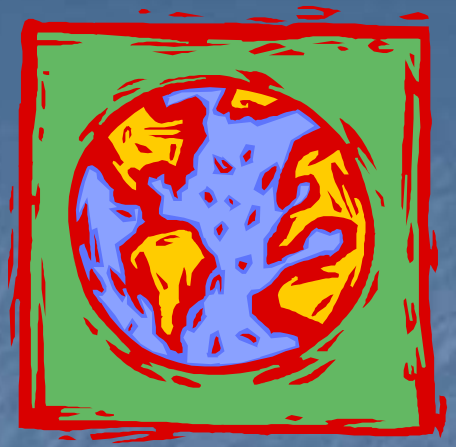
NATURAL HAZARDS
&
NATURAL DISASTERS

The World is always changing.



Natural disasters are changes which are so great they may cause damage to the shape of the land or to the lives of people and other living things.

Great changes happen deep inside the Earth and on its surface. Both threaten the Earth’s habitants and its environment, which need constant adjustments.

What are Natural Disasters?

A **natural disaster** is the effect of a natural hazard that affects the environment, and leads to financial, environmental and/or human losses

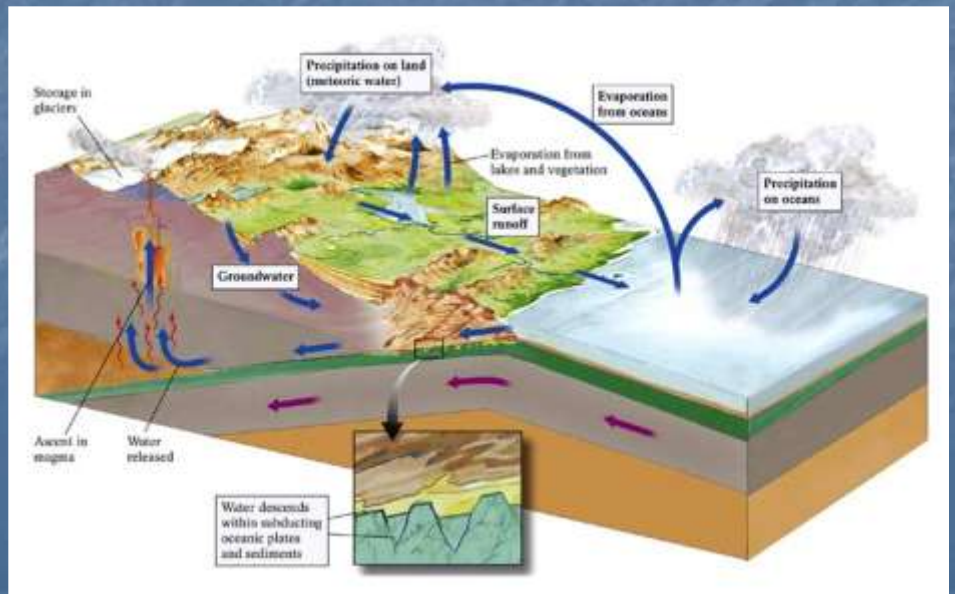
Disasters occur when hazards meet vulnerability

- Volcanic eruption
- Earthquake & Tsunami
- Cyclone or Hurricane
- Mass Movements
- Floods
- Drought
- Forest fire or Bushfire

Volcanoes

A volcanic eruption is the spurting out of gases and hot lava from an opening in the Earth's crust.

Pressure from deep inside the Earth forces ash, gas and molten rock to the surface.



Mass Movements

- Landslides
- Debris Flows
- Avalanches

Earthquake

An earthquake is a violent shaking of the ground. Sometimes it is so strong that the ground splits apart.

When parts of the earth, called plates, move against each other giant shock waves move upwards towards the surface causing the earthquake.

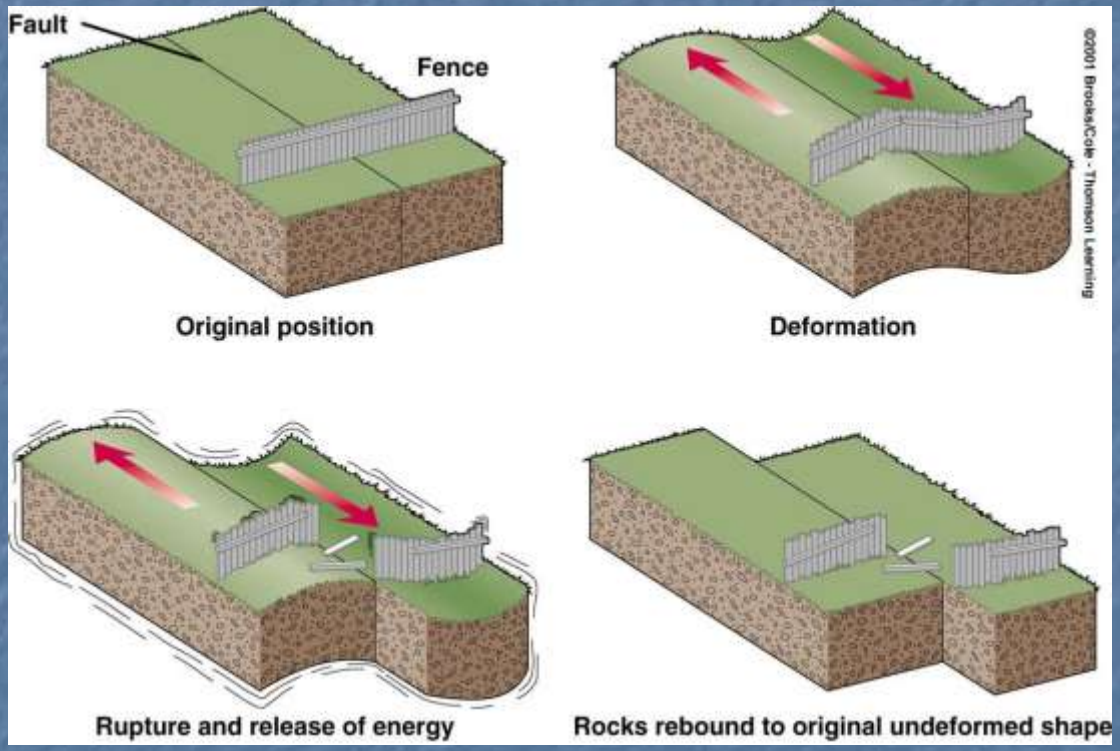
Earthquakes & Tsunamis

What are Earthquakes?

- The shaking or trembling caused by the sudden release of energy
- Usually associated with faulting or breaking of rocks
- Continuing adjustment of position results in aftershocks

What is the Elastic Rebound Theory?

