Master Degree Programme in Physics - UNITS
Physics of the Earth and of the Environment

Seismic (and volcanic) Risk

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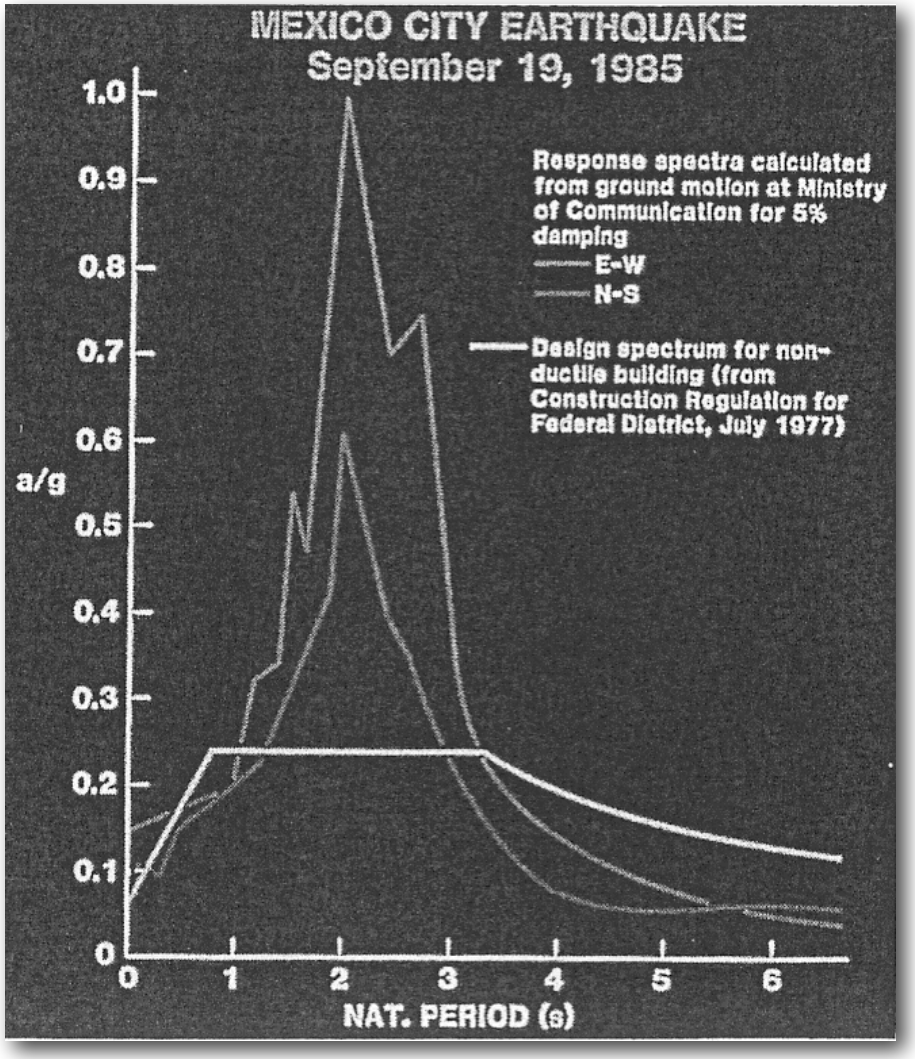
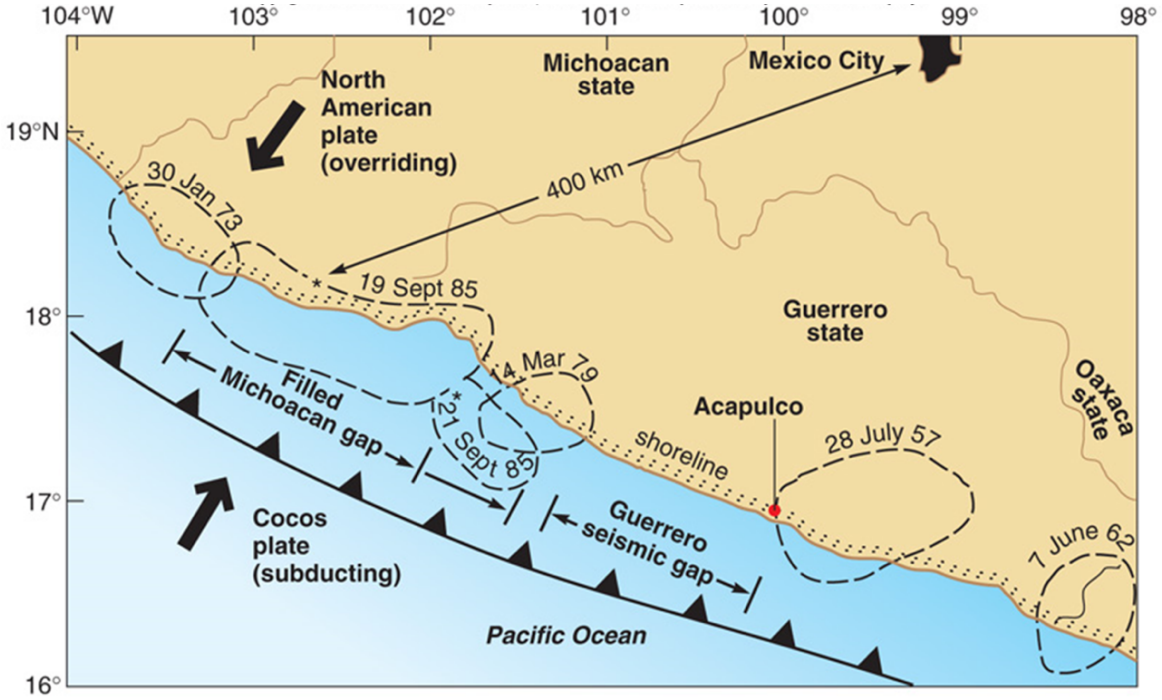
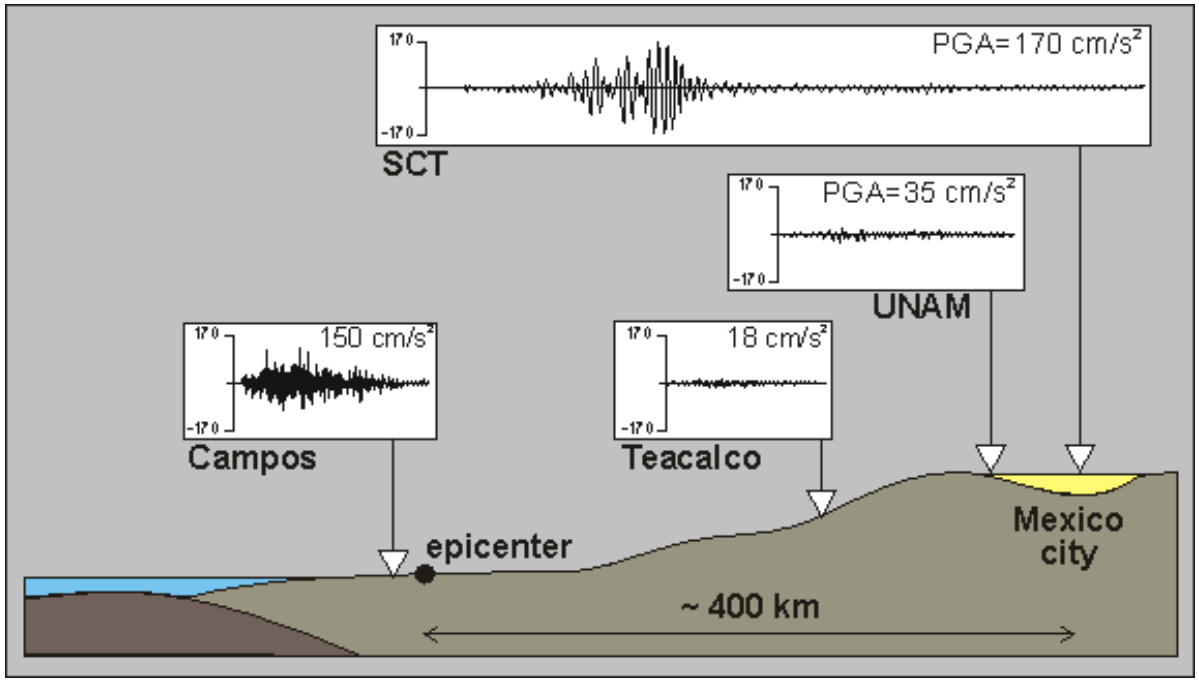
the road to (earthquake) safety...

