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Cat Nat Exposure to Buildings using the example of Central America

Eduardo Reinoso

IMIA The International Association of Engineering Insurers ™

48th IMIA Meeting
Tuesday 29th September 2015, Mérida, México

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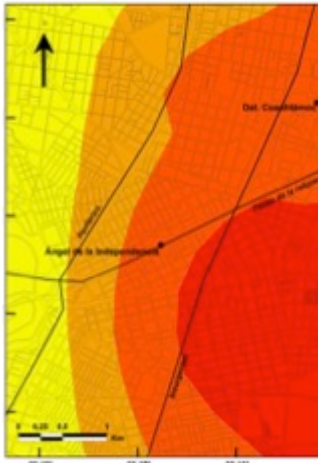
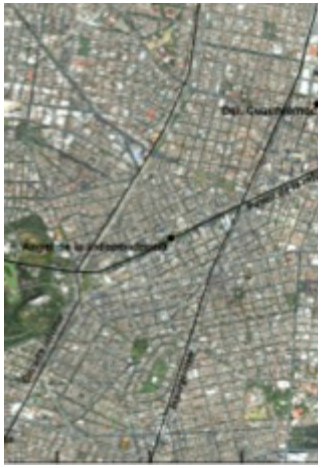
Probabilistic Risk Model or Engineering Cat Models

Hazard

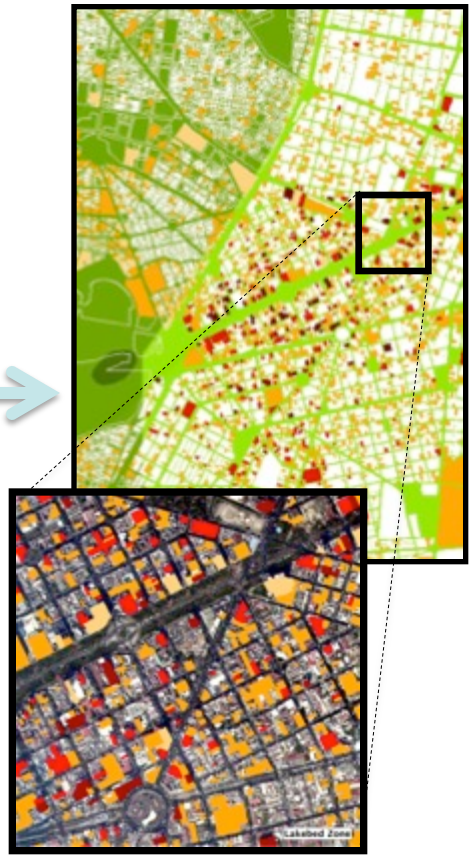




Exposure

Vulnerability

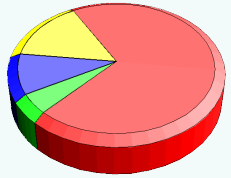
Expected physical damage



Losses

$

Human



Applications

- Emergency Response
- Vulnerability Reduction
- Land use planning
- Financial protection

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UNAM and Cat Modelling

Since 19 years ago (1996) with strong ties to other UNAM groups (Geophysics. Geology. ...)

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1999. Earthquake model for Mexico
+ Modern architecture
+ Fully probabilistic
+ Detailed site effects
+ Numerous vulnerability functions

Regulation (Mexico and Peru in 2008)

2005. **Hurricane model** (wind. storm surge. flood) and other perils
2008. **CAPRA** (WB. IDB. GAR). a peril agnostic software
2009. FONDEN. **all perils** for **all assets** of the Federal Government

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Engineering Models

Classic Mats + Engineering + Computers + Data Bases

Cat Risk

Large **occasional**, events

History does no reveal the true risk: short observation period

Exposed elements and their vulnerability **change rapidly over time**

Secondary effects are becoming very important

Not feasible to build model: statistics

empirical

rely on **probability**

¿Are they new?

Large, important buildings and infrastructure

(dams, bridges, nuclear power plants, tall buildings, …)

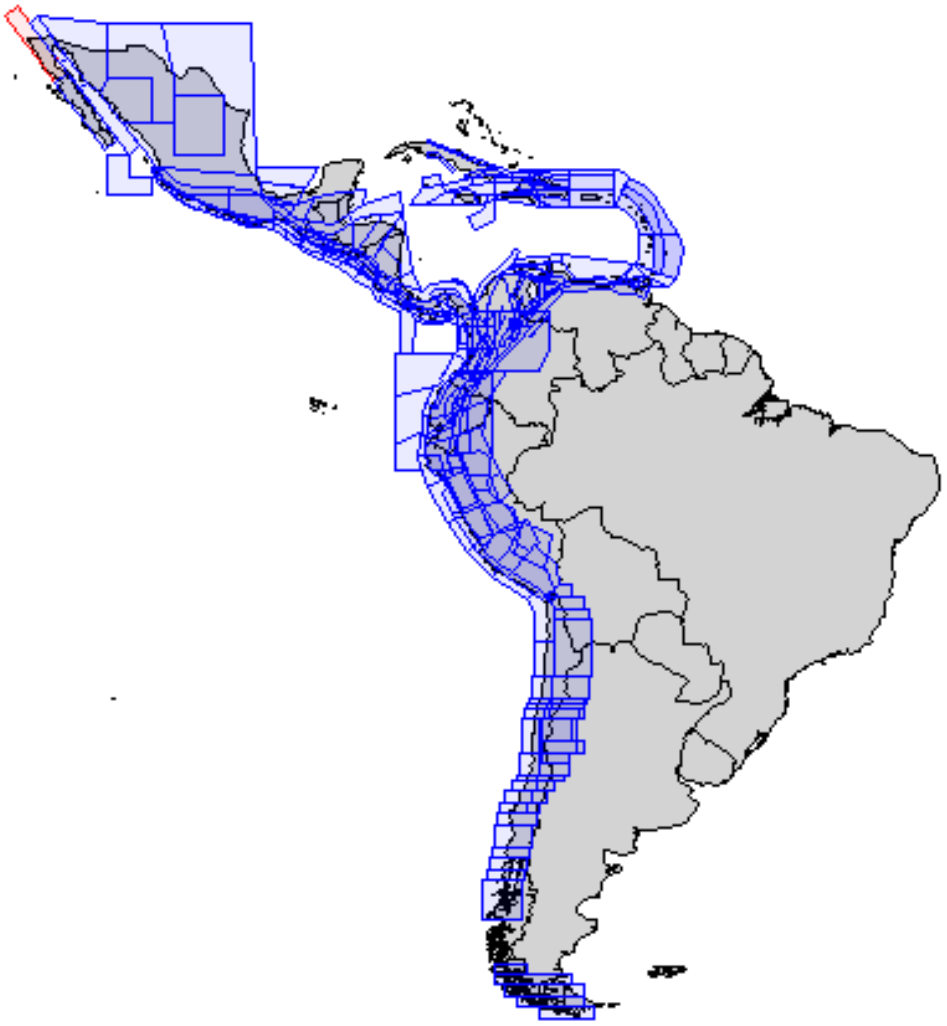
Torre Latinoamericana (1950)

Laguna Verde (1985)

Building Codes

Earthquake 1942, 1957, 1985 …

LA EQ Hazard



Seismic Source Model for Latin America.

Extensive evaluation of data sources including work of many institutions:

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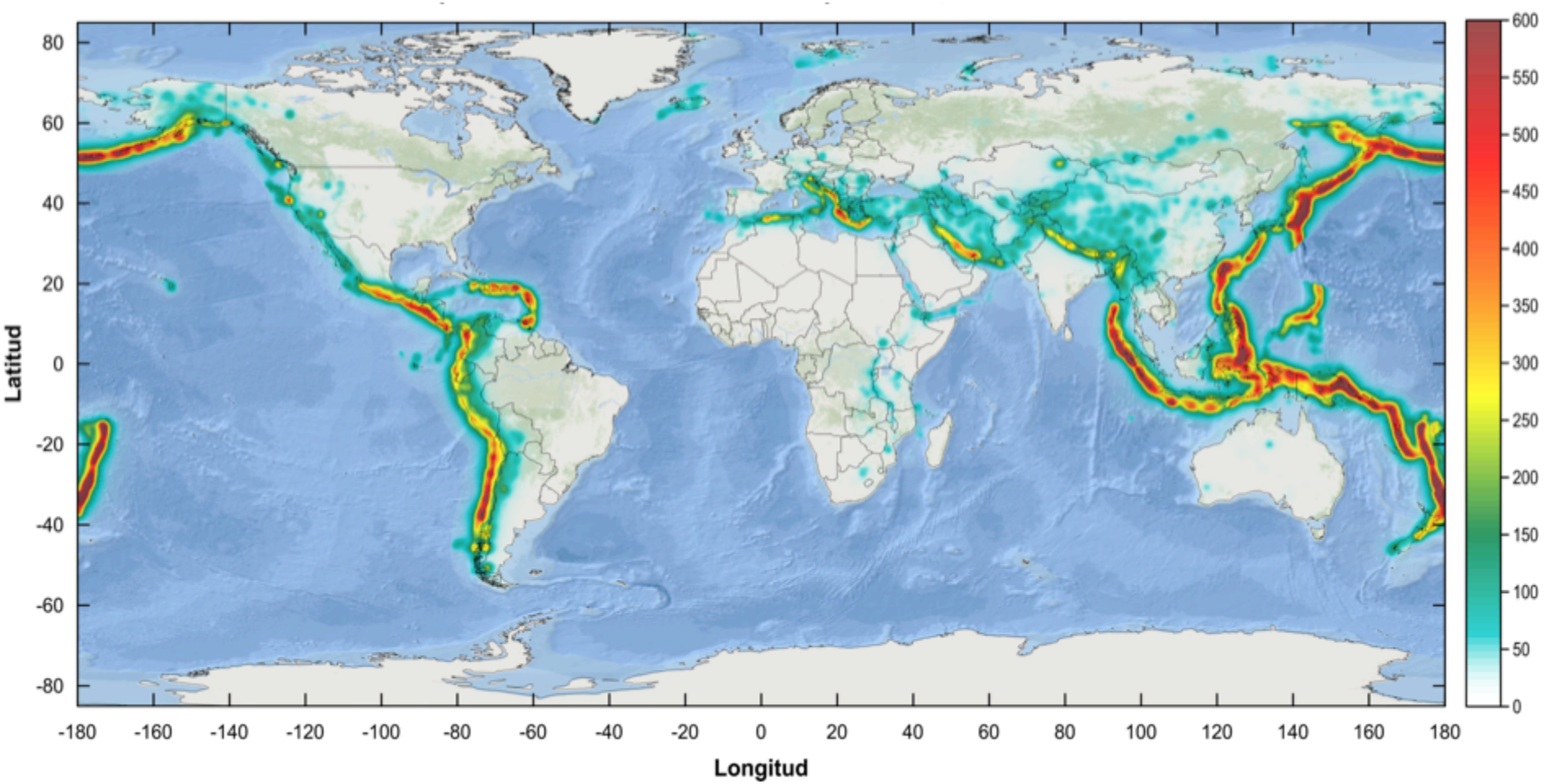
Worldwide EQ Hazard - GAR

PGA, Tr = 150 years



Ordaz et al, (2013). *Global Assessment Report on Disaster Risk Reduction* **– GAR 2013**