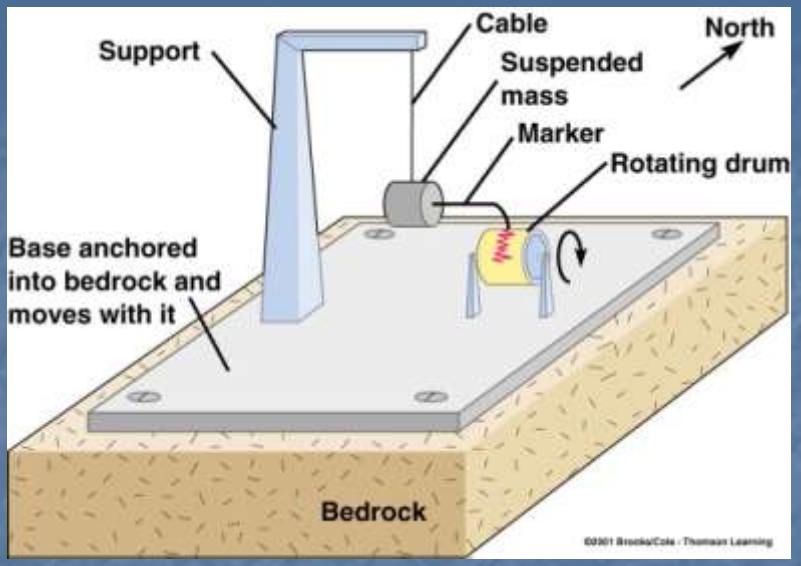
- Explains how energy is stored in rocks
  - Rocks bend until the strength of the rock is exceeded
  - Rupture occurs and the rocks quickly rebound to an undeformed shape
  - Energy is released in waves that radiate outward from the fault

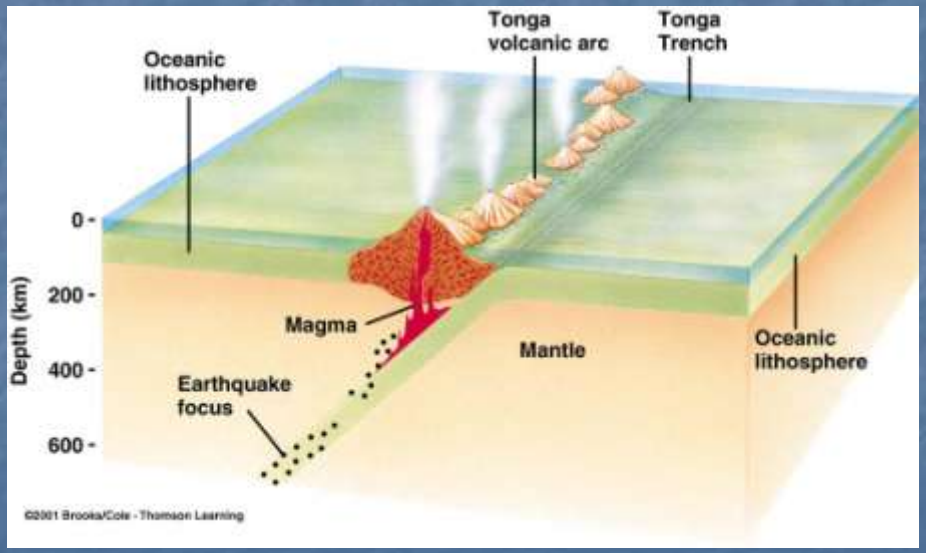


The Focus and Epicenter of an Earthquake

- The point within Earth where faulting begins is the focus, or hypocenter
- The point directly above the focus on the surface is the epicenter

Seismographs record earthquake events

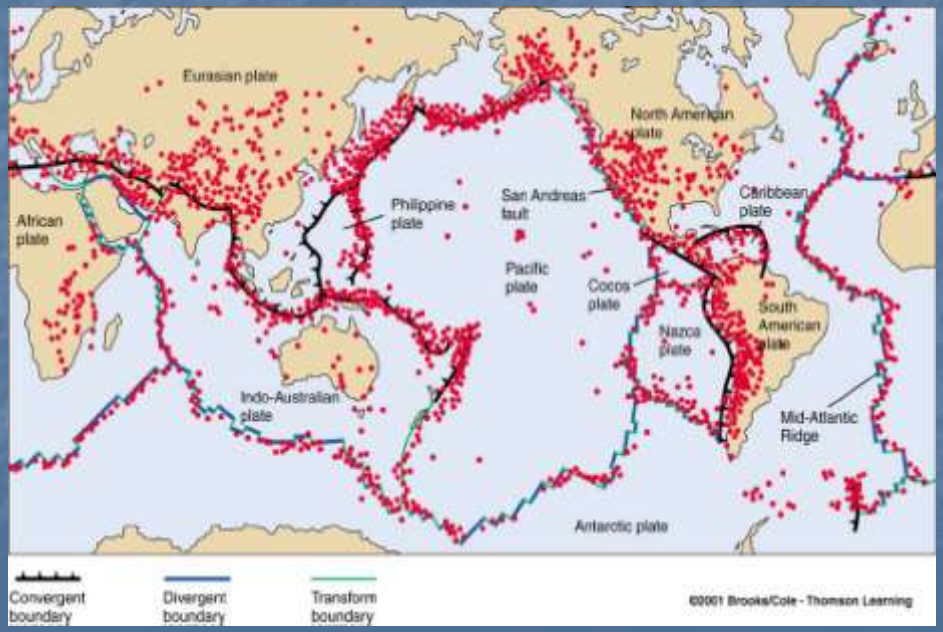




At convergent boundaries, **focal depth** increases along a dipping seismic zone called a **Benioff zone**

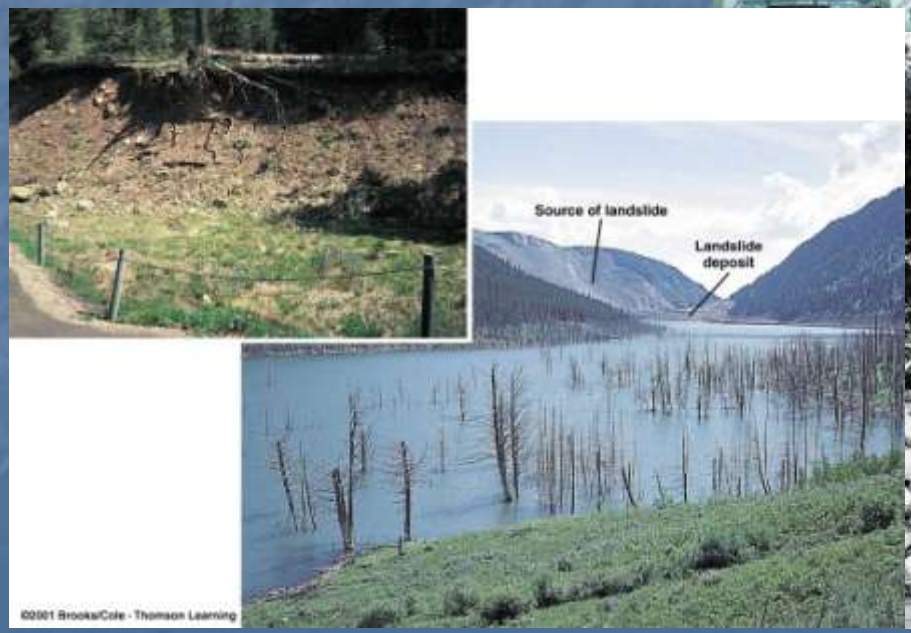
Where Do Earthquakes Occur and How Often?