Know the input - Bound the output...



Michoacan 1985 event: way to DF...



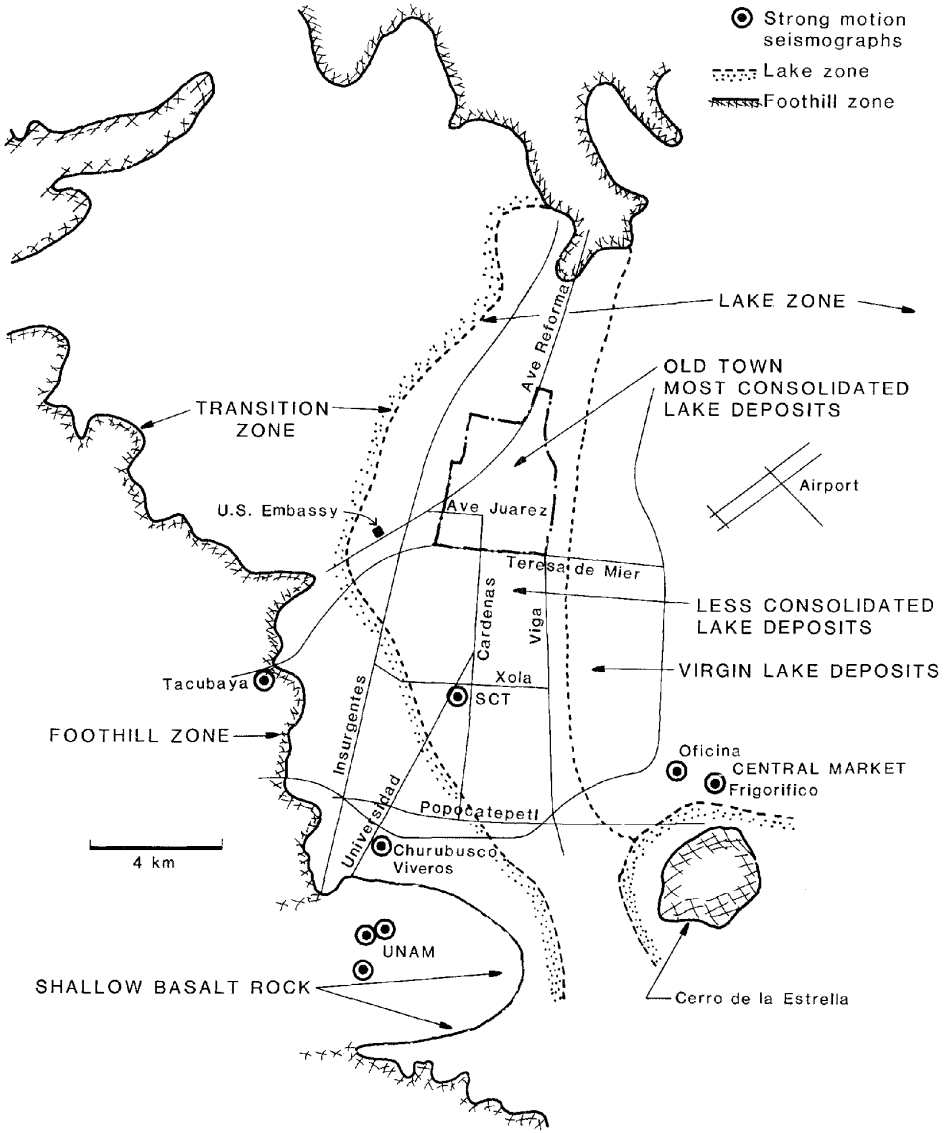


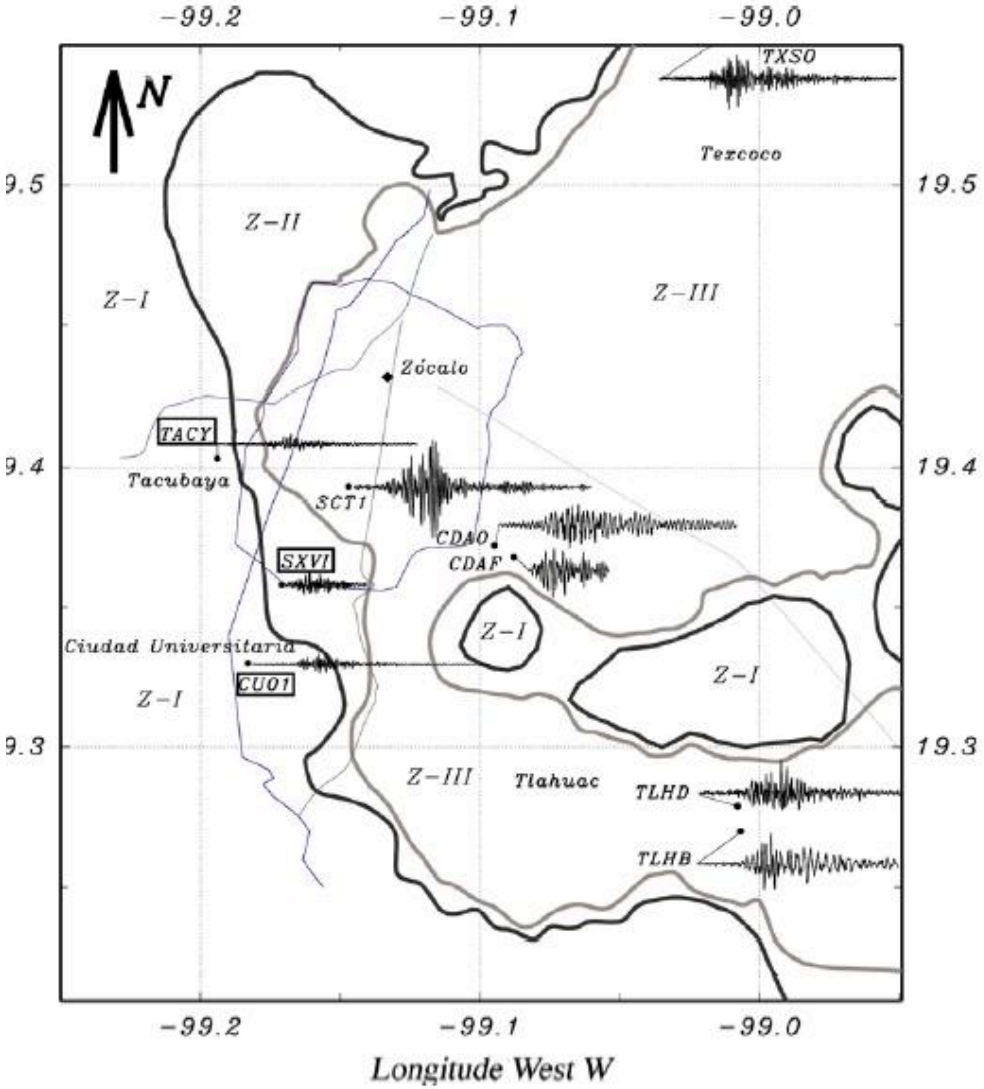
Tenochtitlan and Mexico City (DF)

La ciudad de Tenochtitlan y su entorno en el siglo XVI Pintura de Miguel Covarrubias, Museo Nacional de Antropología, México DF

The actual boundaries of the World Heritage Property follows the boundaries of the Historical Monuments Zones, according to the limits of the city in the 19th century (perimeter A), and a buffer zone (perimeter B)