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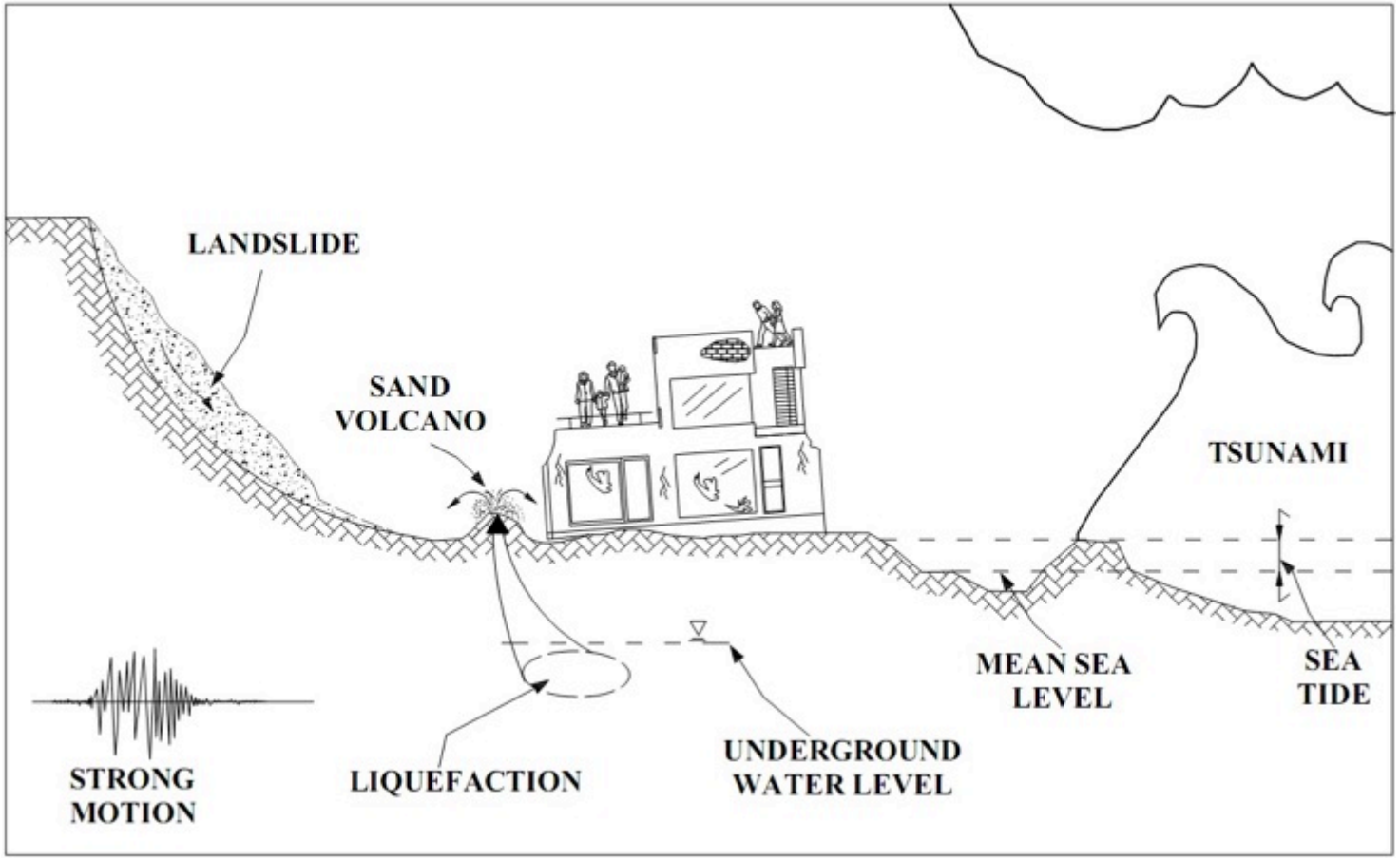
Simultaneous Hazards, EQ



Jaimes, M.A, Reinoso, E. y Esteva, L. (2014).
Risk analysis for structures exposed to several multi-hazard sources
Journal of Earthquake Engineering

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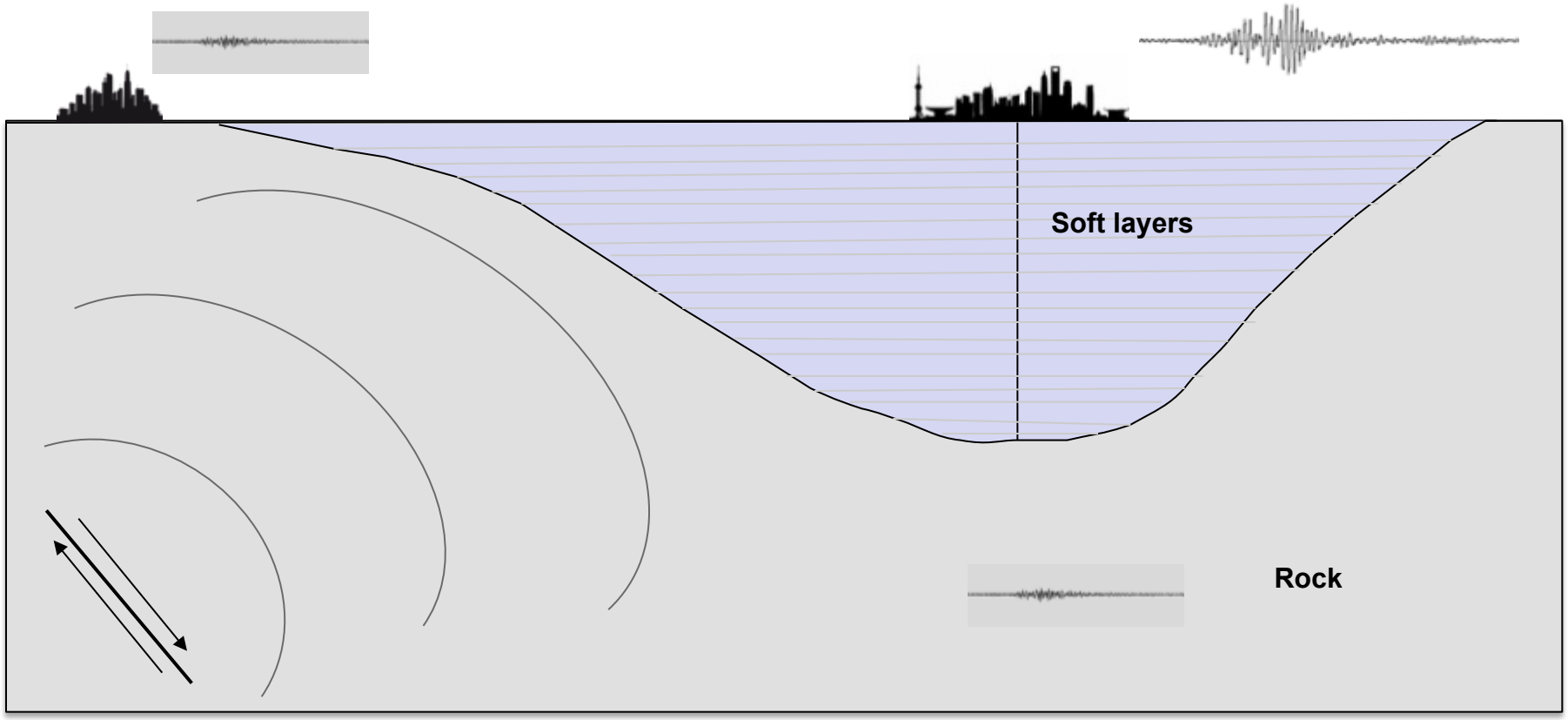
Site Effects



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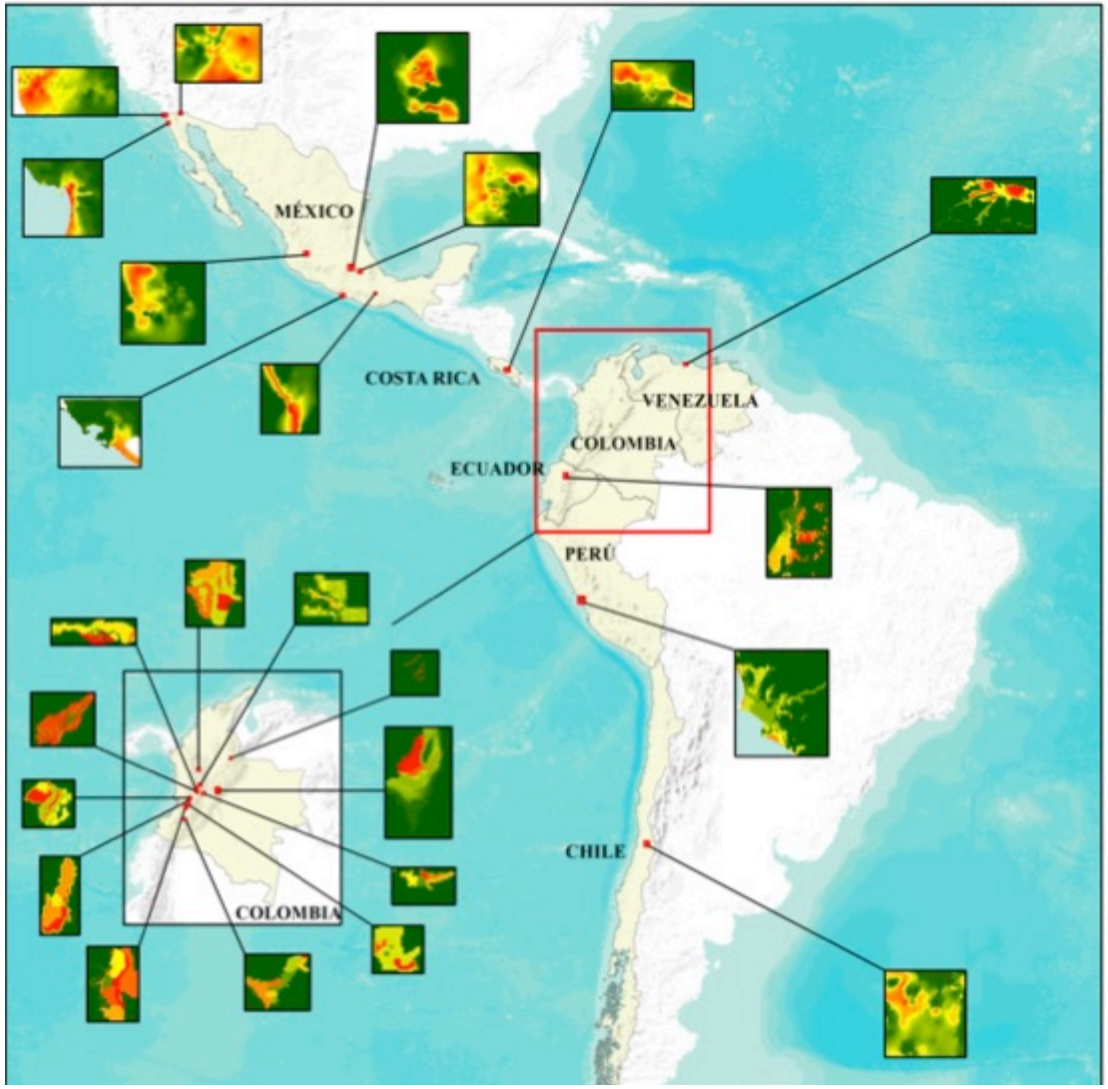
Site Effects

México
- Distrito Federal
- Acapulco
- Oaxaca
- Puebla
- Guadalajara
- Ensenada
- Tijuana
- Mexicali

Costa Rica
- San José

Venezuela
- Caracas

Ecuador
- Quito



Colombia
- Bogotá
- Medellín
- Cali
- Armenia
- Pereira
- Maizales
- Popayán
- Tuluá
- Palmira
- Buga
- Ibagué
- Bucaramanga

Perú
- Lima

Chile
- Santiago

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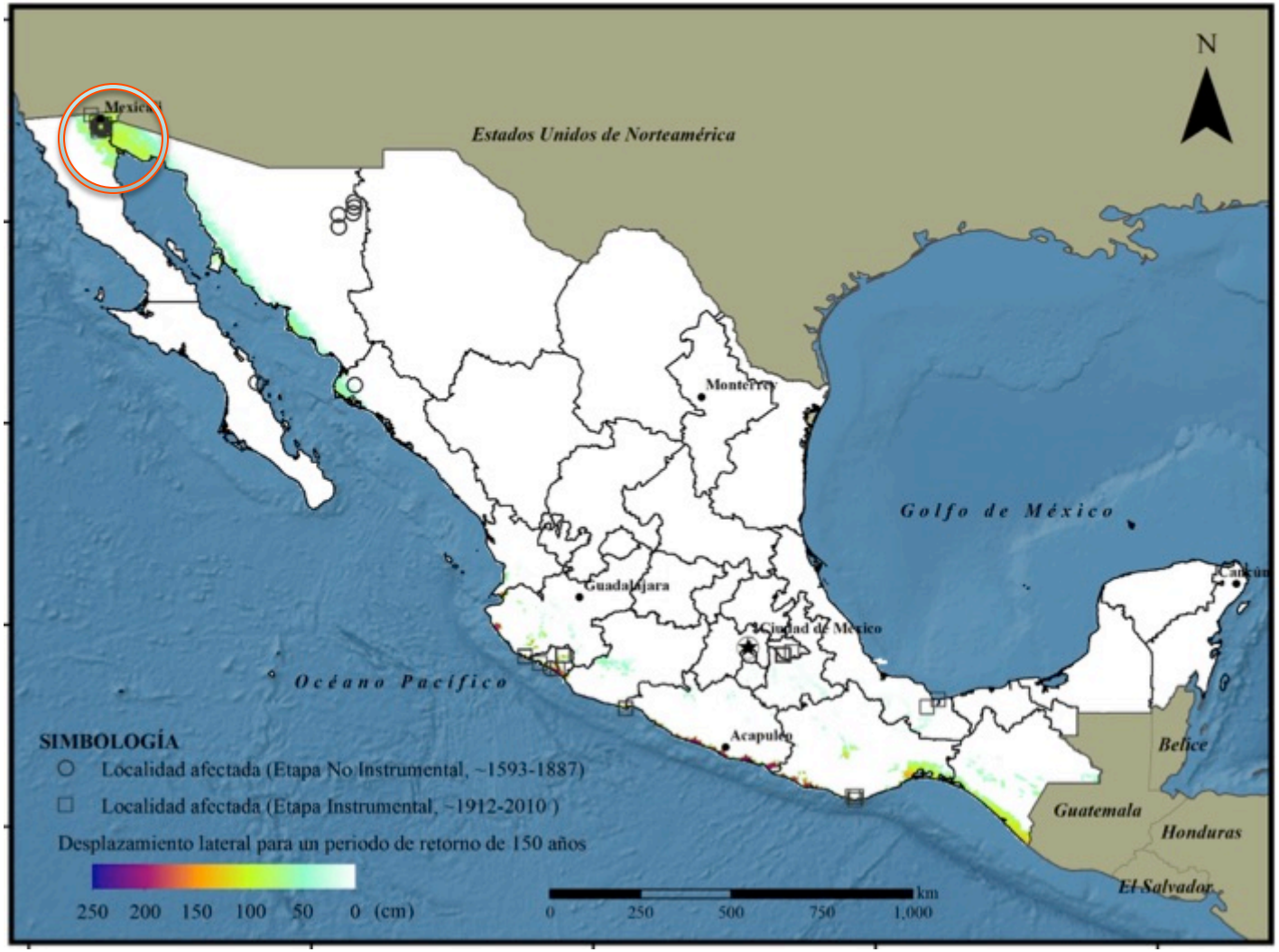
Liquefaction



