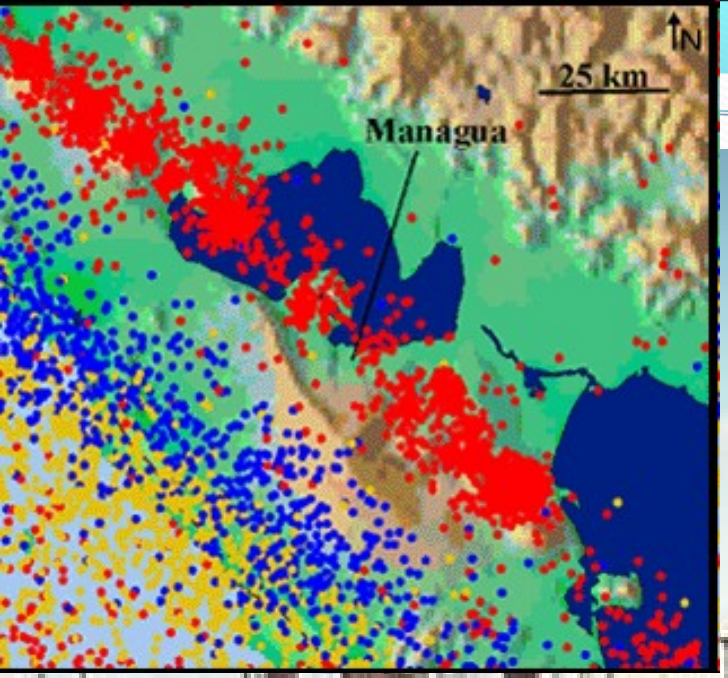
- Guatemala: 1976, 2001, 2008…
- Nicaragua: 1972…
- El Salvador: 1986, 2001
- Honduras: 2008
- Costa Rica: 1991, 2009

Sta Tecla, El Salvador 1986

Caribe de Honduras, 2009

Structural vulnerability (Honduras)

Nicaragua´s seismic area



Costa Rica, 2009

Logistic optimization

- Multiobjective optimization plan for a disaster ➡ ➡
- Countries priorities emergency needs
- Finantial plan for disasters
- Optimal to promote private donations.
- Countries have dificulty to distribute international help, water, food, medical atention & rescue brigades (Haiti 2010, Chile 2010).

Multicriteria Optimization

- Funds must respond to country´s emergency.
- Communities, affected governments: requirements must be identified by UN
- Immediate response to a desaster implies new funding.
- Public health response.
- Long term emergency needs
- Organize brigades for desasters´ response.

International Organizations

- CONRED (Guatemala)
- (NDR) Natural Disaster Reduction: emphasis on Technology & Hazard Management.
- CRID
- CEPREDENAC: Centro de Coordinación para los Desastres en Centroamérica.
- DNR: Natural Disaster Reduction
- EIRD
- UNDRO: United Nations Disaster Reduction

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