- ~80% of all earthquakes occur in the circum-Pacific belt
- most of these result from convergent margin activity
- ~15% occur in the Mediterranean-Asiatic belt
- remaining 5% occur in the interiors of plates and on spreading ridge centers
- more than 150,000 quakes strong enough to be felt are recorded each year



The Economics and Societal Impacts of EQs

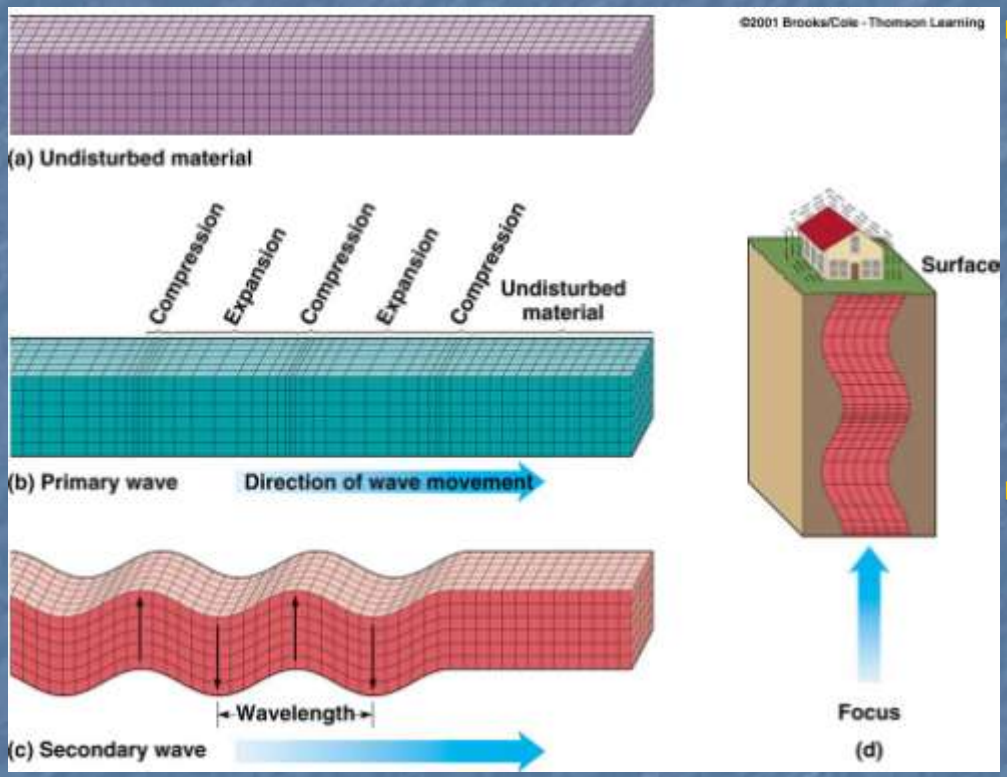
- Building collapse
- Fire
- Tsunami
- Ground failure



What are Seismic Waves?

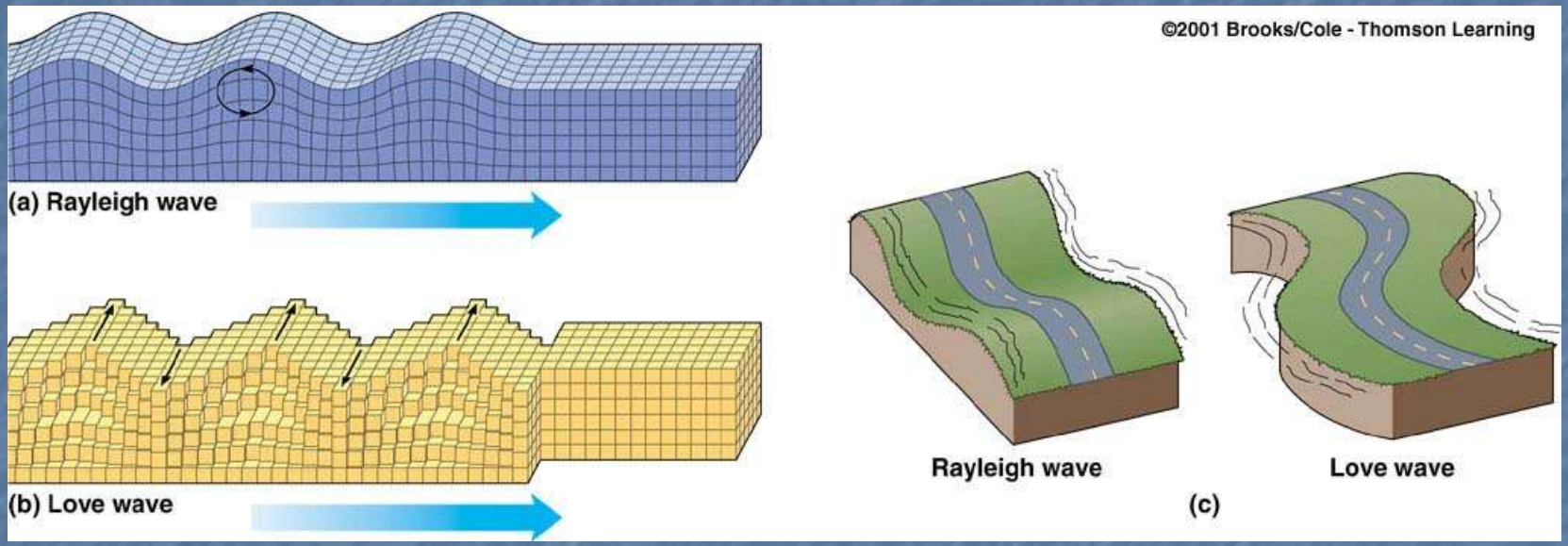
- Response of material to the arrival of energy fronts released by rupture
- Two types:
  - Body waves
    - P and S
  - Surface waves
    - R and L

Body Waves: P and S waves



- Body waves
- P or primary waves
  - fastest waves
  - travel through solids, liquids, or gases
  - compressional wave, material movement is in the same direction as wave movement
- S or secondary waves
  - slower than P waves
  - travel through solids only
  - shear waves - move material perpendicular to wave movement