Jaimes, M.A., Niño, M. y Reinoso, E. (2014)
Regional map of earthquake-induced liquefaction hazard using the lateral spreading displacement index DLL
Natural Hazards

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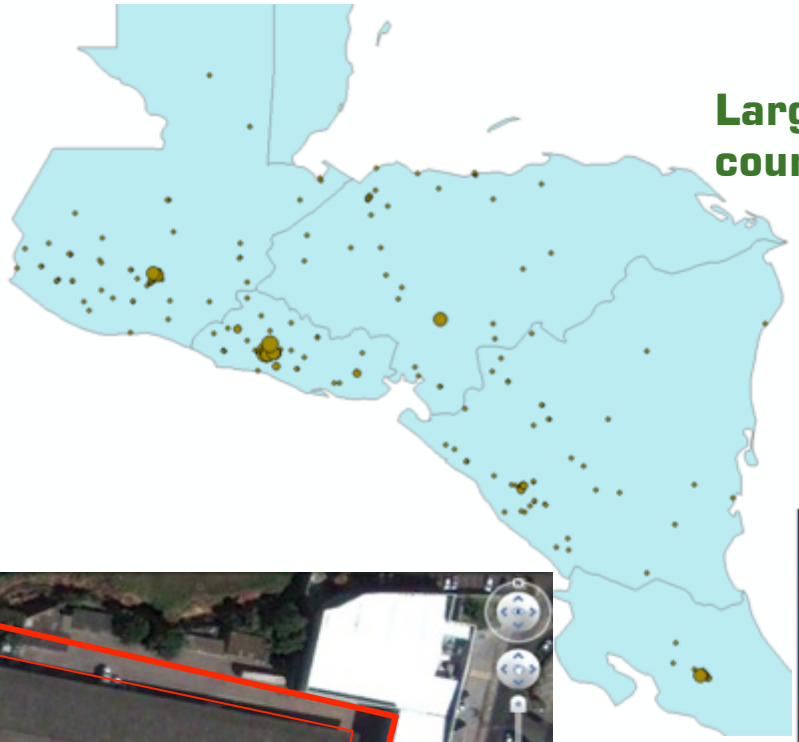
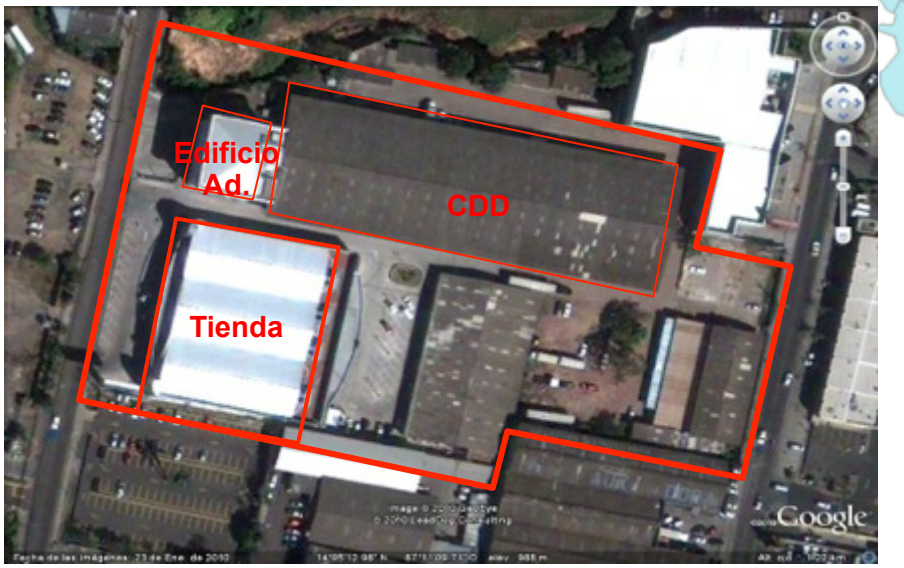
Central America EQ Hazard



Large portfolios in many countries



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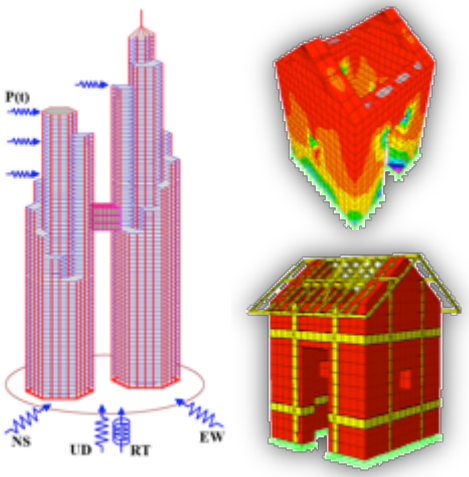
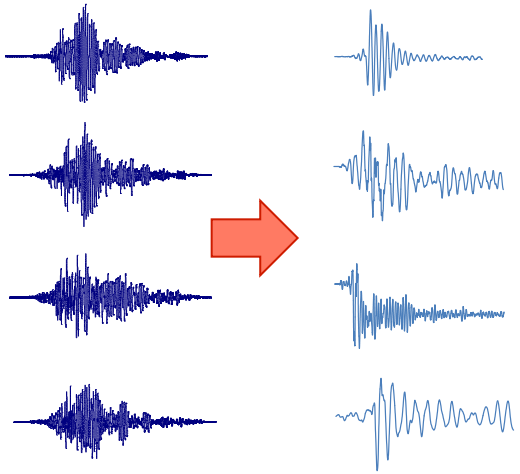
VF, individual structures

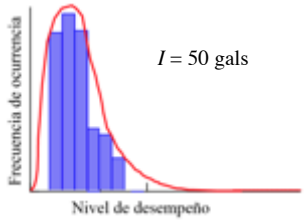


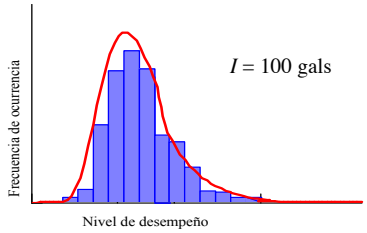
Model

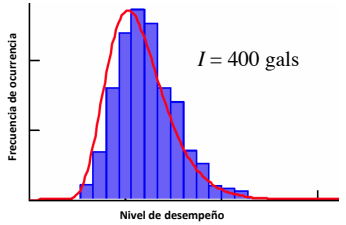


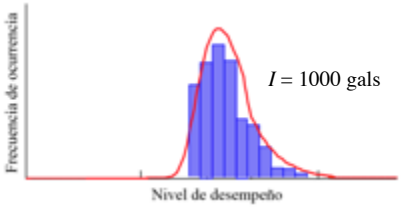
Seismic Response

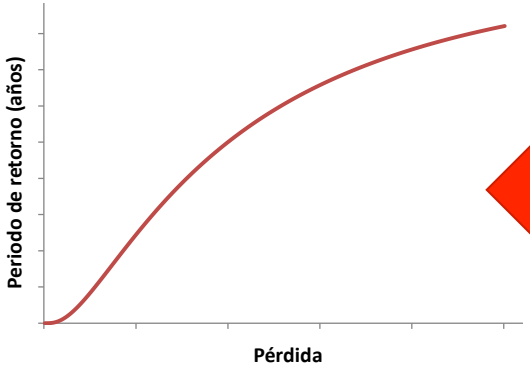
Statistics

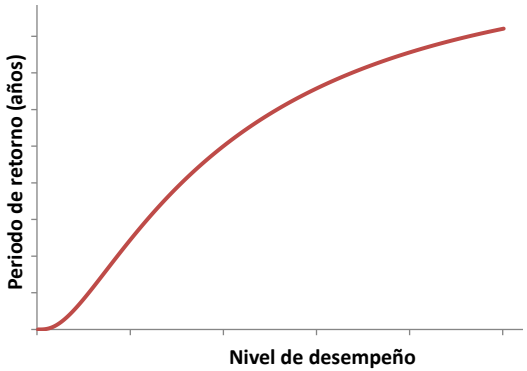












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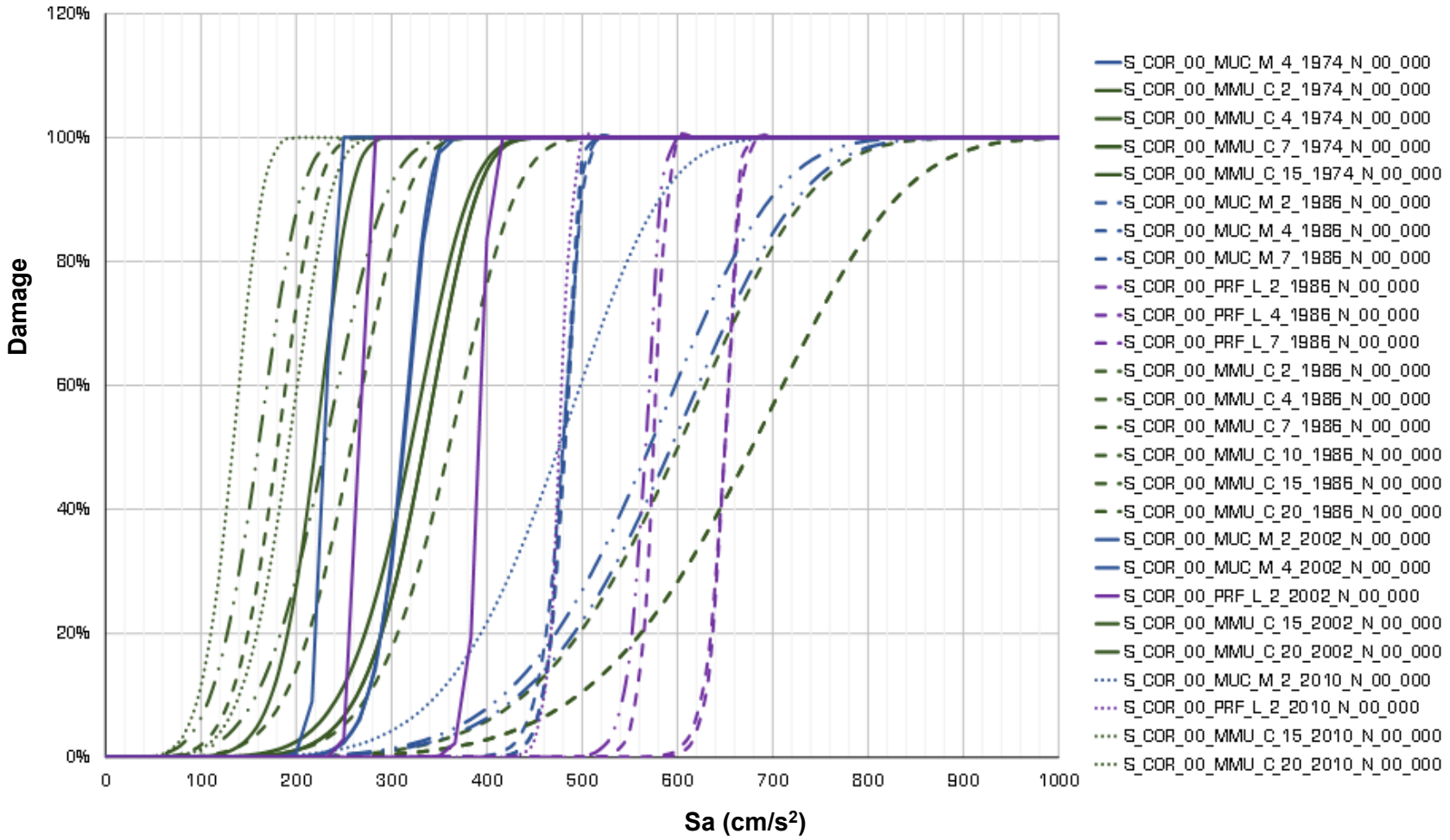
Vulnerability Functions