Michoacan 1985 event: GM in DF





Response spectra

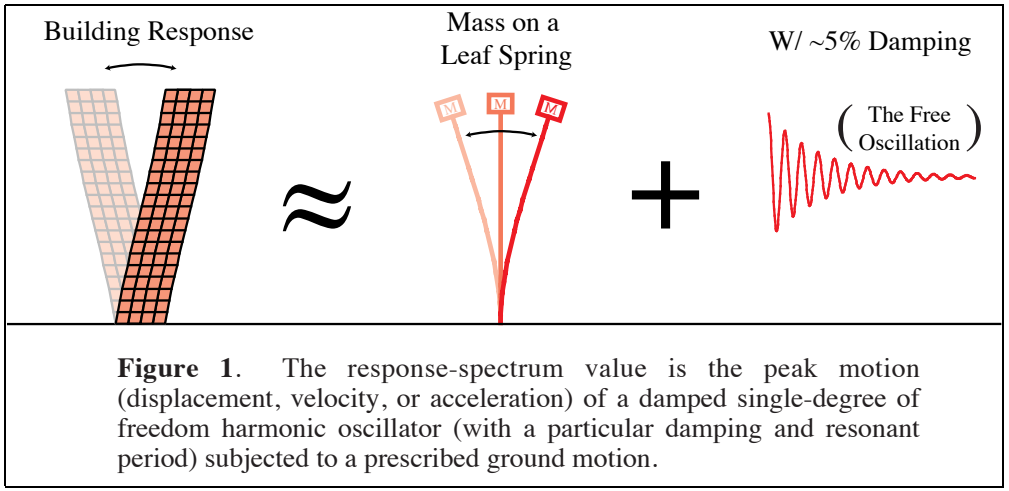
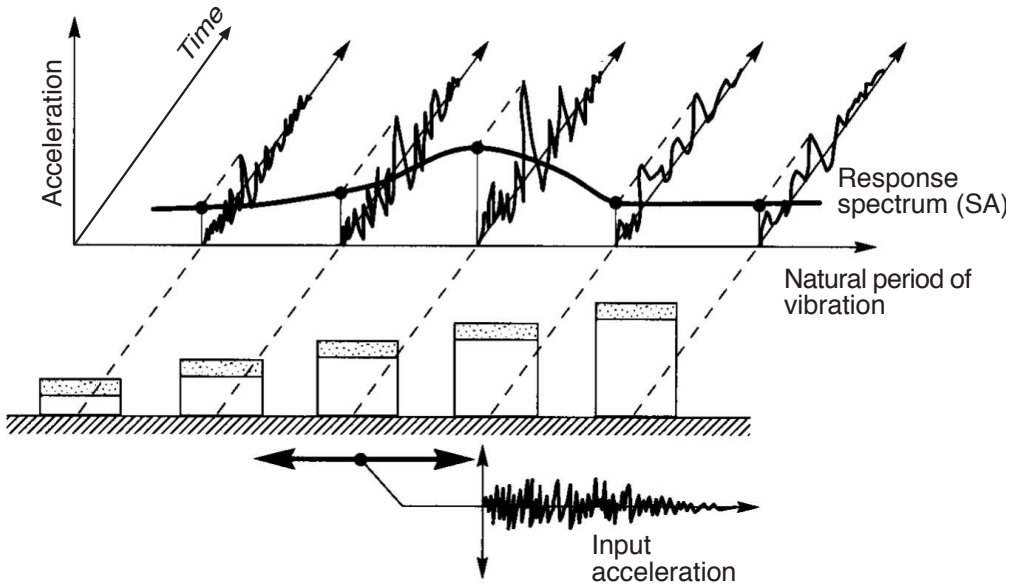


Figure 1. The response-spectrum value is the peak motion (displacement, velocity, or acceleration) of a damped single-degree of freedom harmonic oscillator (with a particular damping and resonant period) subjected to a prescribed ground motion.