Surface Waves: R and L waves

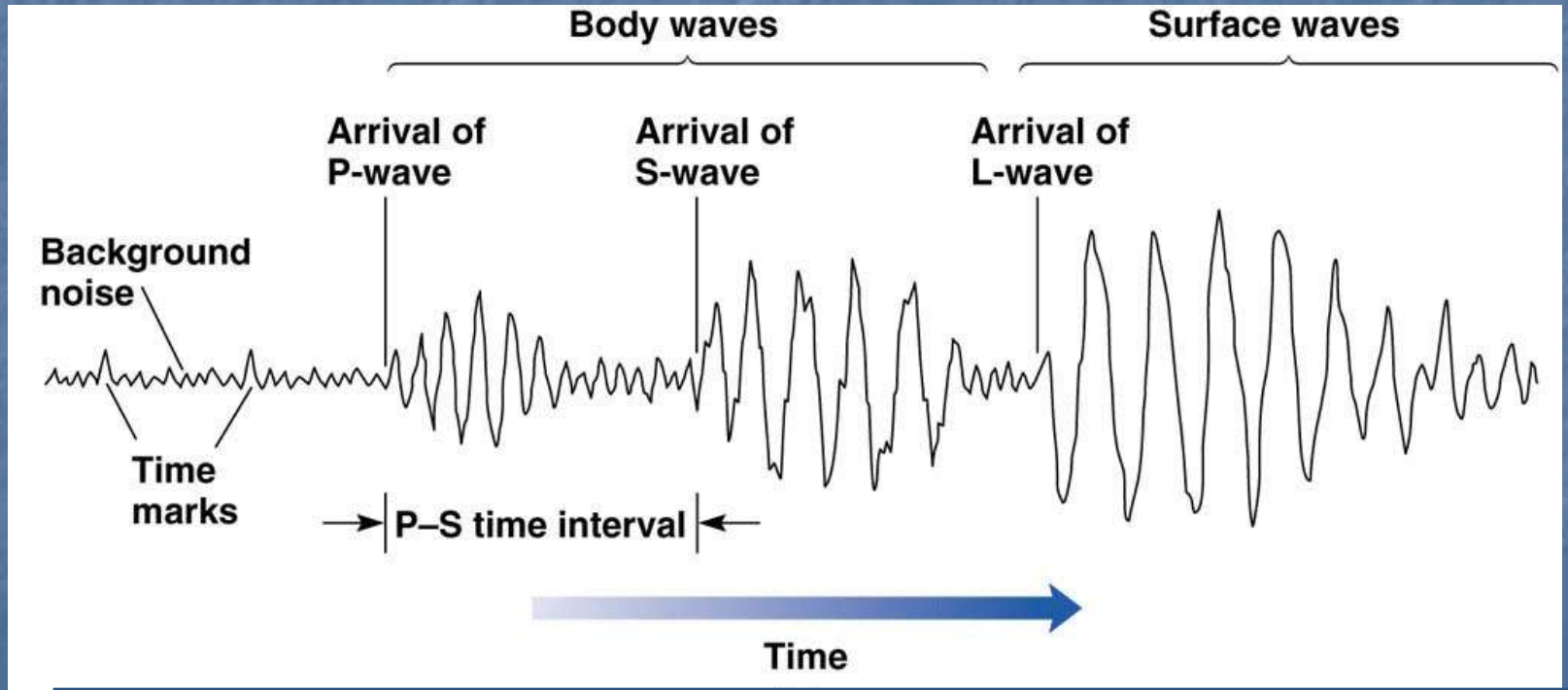


- Surface Waves
  - Travel just below or along the ground's surface
  - Slower than body waves; rolling and side-to-side movement
  - Especially damaging to buildings

How is an Earthquake's Epicenter Located?

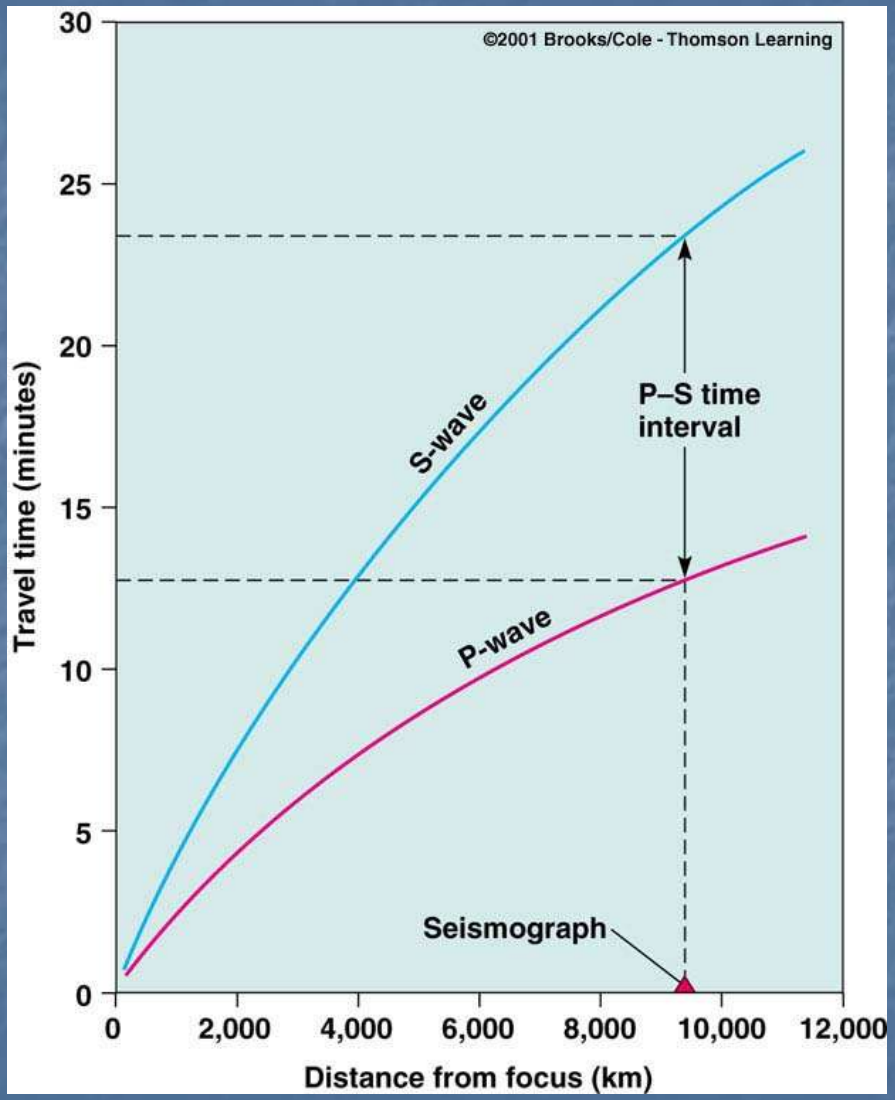
Seismic wave behavior

- **P waves arrive first, then S waves, then L and R**
- **Average speeds for all these waves is known**
- **After an earthquake, the difference in arrival times at a seismograph station can be used to calculate the distance from the seismograph to the epicenter.**



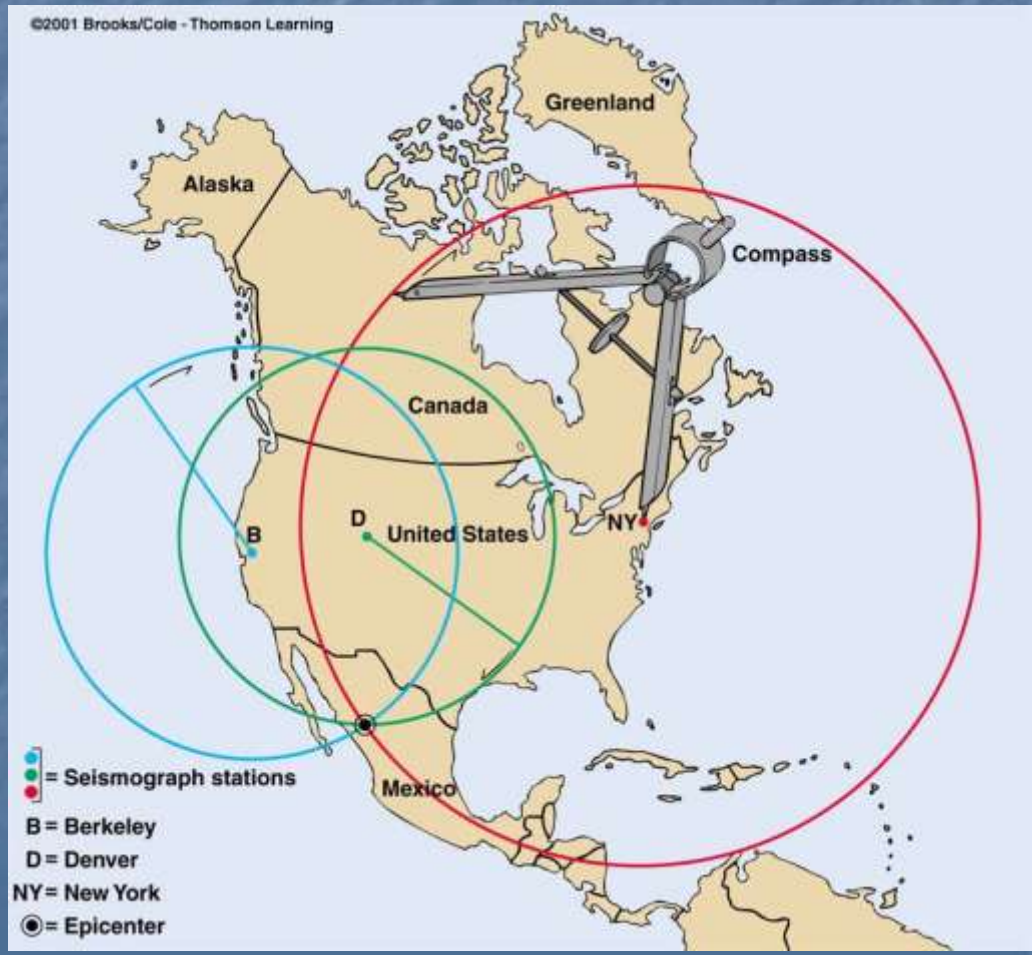
How is an Earthquake's Epicenter Located?