30 VULNERABILITY FUNCTIONS- 4 DIFFERENT BUILDING USES AND 8 STRUCTURES TYPES for COSTA RICA



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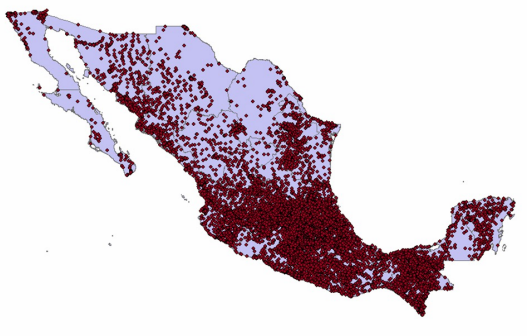
Examples FONDEN

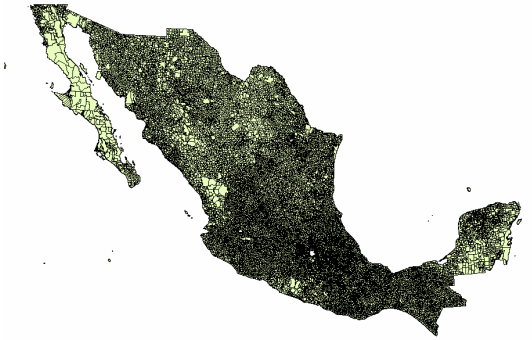


SSA: Health sector

13,500 units

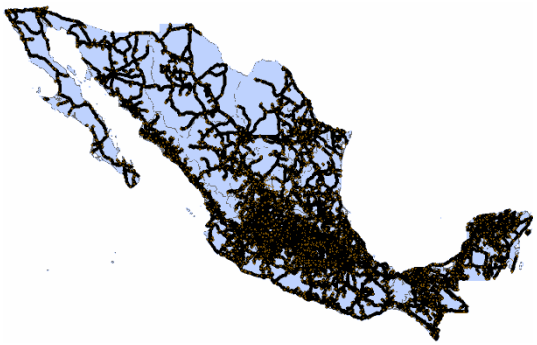
SEP: Public Schools

More than 210,000 schools



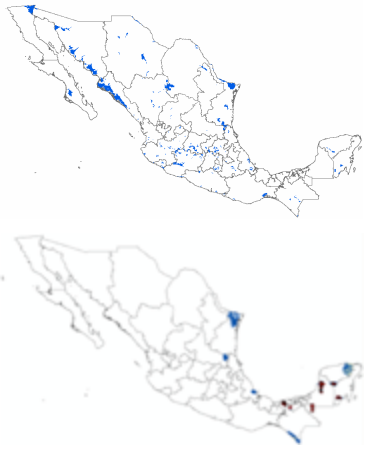
SEDATO: Poor housing

More than10 millon dwellings



SCT: Roads, highways, bridges…

135,000 km of roads, more than 7000 bridges



CONAGUA: Dams, Irrigation, …

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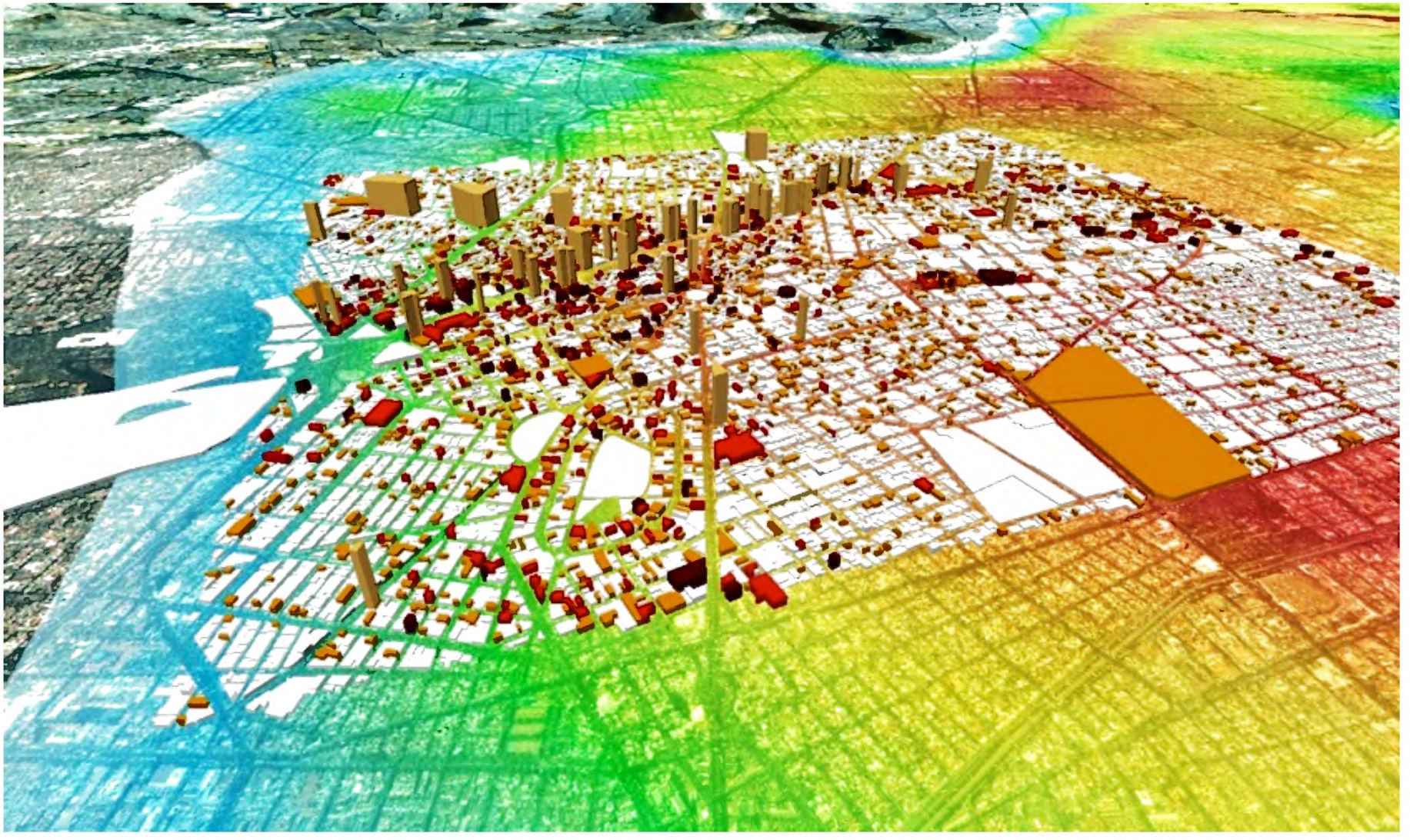
What if ?



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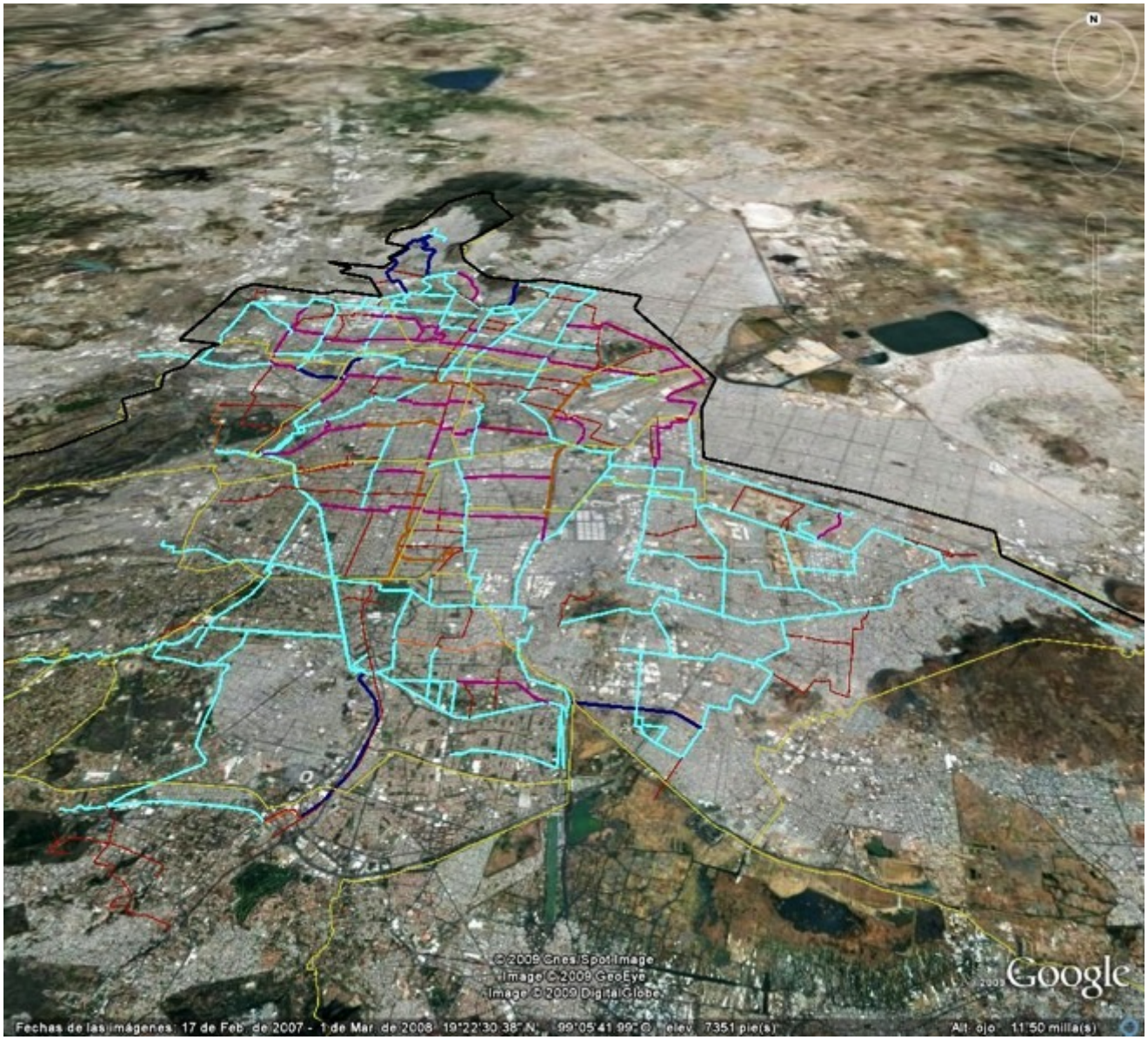
What if ?



Water supply main pipelines

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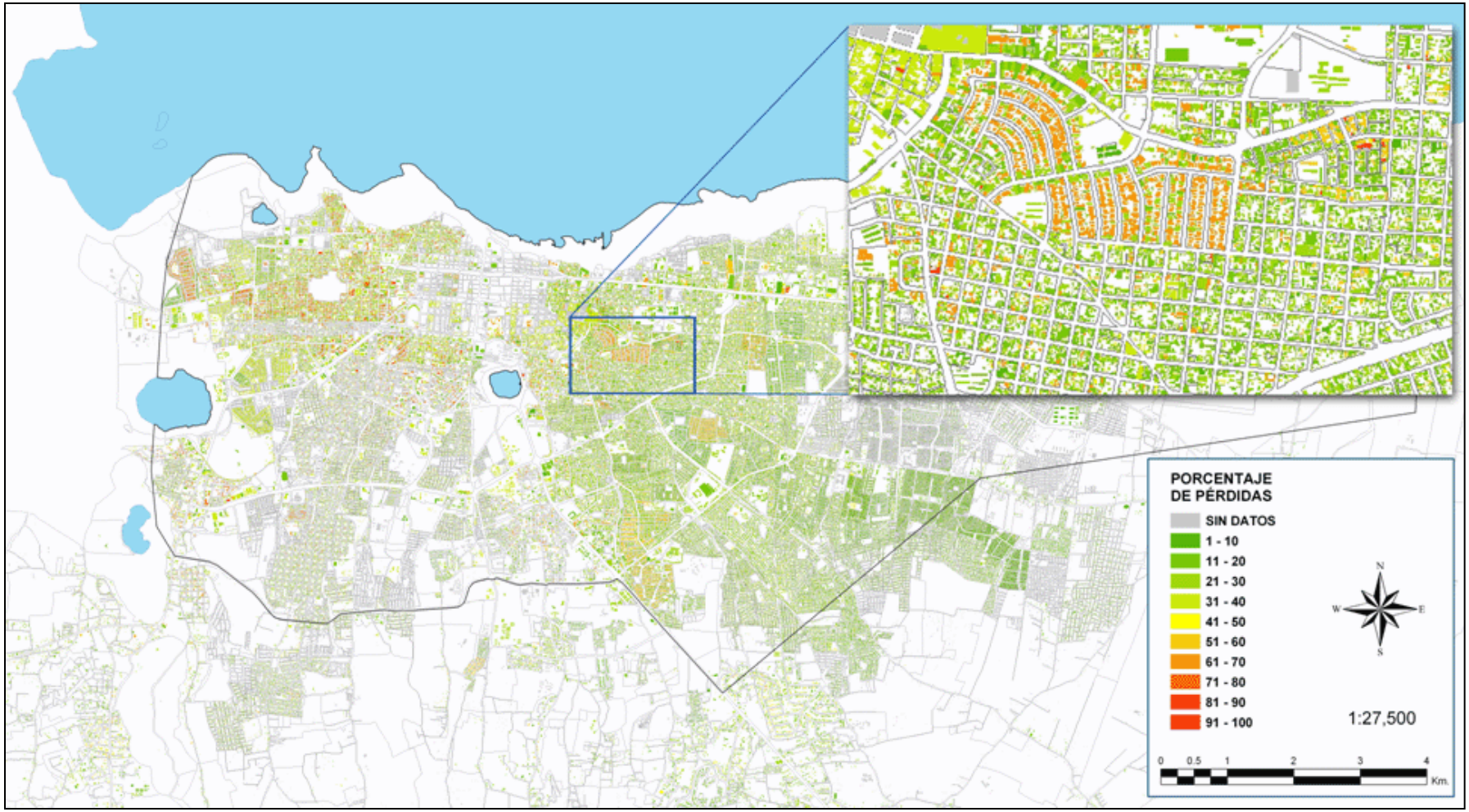
What if ?