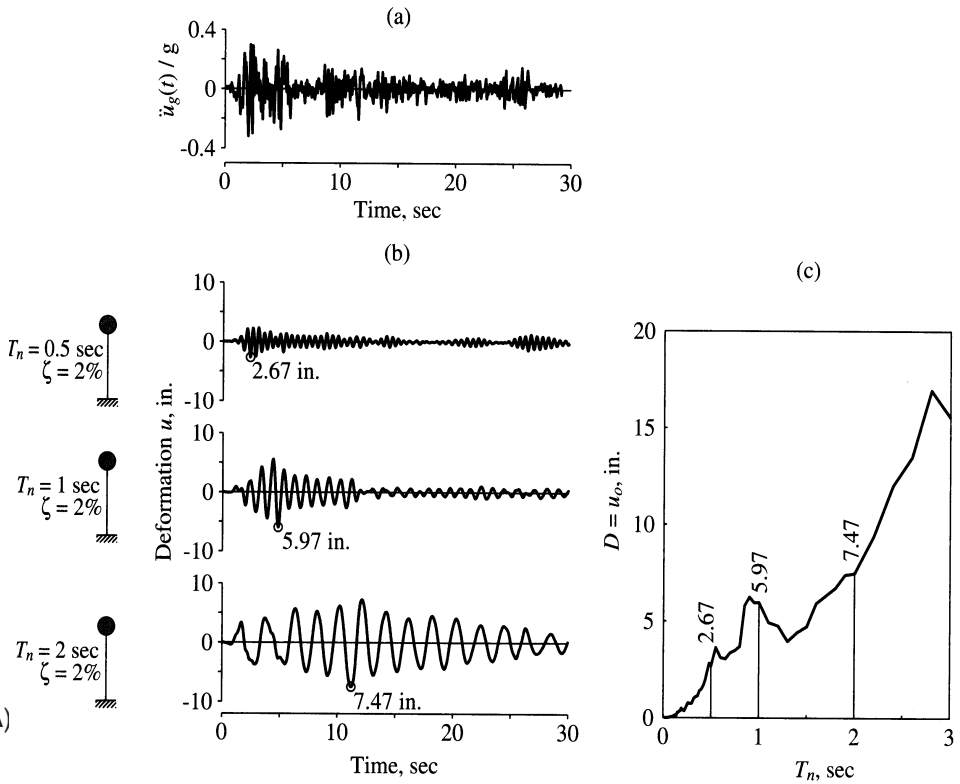


Figure 6.6.1 (a) Ground acceleration; (b) deformation response of three SDF systems with $\zeta = 2\%$ and $T_n = 0.5$, 1, and 2 sec; (c) deformation response spectrum for $\zeta = 2\%$.