Time-distance graph showing the average travel times for P- and S-waves. The farther away a seismograph is from the focus of an earthquake, the longer the interval between the arrivals of the P- and S- waves

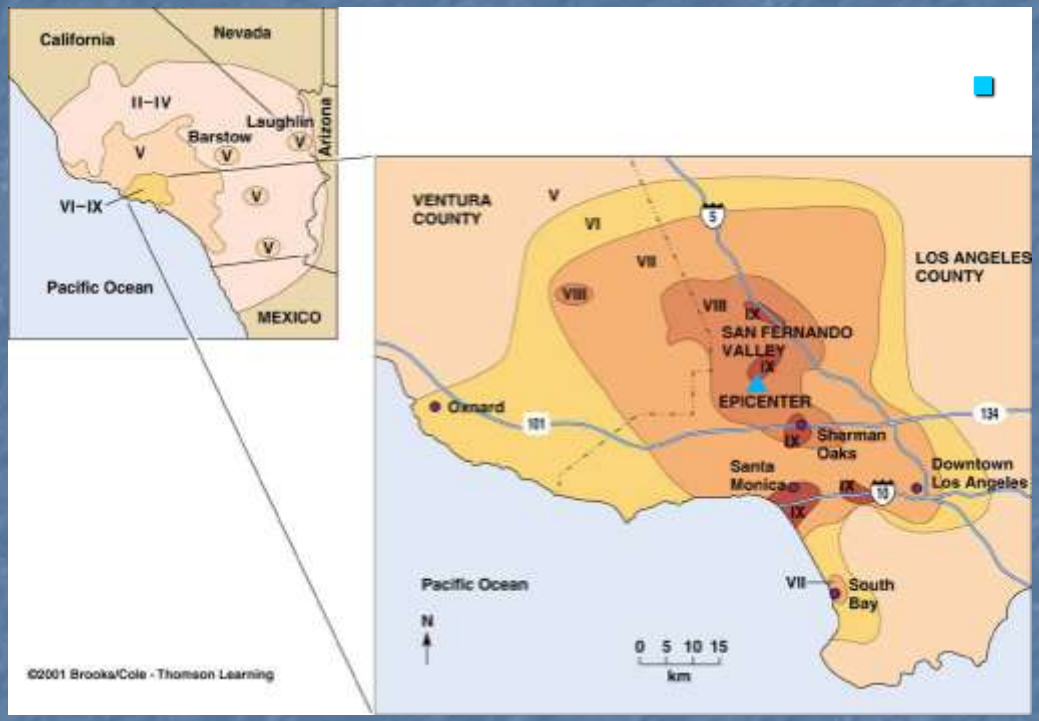


How is an Earthquake's Epicenter Located?

- Three seismograph stations are needed to locate the epicenter of an earthquake
- A circle where the radius equals the distance to the epicenter is drawn
- The intersection of the circles locates the epicenter



How are the Size and Strength of an Earthquake Measured?

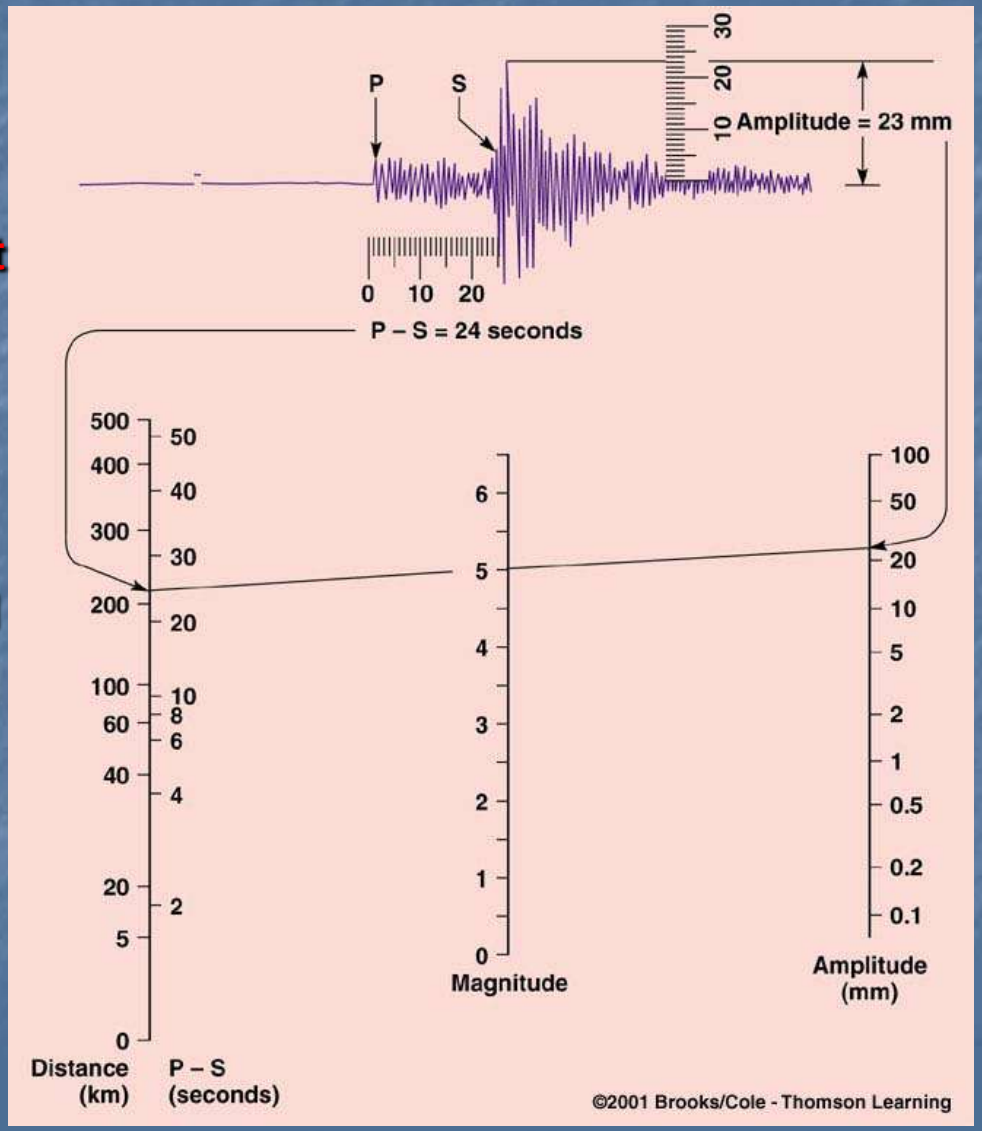


- Intensity
  - **subjective** measure of the kind of damage done and people's reactions to it
  - isoseismal lines identify areas of equal intensity