Managua, 1972 earthquake, today

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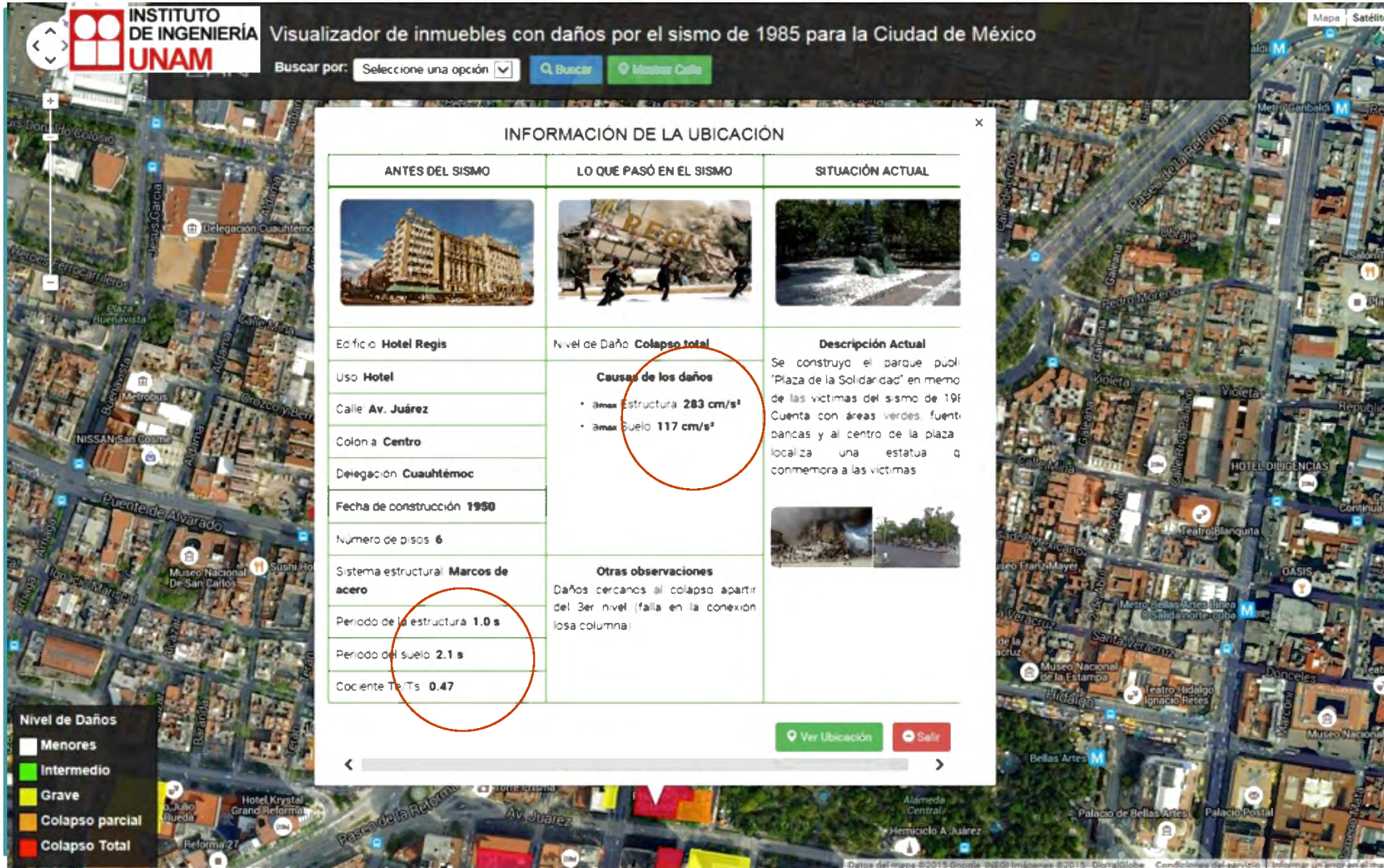
Calibration/Verification



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Landslides

San Salvador

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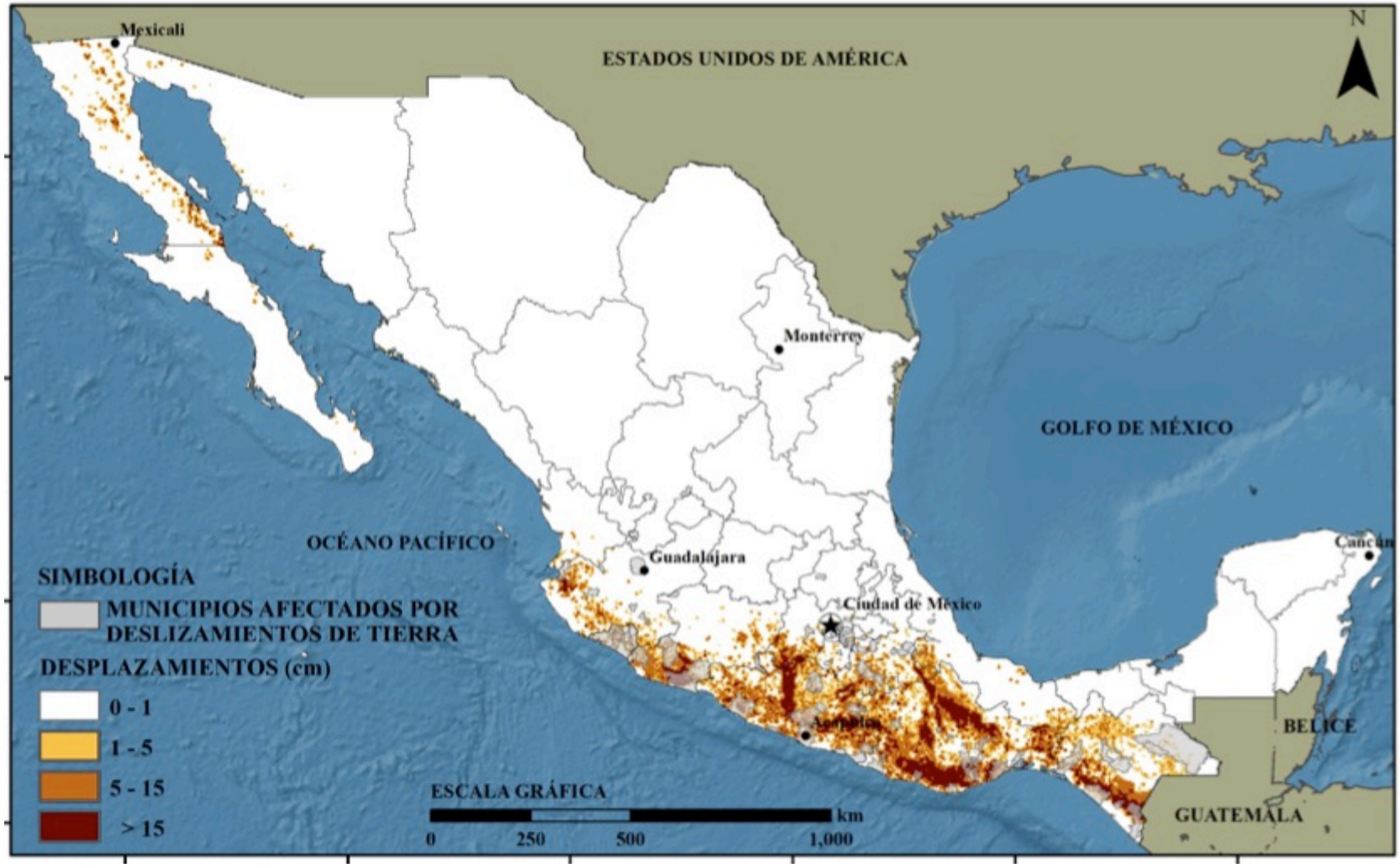
Landslides



Niño, M., Jaimes, M.A. y Reinoso E. (2014)
Seismic-event-based methodology to obtain earthquake induced translational landslide regional hazard maps
Natural Hazards

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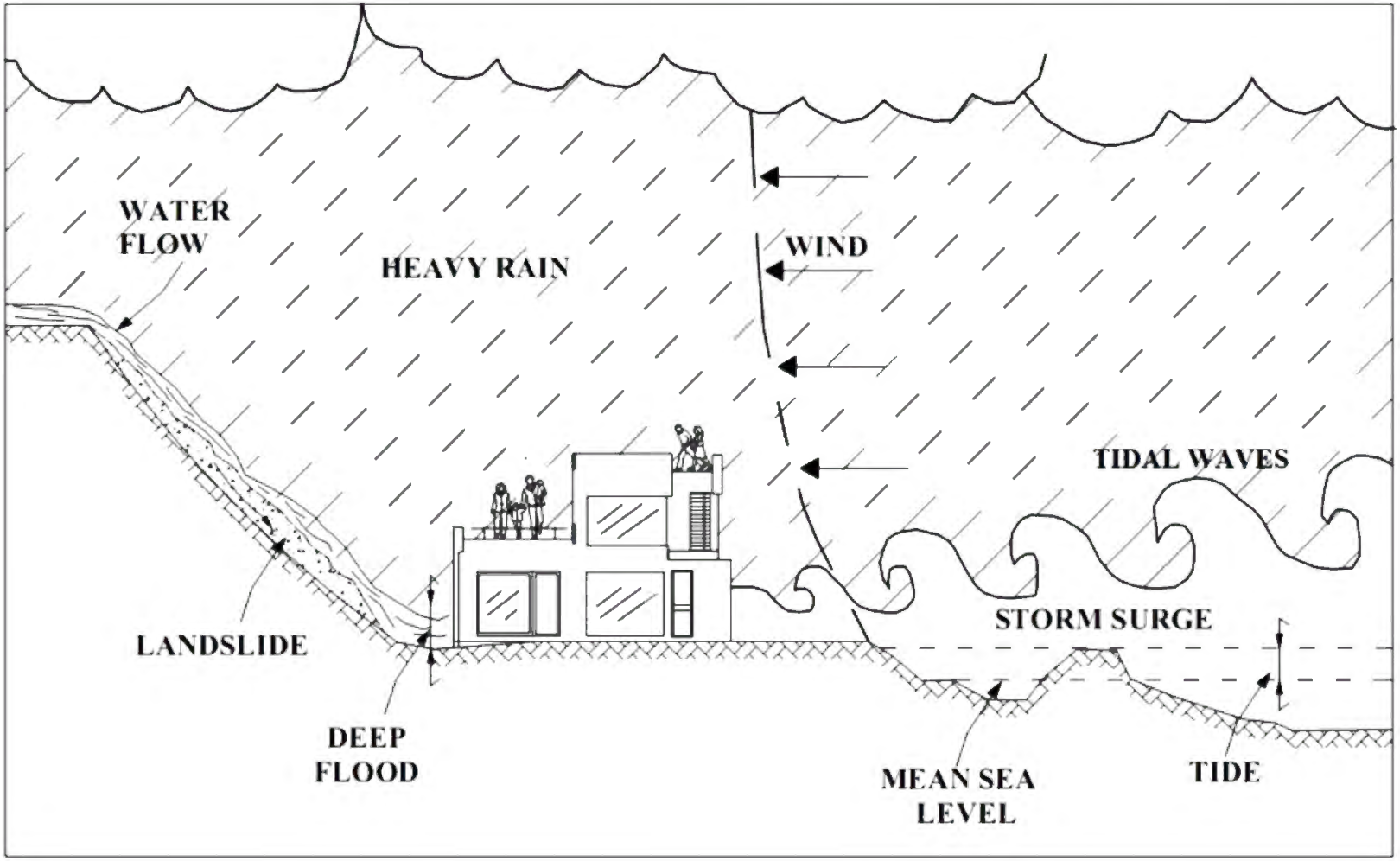
Simultaneous Hazards, Storms



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Wind Hazard

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5 days after Odile: Sites visited