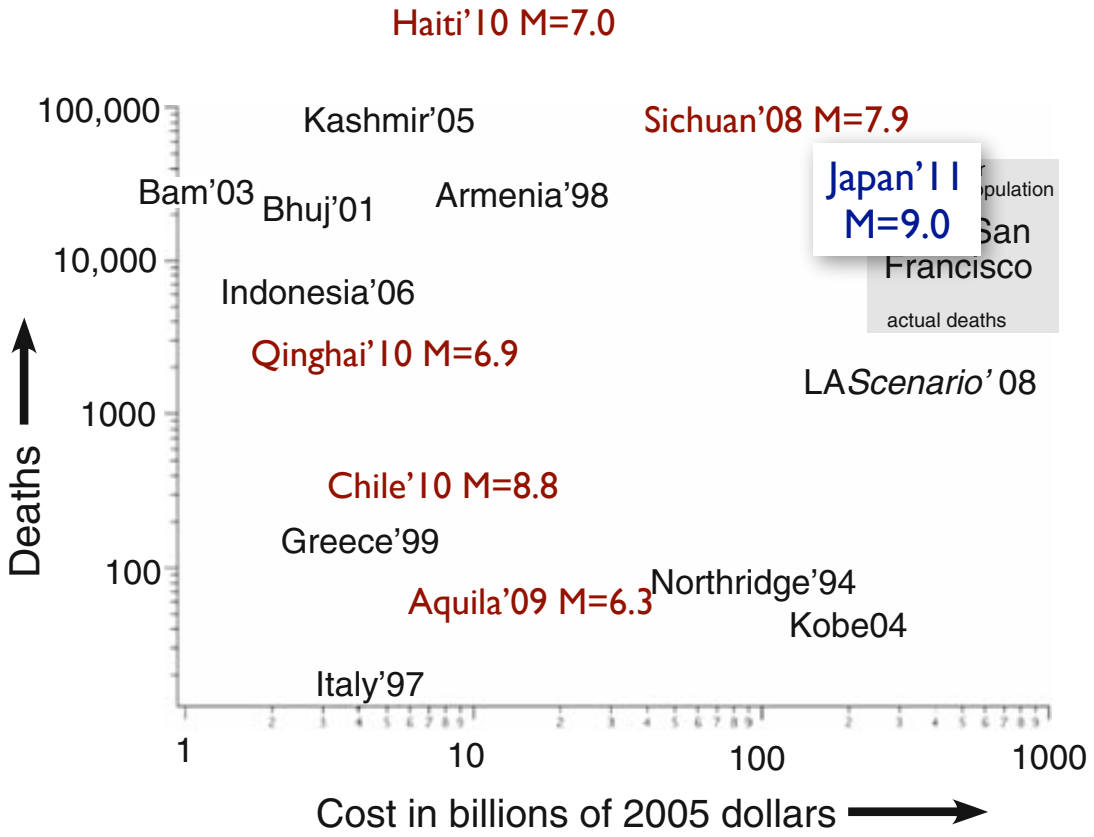
Michoacan 1985 event: damage in DF

Wreckage of a twenty-one-story building in Conjunto Pino Suarez Complex

Totally destroyed office building in the foreground, while the 44-floor Torre Latinoamericana office building, in the background on the right, stands

the road to (earthquake) safety...

Know the input - Bound the output...

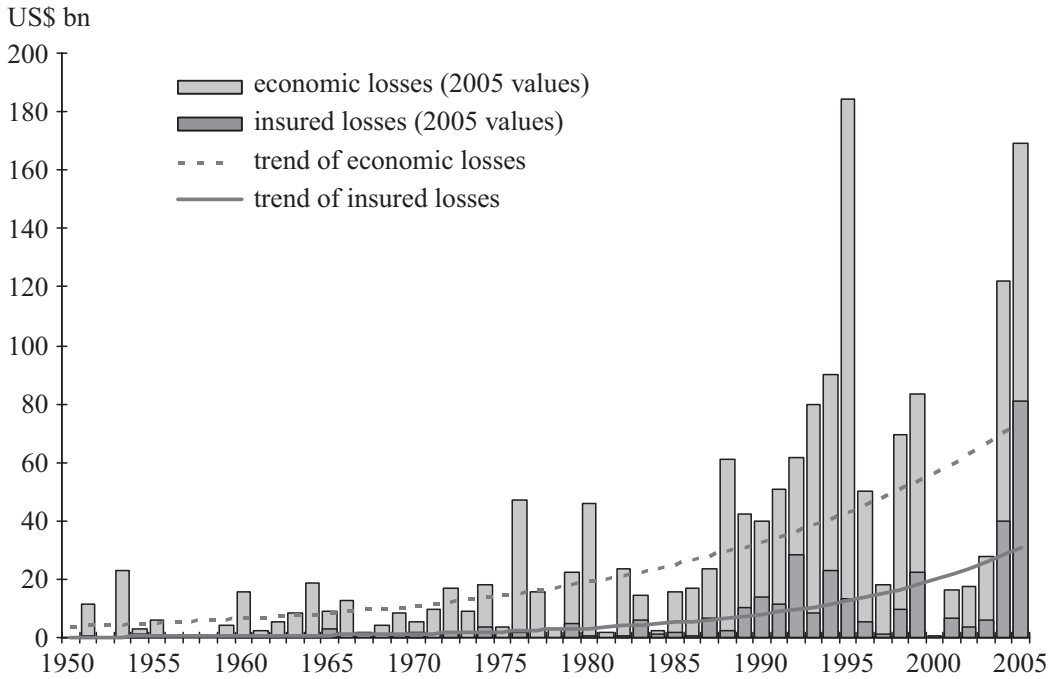


Earthquake fatalities versus repair costs in 2005 US$

Bilham, 2009. The seismic future of cities, Bull Earthquake Eng.
Roughly updated with help of Bilham, 2010 (Personal communication)

Mitigate the difference...

Losses from great natural disasters...



Losses from great natural disasters
(far exceeding 100 deaths or US$ 100 m in losses), 1950–2005

Smolka, 2006.
Natural disasters and the challenge of extreme events: risk management from an insurance perspective, Phil. Trans. R. Soc.