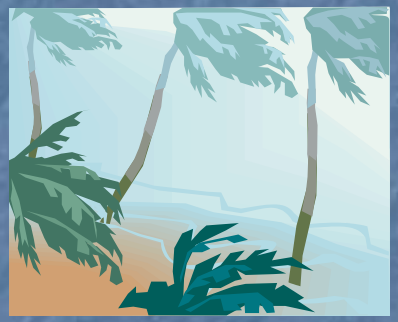
- Modified Mercalli Intensity Map
  - 1994 Northridge, CA earthquake, magnitude 6.7

How are the Size and Strength of an Earthquake Measured?

- Magnitude
  - Richter scale measures **total amount of energy** released by an earthquake; independent of intensity
  - Amplitude of the largest wave produced by an event is corrected for distance and assigned a value on an open-ended logarithmic scale



Cyclone, Hurricane, Tornado or Typhoon



A Cyclone is a fierce storm with storm winds that spin around it in a giant circle. During a cyclone trees can be uprooted, buildings can be destroyed and cars can be overturned.

Avalanche

An Avalanche is a movement of snow, ice and rock down a mountainside. Avalanches happen very suddenly and can move as fast as a racing car up to 124mph.

Avalanches can be caused by –

- snow melting quickly
- snow freezing, melting then freezing again
- someone skiing
- a loud noise or an earth tremor

Flood

A flood is caused by an overflow of water which covers the land that is usually dry.

Floods are caused by heavy rain or by snow melting and the rivers burst their banks and overflow.

Costal floods are caused by high tides, a rise in sea level, storm waves or tsunami (earthquakes under the sea).

Flood images

Flood images

Flash Flood - Facts

- Flash floods kill more people than Hurricanes
- Water moving at 4 miles per hour exerts a force of about 66 pounds on every square feet of anything it encounters

Drought

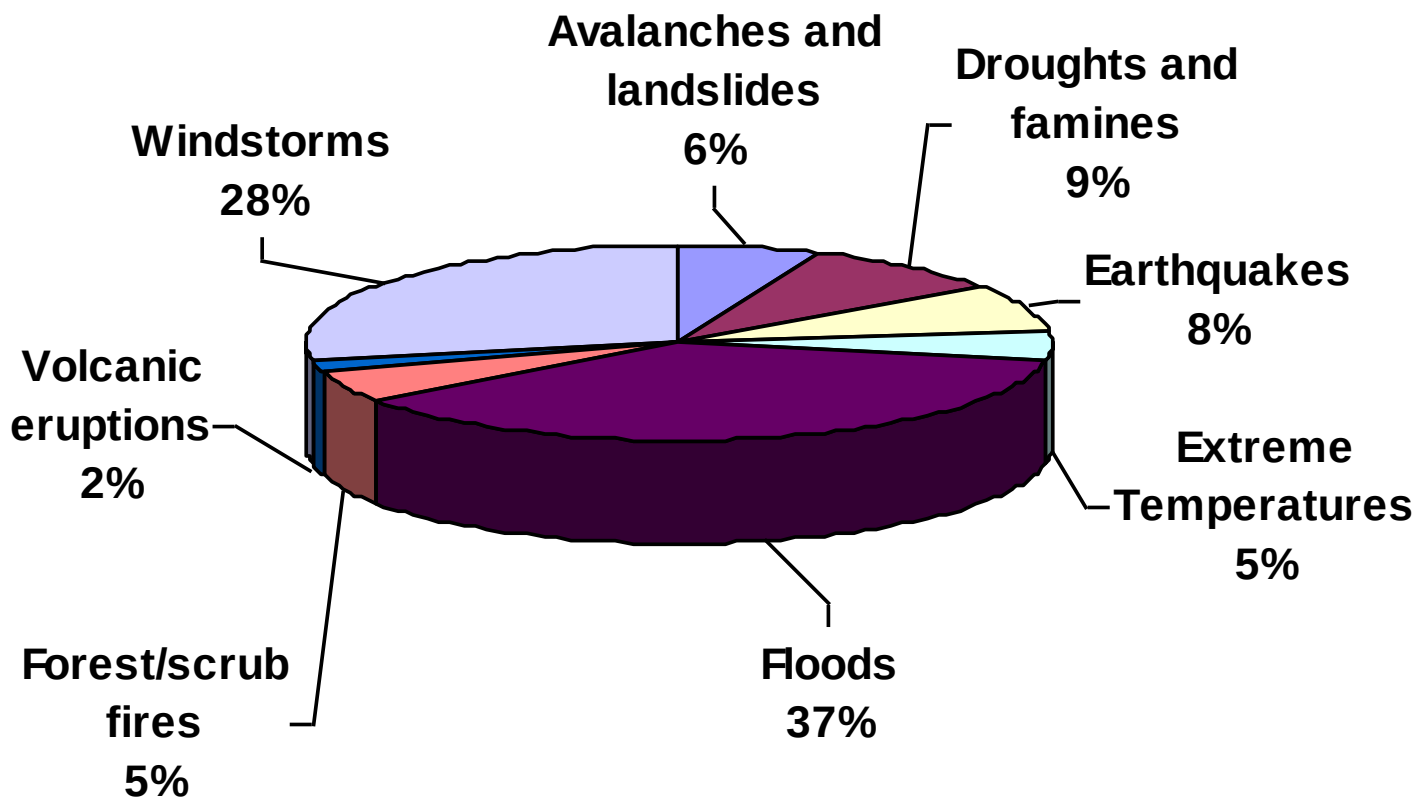
A drought is the lack of rain for a long time.

In 1968 a drought began in Africa. Children born during this year were five years old before rain fell again.