12 researchers from five institutions

Strong support from the Federal Government and Insurance companies

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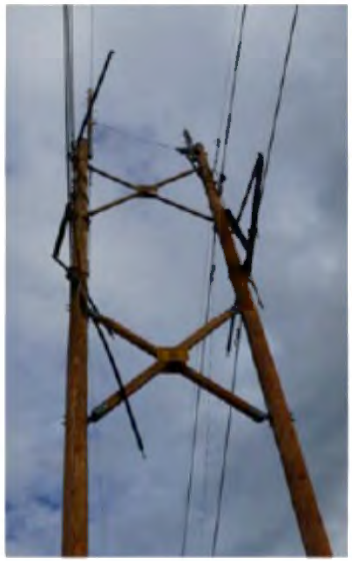
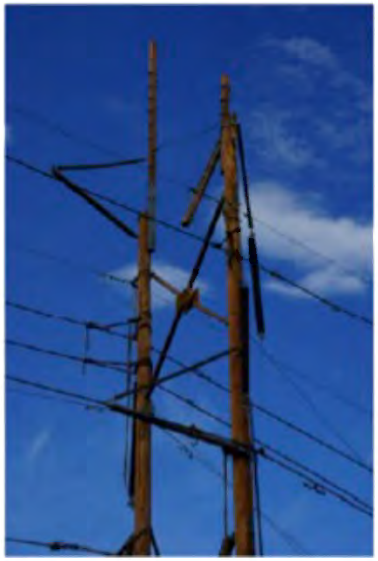
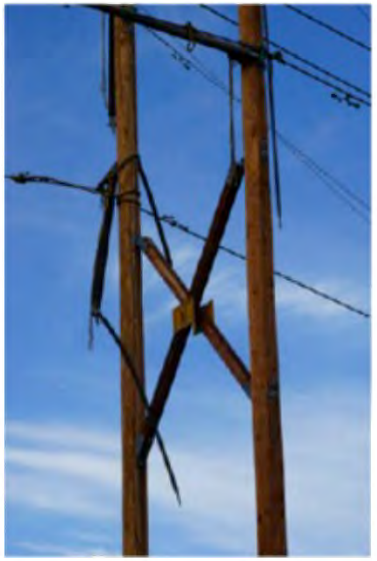
Electric power lines







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Hotels

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A water tank

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Hotels and Condos

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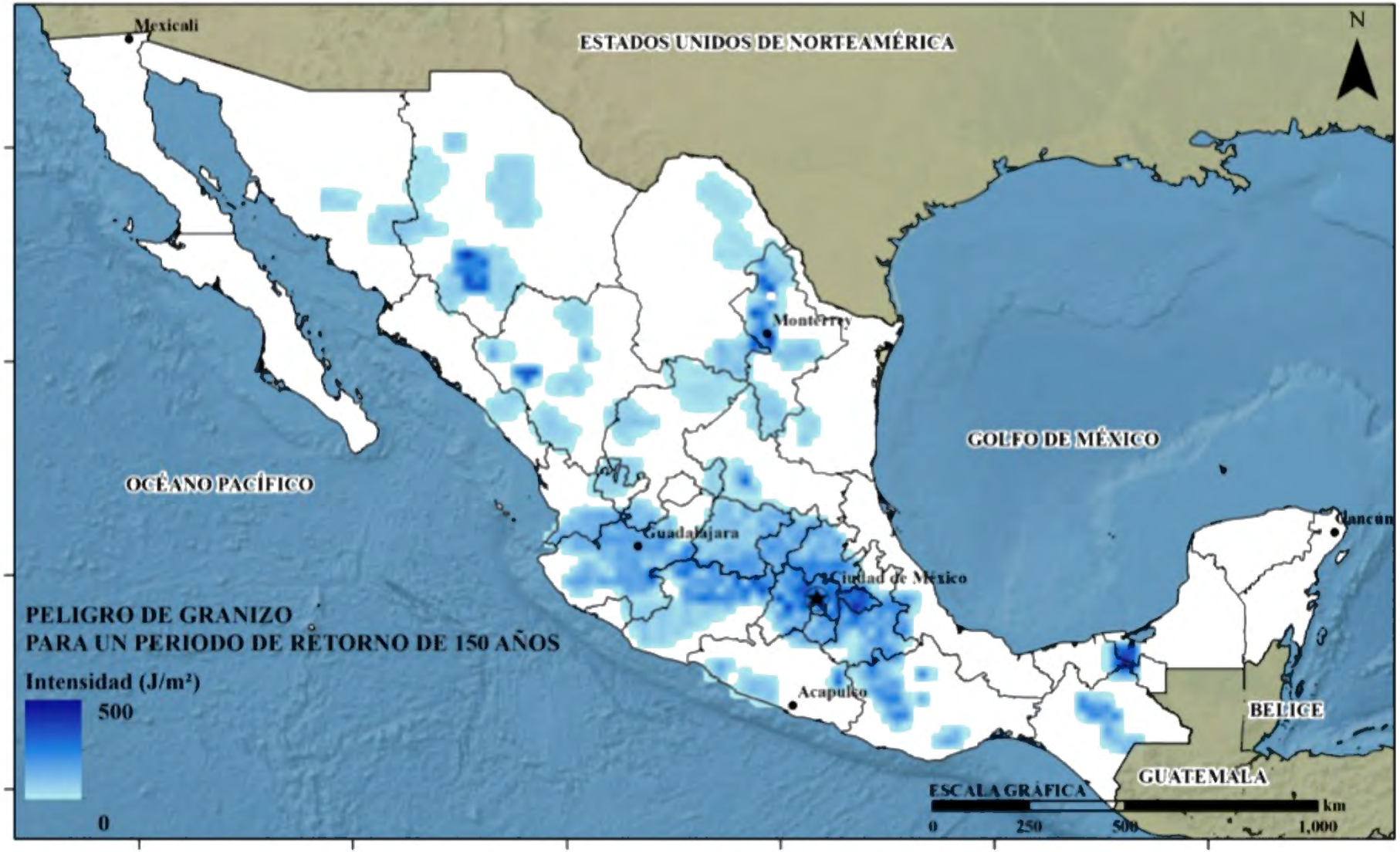
Hail



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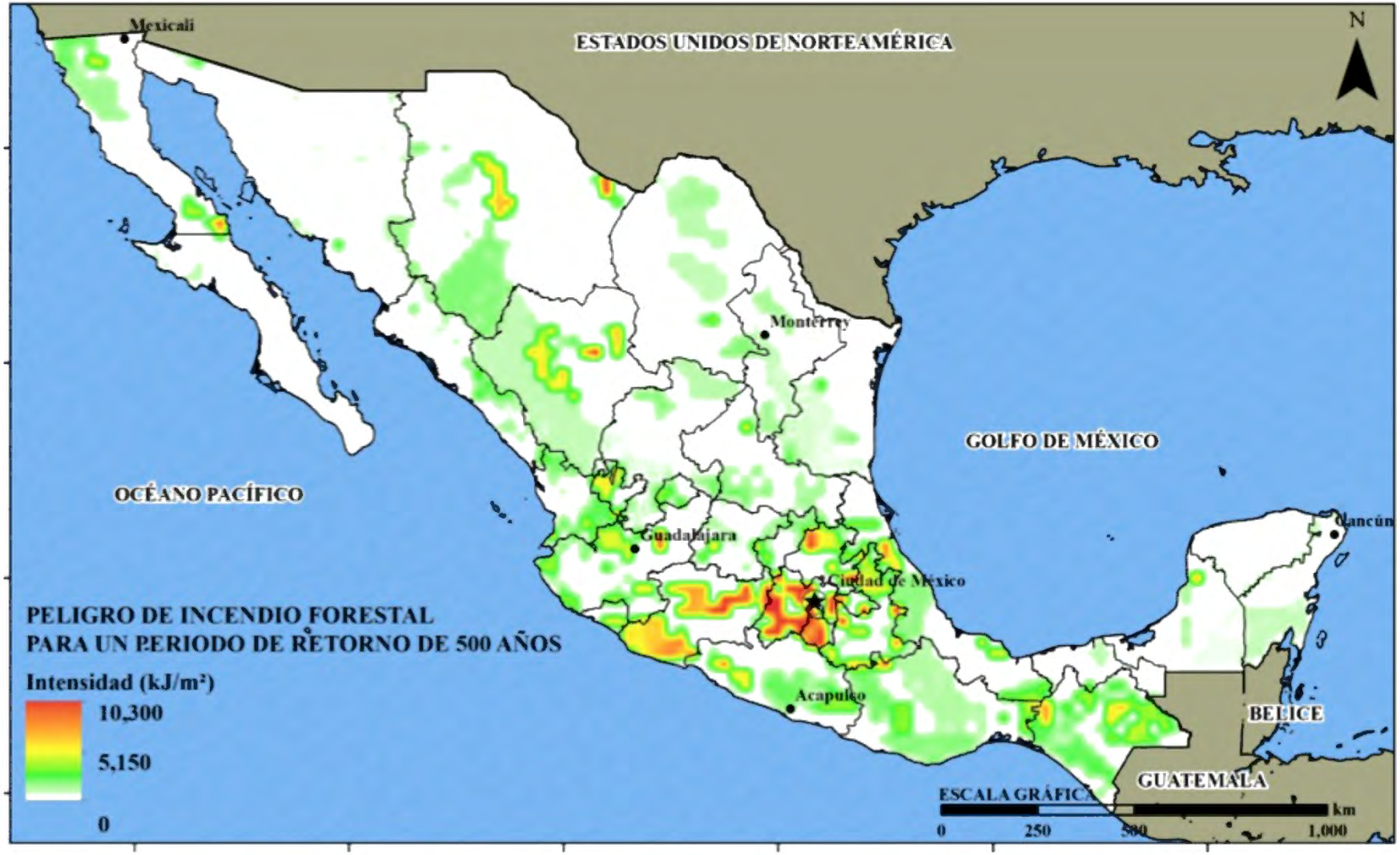
Wildfires



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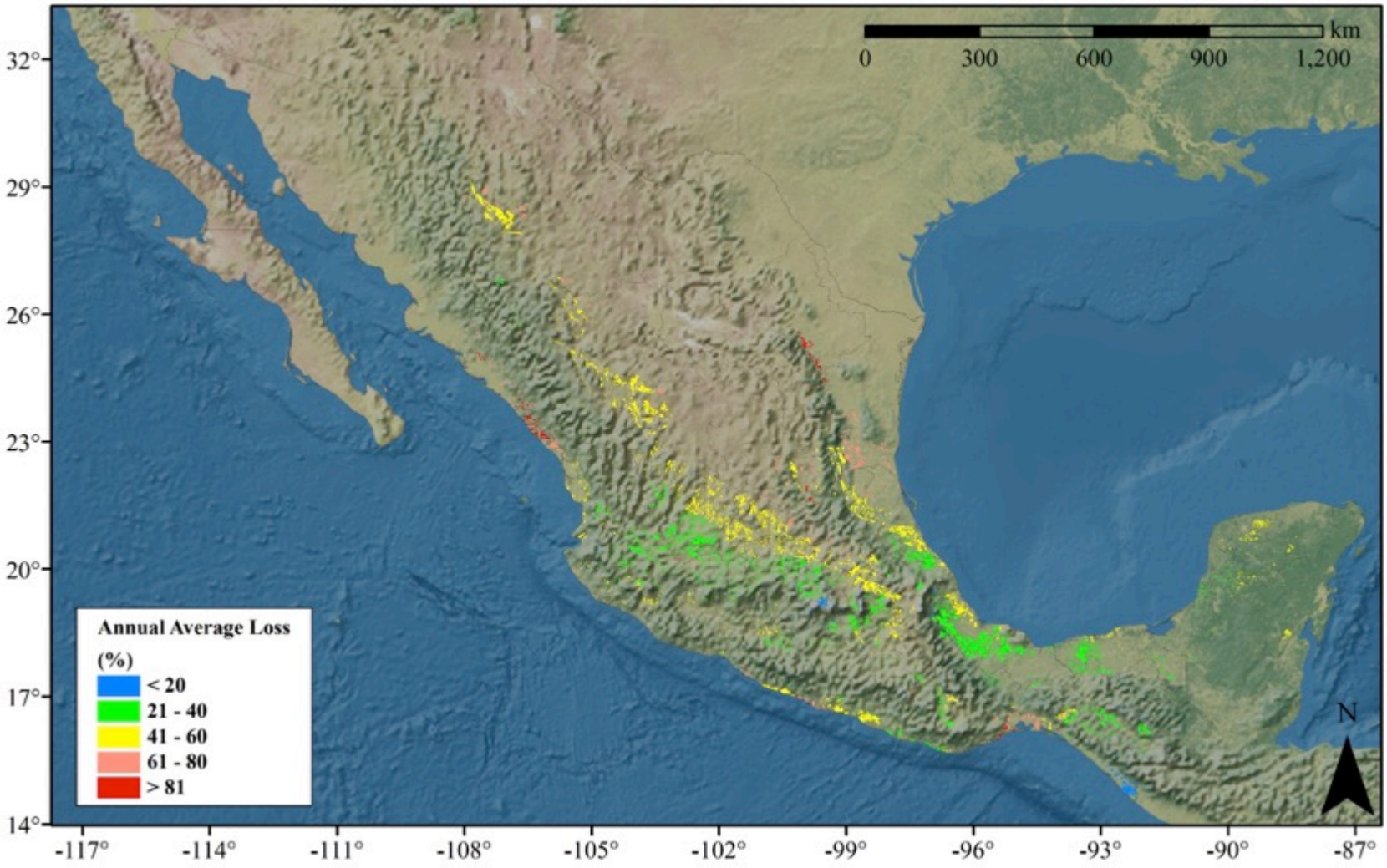
Drought - Corn



