Earthquakes, an overview...

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Earthquakes?!?!?!

Date-Time 2002 04 20 10:50:44 UTC
Location 44.51N 73.66W
Depth 5.0 kilometers
Magnitude 5.0
Region NEW YORK
Reference 15 miles (25 km) SW of Plattsburgh, New York
Source USGS NEIC
Myth #1

The main danger associated with Earthquakes are the fissures which can open up in the ground...
Myth #2

Earthquakes can be predicted...

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Myth #3

Earthquakes produce tsunamis that reach 10s of Kilometers inland....

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Myth #4

An increase or decrease of seismic activity is a sure sign that an earthquake is going to occur any moment...

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Realidad #5

In large earthquakes barely no buildings are left standing...

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Myth #6

In the US Earthquakes are only a real threat to the West coast, Alaska and Hawaii...

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Realidad #7

There’s nothing we can do in the face of an earthquake....

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Why do earthquakes happen?
“Our Dynamic Earth”
Subduction and Strike-slip plate boundaries
What happens during an earthquake?

From: http://atlas.geo.cornell.edu
Size of an Earthquake

- Magnitude - reflects the energy released by an earthquake and can be calculated based on the duration or the amplitude of the event as recorded on a seismogram and corrected for distance.
Size of an Earthquake

- Intensity-size of an earthquake in a specific locality. Can be obtained from the damage done to structures built by humans, changes in the Earth’s surface and felt reports (Mercalli Scale). Expressed in Roman Numerals (I-XII).
Size of an Earthquake

- Ground Acceleration expresses “how fast and by what amount does the ground move”, referenced to acceleration due to gravity, this acceleration is 1g
- Equivalent to a car traveling 100 meters from rest in just 4.5 seconds.

Strong motion instruments
Know as accelerometers
Are used calculate this value.
Some significant earthquakes in the US...

- 1638-MM=IX, Plymouth, Massachusetts
- 1811-MM=XI, New Madrid, Missouri
- 1867-M=7.3, MM=VIII, US Virgin Islands, Tsunami 20’
- 1868-MM IX-X, Big Island, Hawaii, Tsunami 65’
- 1886-MM X, Charleston, South Carolina
- 1906-M=8.1, MM XI, San Francisco, California
- 1918-M=7.3, MM VIII, Western PR, Tsunami 20’
- 1989-M=7.1, MM X Loma Prieta, California
- 1994-M=6.8, MM VIII, Northridge, California
An Earthquake’s capacity to generate destruction is closely dependent on:

- Magnitude
- Depth and distance of the hypocenter
- Horizontal and vertical acceleration
- Velocity and displacement of the ground
- Properties of the seismic waves
- Duration
- Directivity of rupture
Attenuation Model
Hazard and Risk are not the same thing

- While earthquake hazard reflects the severity of ground shaking, seismic risk takes into account the population and built up environment.
- Among 26 major cities in the US, New York city is 25th in terms of hazard, but when taking into consideration the population, in terms of risk it is 4th, only exceeded by LA, San Francisco and Seattle.
Monitoring earthquakes

- Strong motion vs. weak motion seismic stations
- Local networks
- Regional networks
- National Networks
- Virtual networks
What can happen?
Bahía de Caraquez, Ecuador, August 4, 1998, 33 km, M 7.2

Calipso Condominium

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What can happen?
Armenia, Colombia January 25, 1999, 10 km, M=5.8
What can happen?
Cariaco, Venezuela, July 9, 1997, 20 km, M 6.8

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What can happen?
Cariaco, Venezuela, July 9, 1997, 20 km, M 6.8
What can happen?

Northridge, California, January 17, 1994, 19 km, M 6.8

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What can happen?
Northridge, California, January 17, 1994, 19 km, M 6.8
What can happen?
Kobe, Japan, January 17, 1995, 10 km, M 7.2
What can happen?
Northridge, California, January 17, 1994, 19 km, M 6.8
What can happen?
Northridge, California, 17 de enero de 1994, 19 km, M 6.8
What can happen?
Northridge, California, 17 de enero de 1994, 19 km, M 6.8
What can happen?
Kobe, Japan, January 17, 1995, 10 km, M 7.2
Secondary Phenomena Induced by Earthquakes

- Amplification
- Liquefaction
- Tsunami
- Landslides

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Amplification
Amplification

Benito Juarez Maternity Hospital, México.

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Liquefaction

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Tsunami, 1867, Islas Virgenes, USA
Tsunami, Mayagüez, PR, 1918

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Alaska, 1946 Ms = 7.8.
Atlantic Tsunamis

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Landslides

• “Nothing of what I saw on TV or saw in the newspapers prepared me for what I saw this morning…”

• Governess Sila Calderón, after visiting the ruins of the World Trade Center in New York
What can we do?

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Now...

- Be prepared as best as possible at
  - Home
  - Work

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Now...

- Inspect homes and offices
- Correct dangerous situations
  - Non structural
  - Structural
- Identify safe places
Now...

- Emergency Response Committees
  - Administrator
  - Interested, motivational personnel
  - Other resource (EM)
Now...

- Security back packs...
  - First aid materials
  - Radio with batteries
  - Flashlight with batteries
  - Notebook and pen
  - Gloves
  - Some game
  - Small food items and water
  - List of occupants
  - Special information
Now...

- Prepare evacuation plans
- Do simulation exercises
- Make sure employees have domestic emergency plans
During...

- Protect one’s life and those immediately surrounding you.
- Look for the safest place
  - If you are inside, generally it is best to stay inside.
  - If you are outside, stay outside
- In most cases, it is best not to run, especially if you are not on the ground floor
Afterwards...

- Stay calm…
- Get prepared for the aftershocks.
- See if people are trapped
- Administer first aid
- It might be necessary to evacuate the building
- Check the building

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After...

- Be prudent with phone calls
- Until EMP arrive, one must manage the situation
- Cooperate with authorities
Earthquakes can't be stopped, but the disaster can by…

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Recognize that earthquakes are just one of the hazards in the region and take a multihazard approach.
Questions?

Thank you....
http://rmsismo.uprm.edu