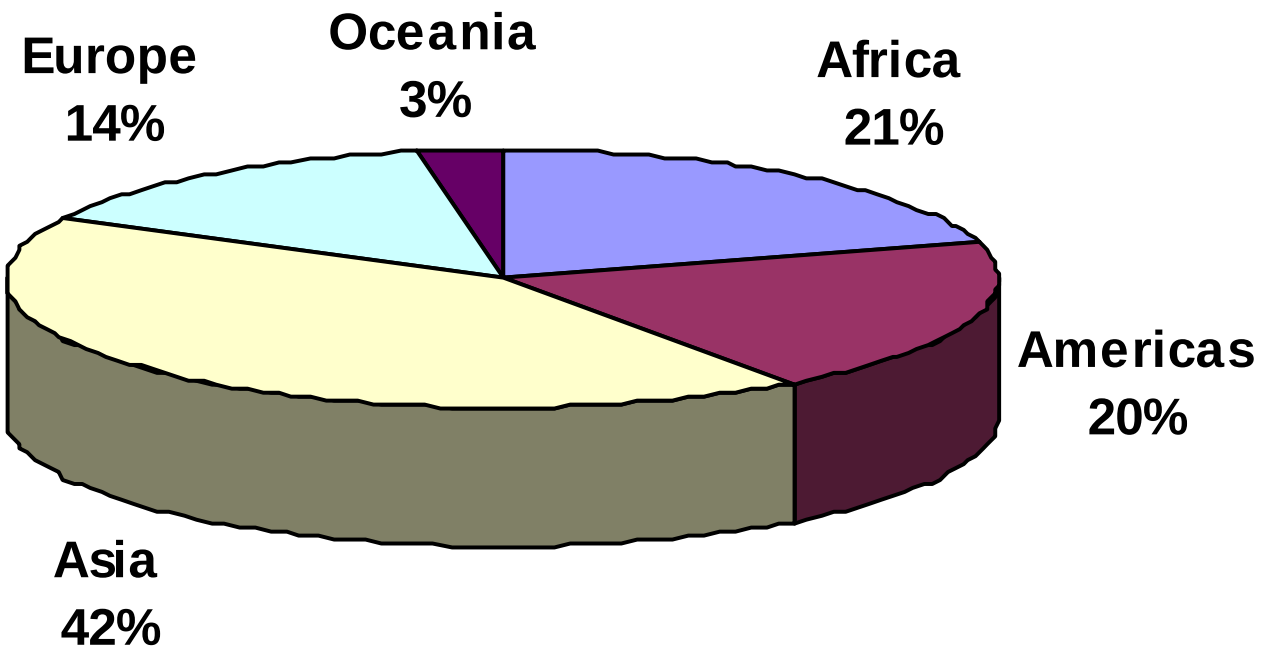
Forest Fire or Bushfire

Fires can burn out of control in areas of forest or bush land. Fires are caused by lightning, sparks of electricity or careless people. Wind may blow a bushfire to areas where people live.

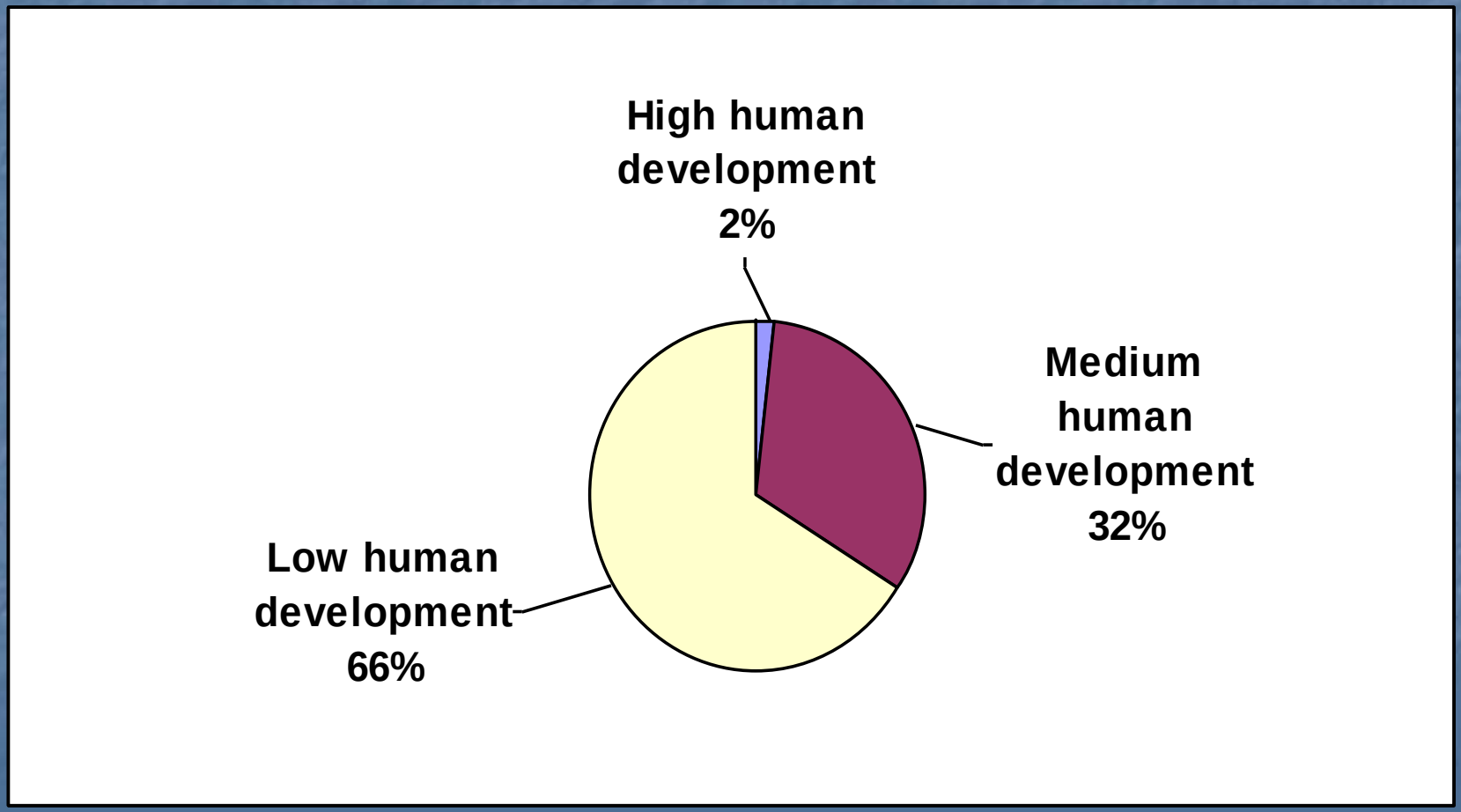
Global distribution of natural hazards (1993-2002)



Regional distribution of natural disasters (193-2002)