Quijano, J., Jaimes, M.A., Torres, M., Reinoso, E., Castellanos, L., Escamilla, J. y Ordaz, M. (2014)
Event-based approach for probabilistic agricultural drought risk assessment under rainfed conditions
Natural Hazards

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Crops exposure

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Crops exposure to wind: Odile

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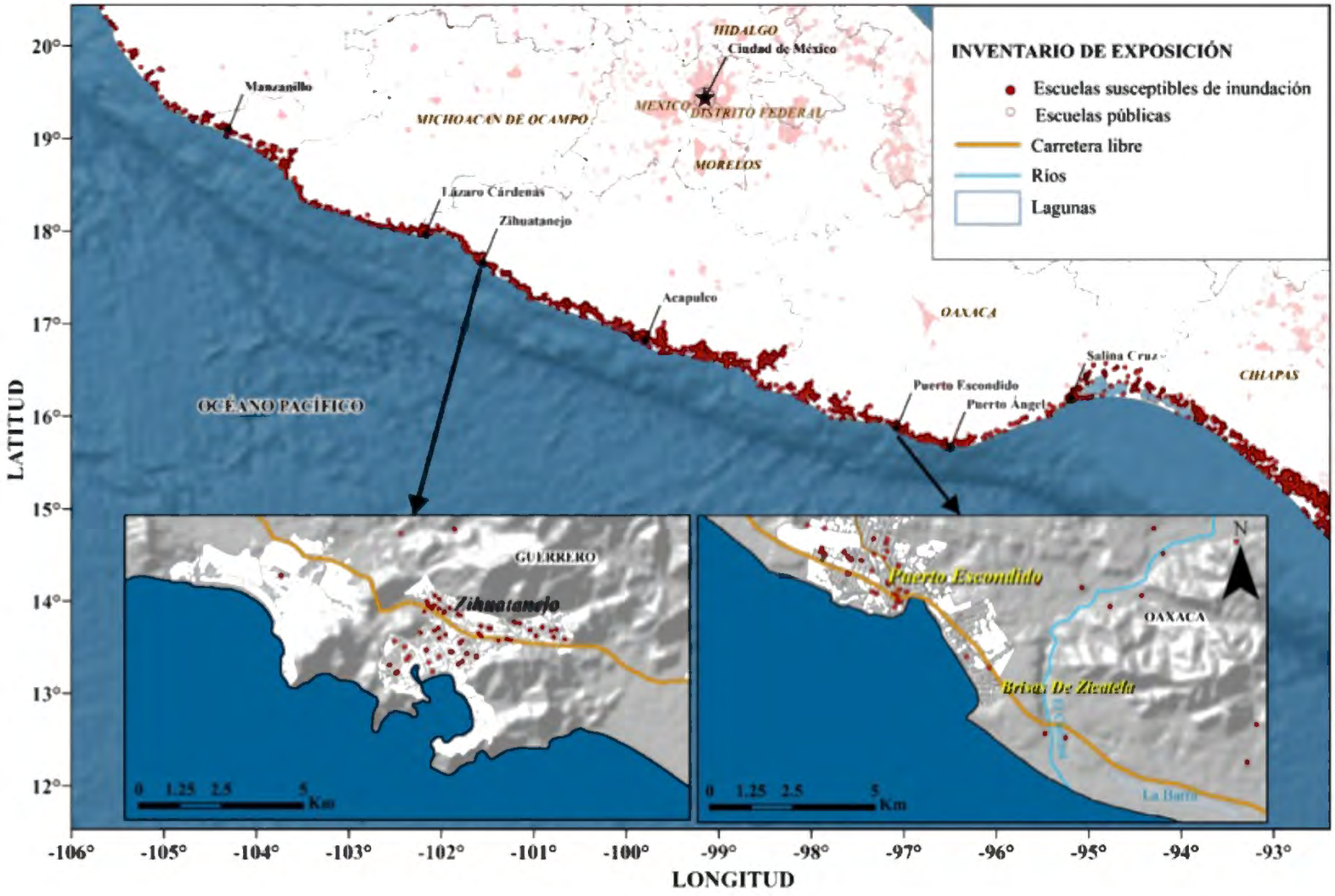
Exposure - Schools



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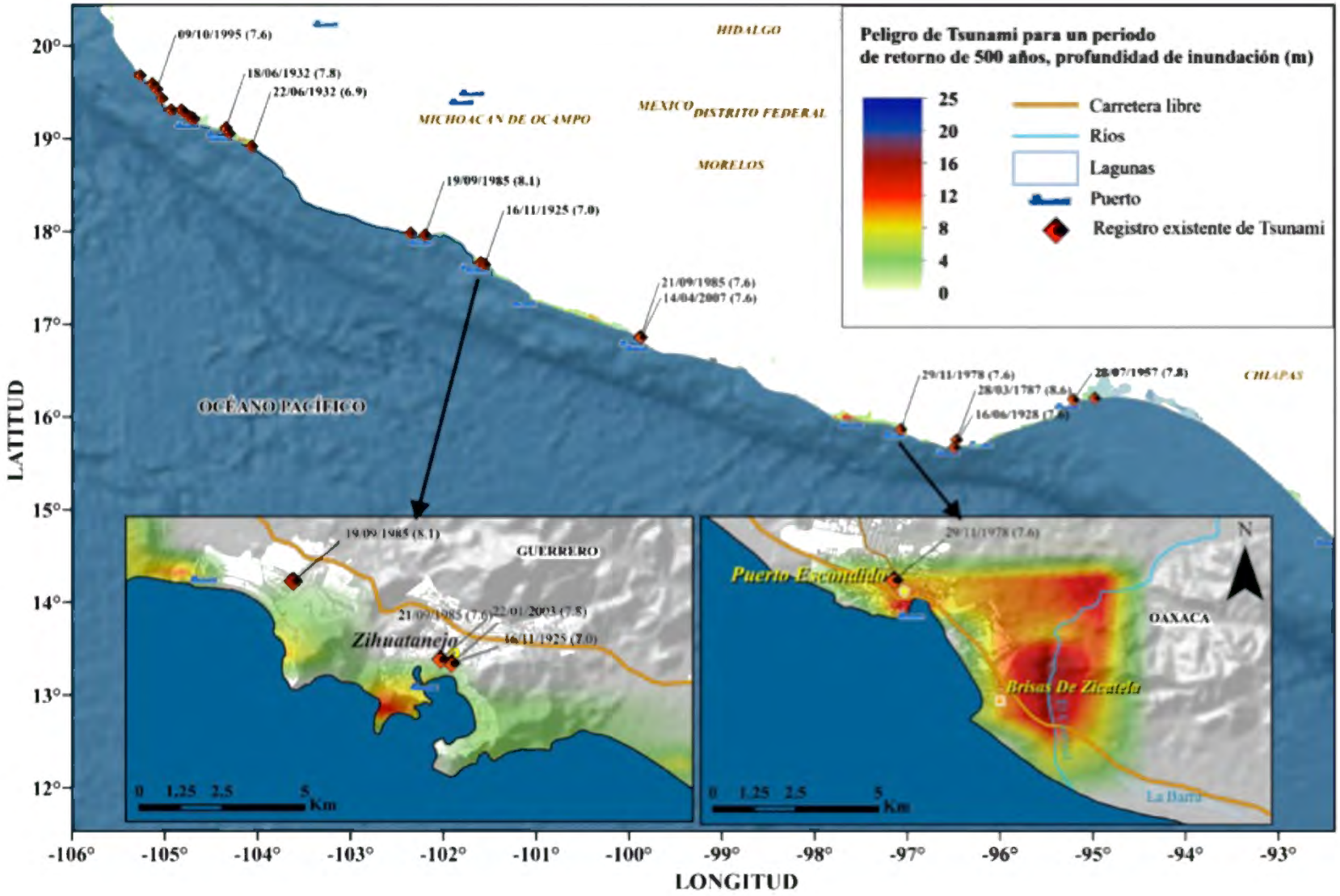
Tsunami Hazard



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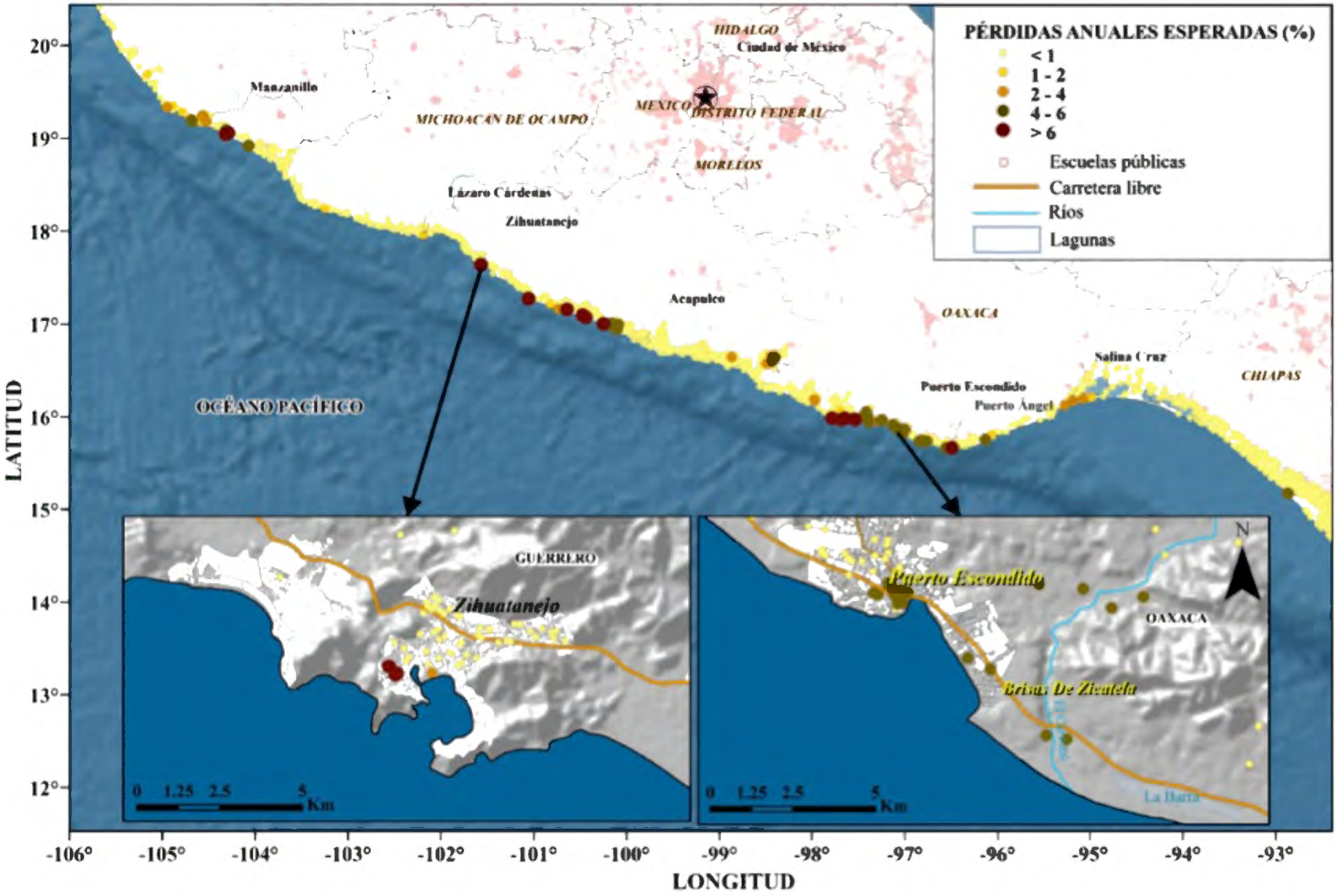
Tsunami- Losses