Hazards classification

- Origin - Anthropogenic (Technological, Sociological), Environmental, Natural
  - Natural - "extreme events that originate in the biosphere, hydrosphere, lithosphere or atmosphere"
- Energy Source - e.g. Biological, Chemical, Mechanical, Psychosocial, Physical
- Effects - Health, Safety, Economic, Environmental

https://en.wikipedia.org/wiki/Hazard

Disaster

- "a serious disruption, occurring over a relatively short time, of the functioning of a community or a society involving widespread human, material, economic, societal or environmental loss and impacts, which exceeds the ability of the affected community or society to cope using its own resources"

- "A disaster hazard is an extreme geophysical event that is capable of causing a disaster. 'Extreme' in this case means a substantial variation in either the positive or the negative direction from the normal trend"

- "The fundamental determinants of hazard and the risk of such hazards occurring is timing, location, magnitude and frequency"

- UNDRO: "an event, concentrated in time and space, in which a community undergoes severe danger and incurs such losses to its members and physical appurtenances that the social structure is disrupted and the fulfillment of all or some of the essential functions of the society is prevented"

Nordquist, Richard. "The Etymology of Words and Their Surprising Histories." ThoughtCo, Aug. 27, 2020, thoughtco.com/etymology-word-stories-1692654

Some basic definitions

- Seismic Hazard: describes the potential for dangerous, earthquake related phenomena, such as ground shaking, fault rupture or soil liquefaction.

- Seismic Risk: probability of occurrence of these consequences.

Reiter, 1990

Some basic definitions

- Seismic Hazard: any physical phenomenon (e.g. shaking) associated with an earthquake that may cause an adverse effect on human activity.

- Seismic Risk: a probability that social or economic consequences will exceed a specified value.

Anderson, 2006

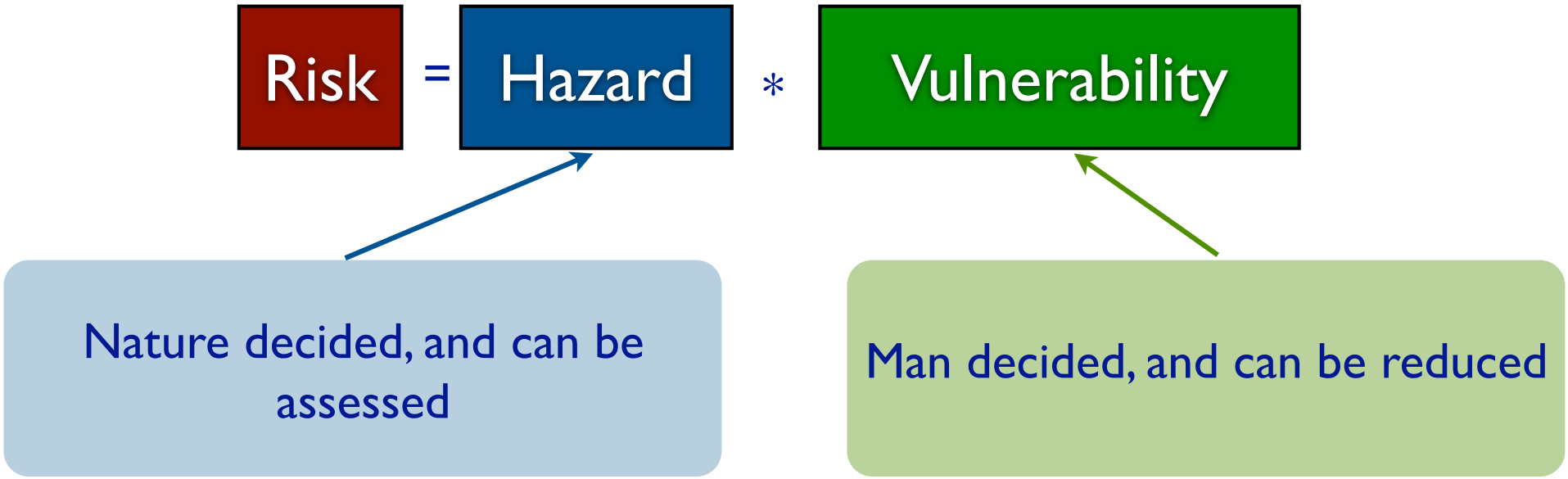
Some basic definitions

- Seismic Hazard: a physical effect associated with an earthquake, such as ground shaking, that MAY produce adverse effects.

- Seismic Risk: the probability that consequences of an earthquake, such as structural damage, will equal or exceed specified values in a specified period of time.

Ventura, 2006

Risk, Hazard & Vulnerability



$$R = \langle N_i, P_i, C_i \rangle$$

set of i-events with possible adverse consequences

associated probabilities of their occurrence

associated intolerable consequences