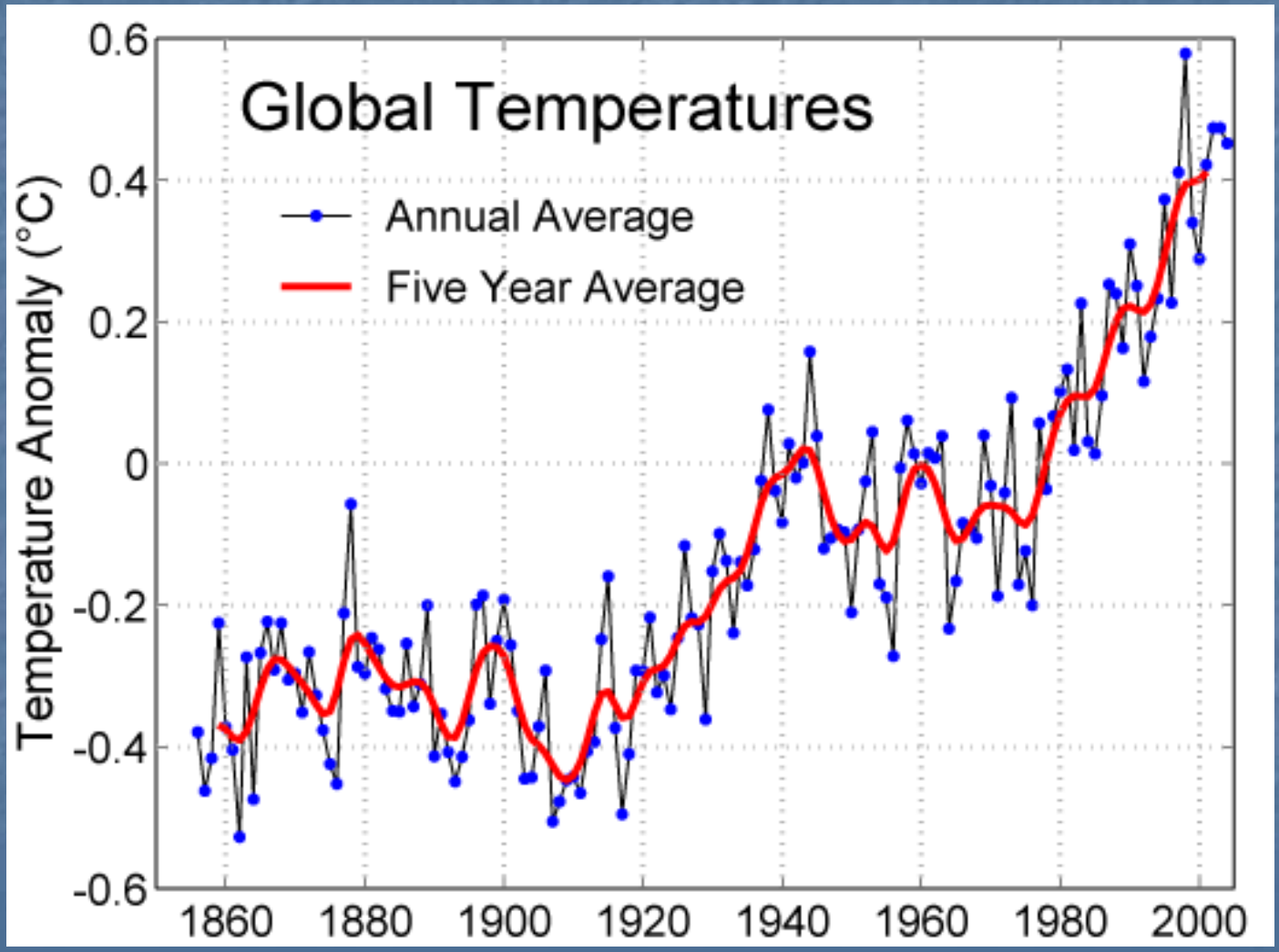


Distribution of people killed (1993-2002)



Climate change - impacts

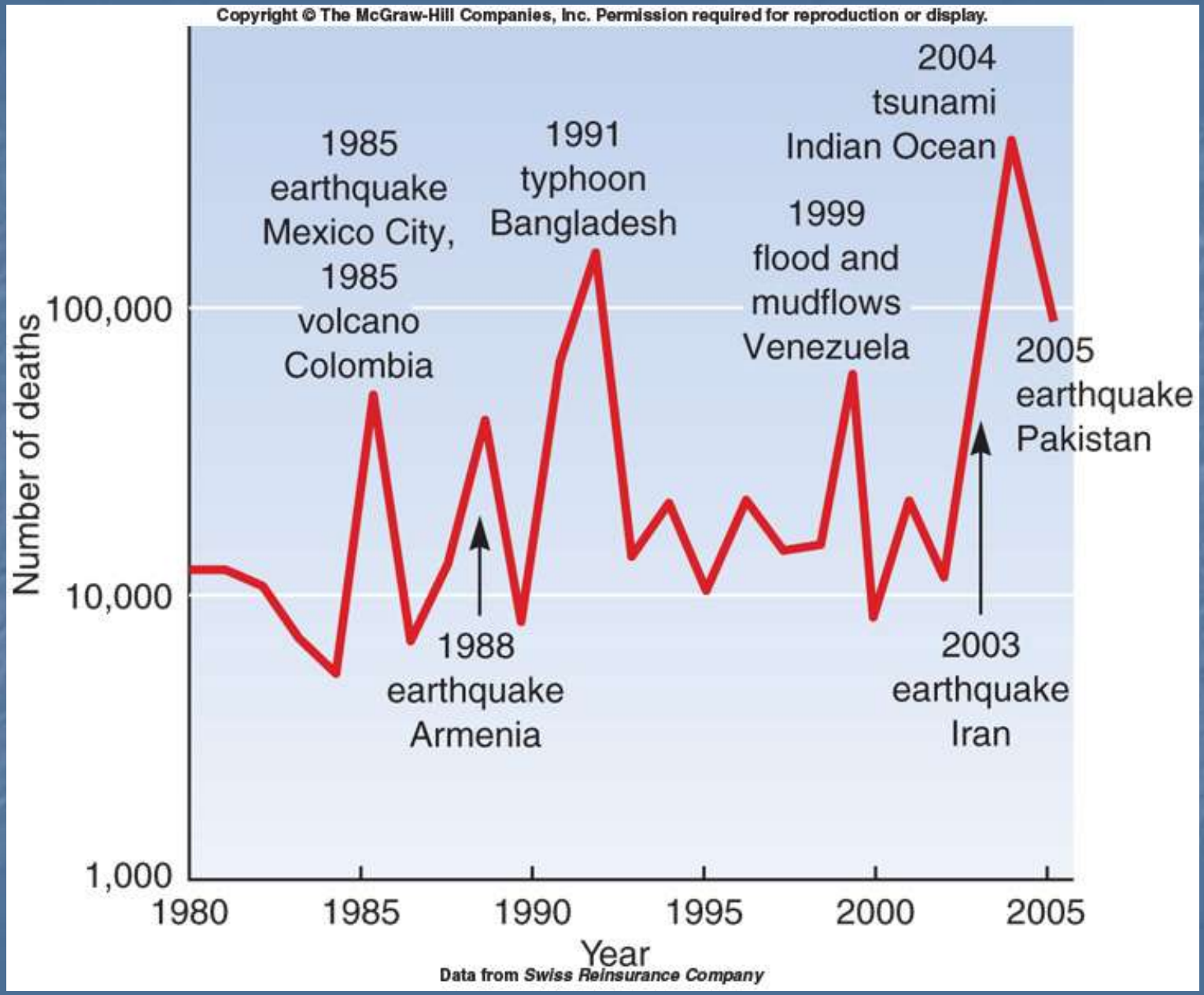
- In 2100 half of the world population will be under water stress
- Subtropical zones: Less precipitations; increased desertification
- Tropical zones: Increased health risks
- High latitudes: permafrost decrease
- Coastal zones: coastal erosion; storm surges; salt water intrusions
- Cost of global warming in 2050: 300 billion US Dollars per year


Global Temperatures
Annual Average
Five Year Average
Temperature Anomaly (°C)
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
1860
1880
1900
1920
1940
1960
1980
2000

Natural Disasters Effects

- 360 natural disasters in 2005, 91,900 people killed, 157 million people affected, 159 billion dollars damage
- 305 natural disasters in 2004, 280,000 people killed, 150 million people affected, 150 billion dollars damage
- More than 83,000 people killed by natural disasters in 2003

- 2005 - 73,338 of the dead in Pakistan's Quake Zone
  - 3.3 million left homeless
  - 2nd wave of deaths from winter storm
- 2005 Hurricane Katrina
- 2004 – 226,408 dead in Indian Ocean Tsunami
- 2003 - Bam, Iran earthquake: 41,000 people



Data from *Swiss Reinsurance Company*

Population Factor