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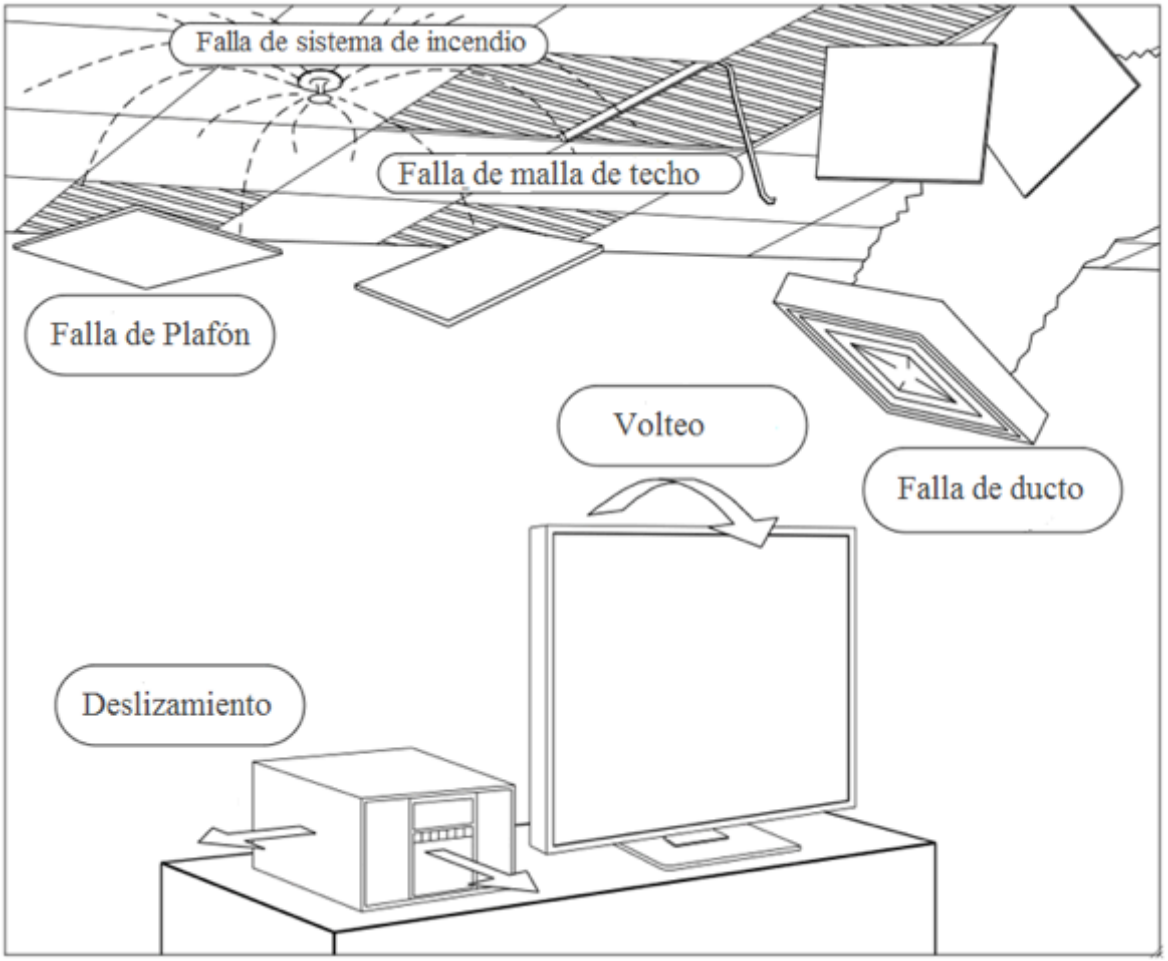
Non Structural Elements



Jaimes, M.A, Reinoso, E. y Esteva, L. (2013)
Seismic vulnerability of building contents for a given occupancy due to multiple failure modes
Journal of Earthquake Engineering

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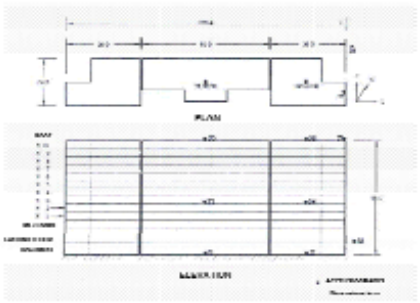
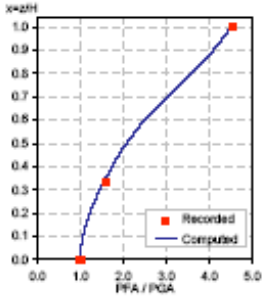
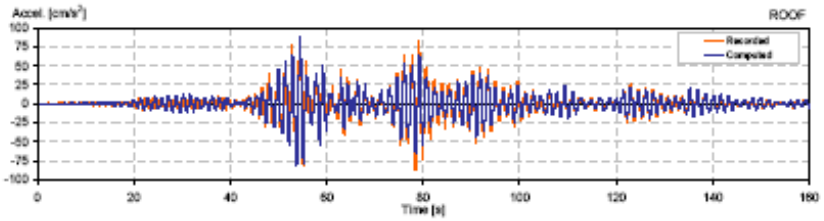
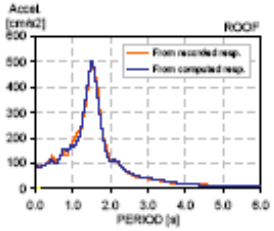
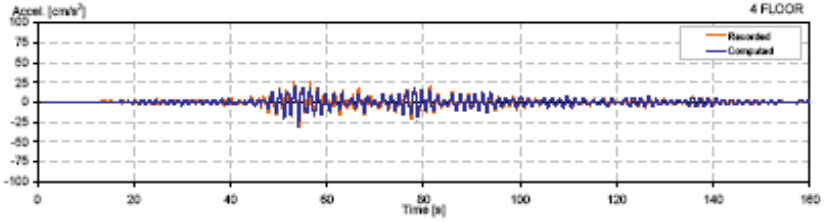
Instrumented buildings in Mexico IMSS, 13 storeys

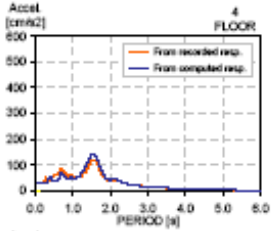


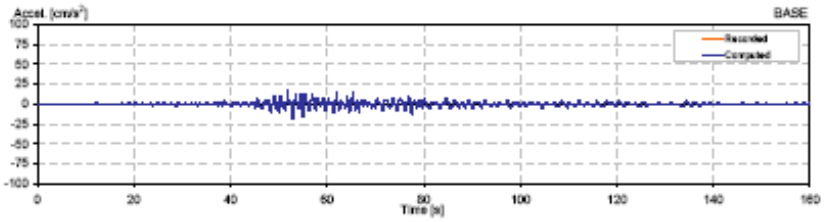


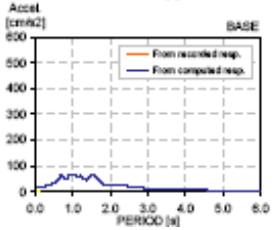


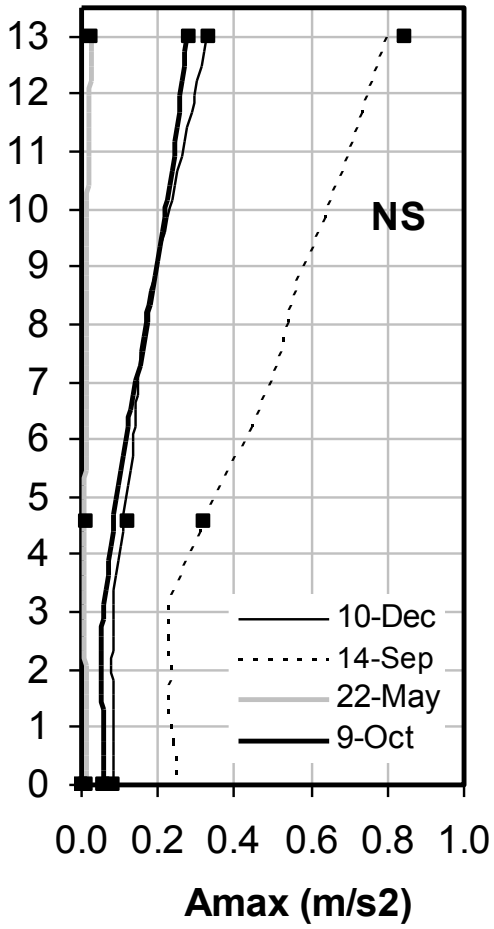












T_s = 1.2 sec

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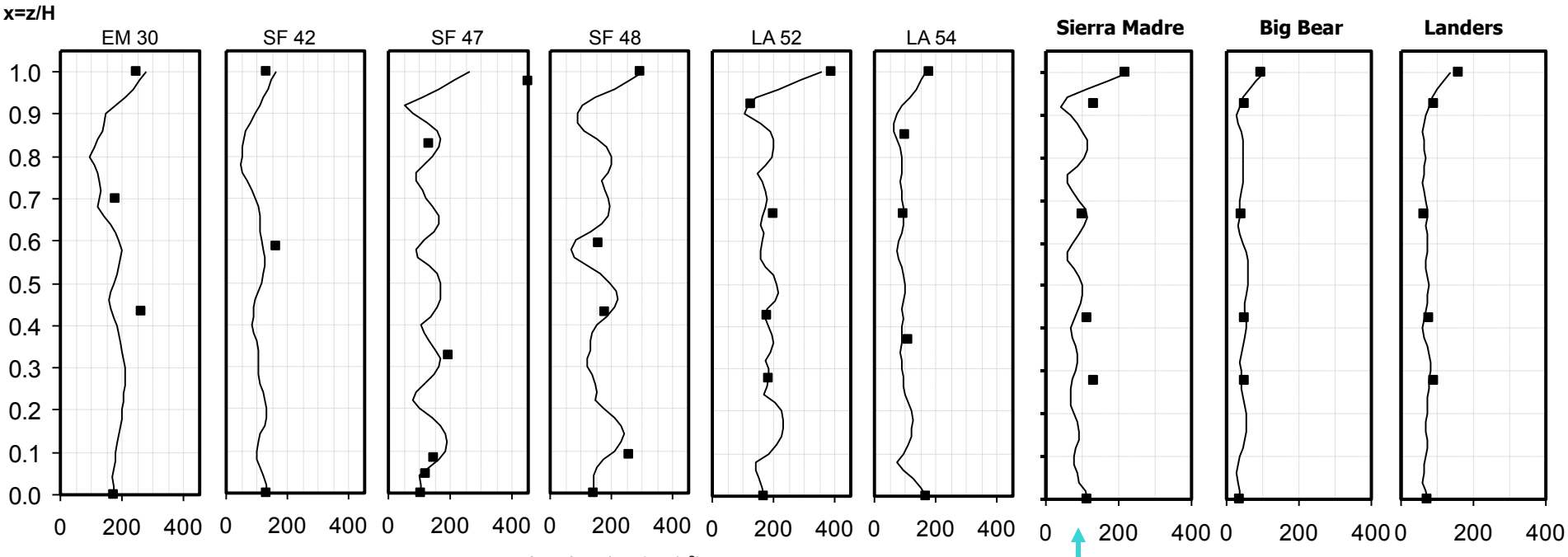
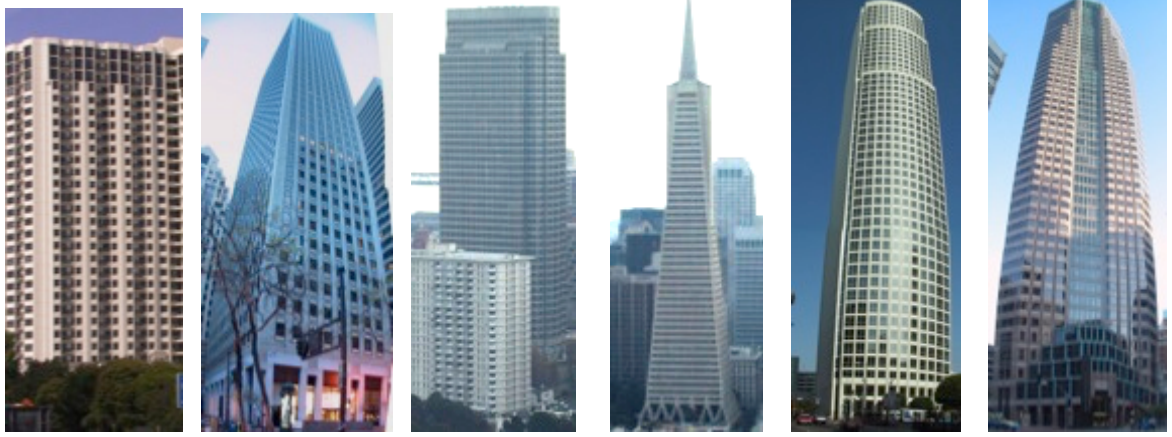
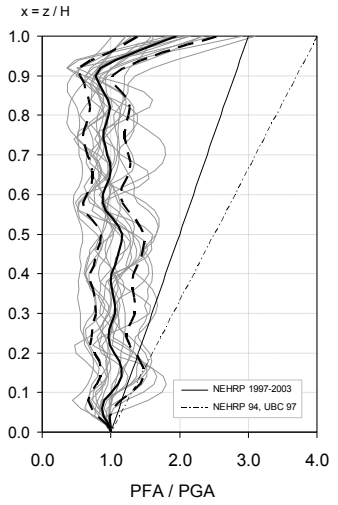
and in California







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Office occupancy, PB, Kobe 1995

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11º storey, Mexico, M7.2

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Final Coments

For the last 30 years

Engineering Cat Models

- (very) good idea of what may happen
- more Vulnerability Functions
- detailed Data Bases

Expected losses for:

- Insurance sector
- Governments
- Infrastructure
- Risk managers

Earthquake, but almost all perils

Thank you !

Eduardo Reinoso

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