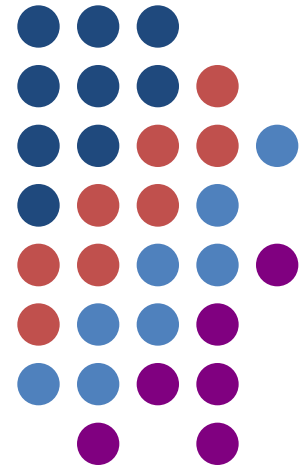


# Natural Disasters

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The Science of Natural Disasters

Chapter 1



# Learning Objectives



- Know the difference between a disaster and a catastrophe
- Understand the scientific method
- Understand the basics of risk assessment
- Recognize that natural hazards that cause disasters are generally high-energy events caused by natural Earth processes

# Learning Objectives, cont.



- Understand the concept that the magnitude of a hazardous event is inversely related to its frequency
- Understand how natural hazards may be linked to one another and to the physical environment
- Recognize that increasing human population and poor land-use changes compound the effects of natural hazards and can turn disasters into catastrophes

# Some Important Definitions



- **Hazard**
  - Naturally occurring
  - Effects on human interests
- **Disaster**
  - Effect of hazard on society
    - Property damage, injury, loss of life
- **Catastrophe**
  - Massive disaster

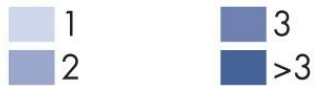
# History & Natural Hazards



- Natural hazards are repetitive.
- History of an area gives clues to potential hazards.
  - Maps, historical accounts, climate, and weather data
  - Rock types, faults, folds, soil composition

### General Areas of Major Flooding:

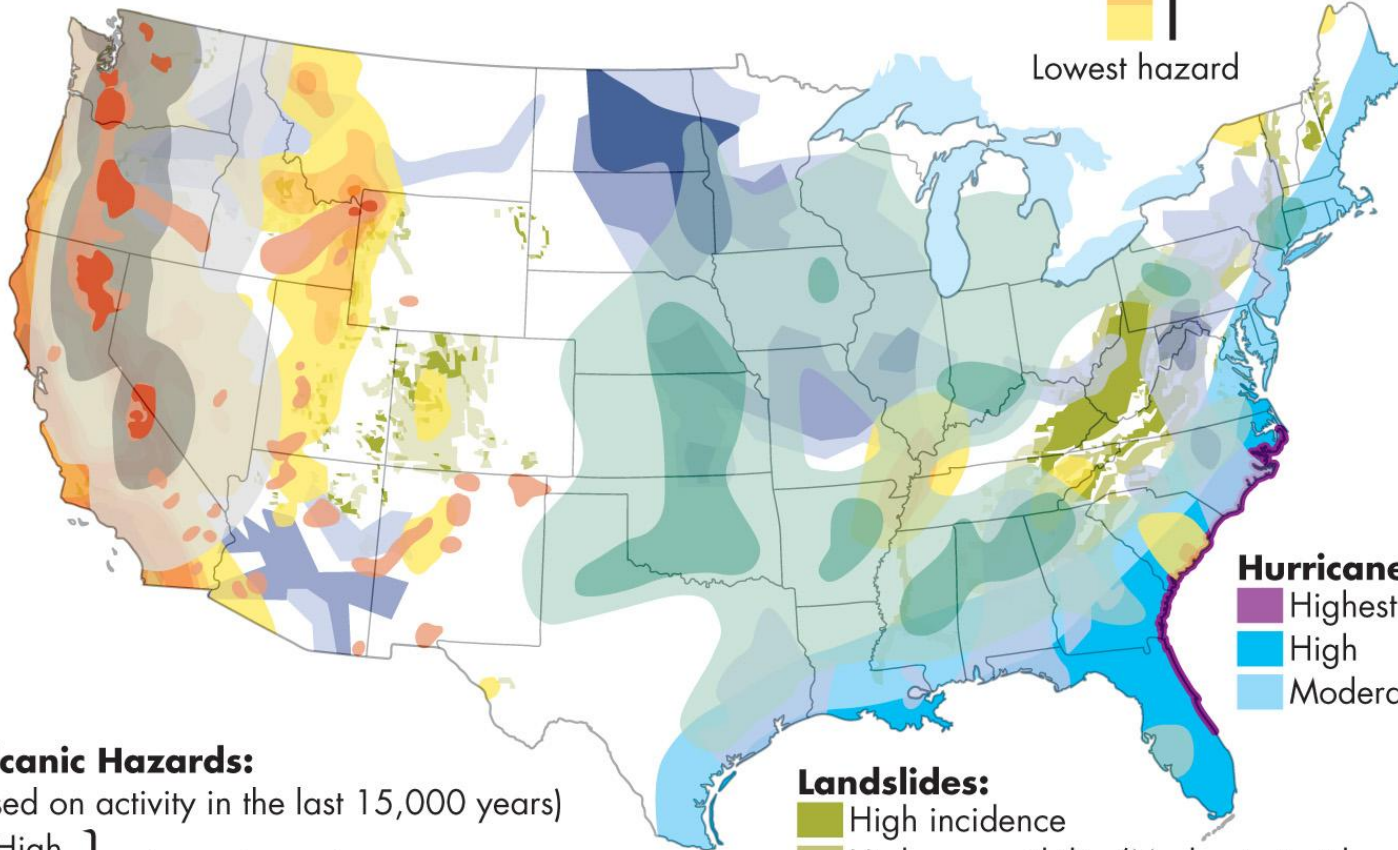
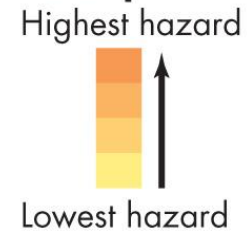
January 1993 - December 1997



### Tornadoes:

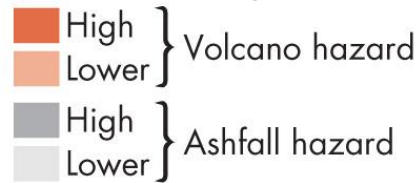


### Earthquakes:

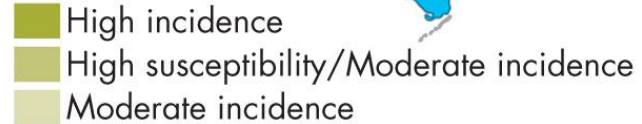


### Volcanic Hazards:

(Based on activity in the last 15,000 years)



### Landslides:



### Hurricanes:



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Figure 1.4

# Natural Hazards & Catastrophes



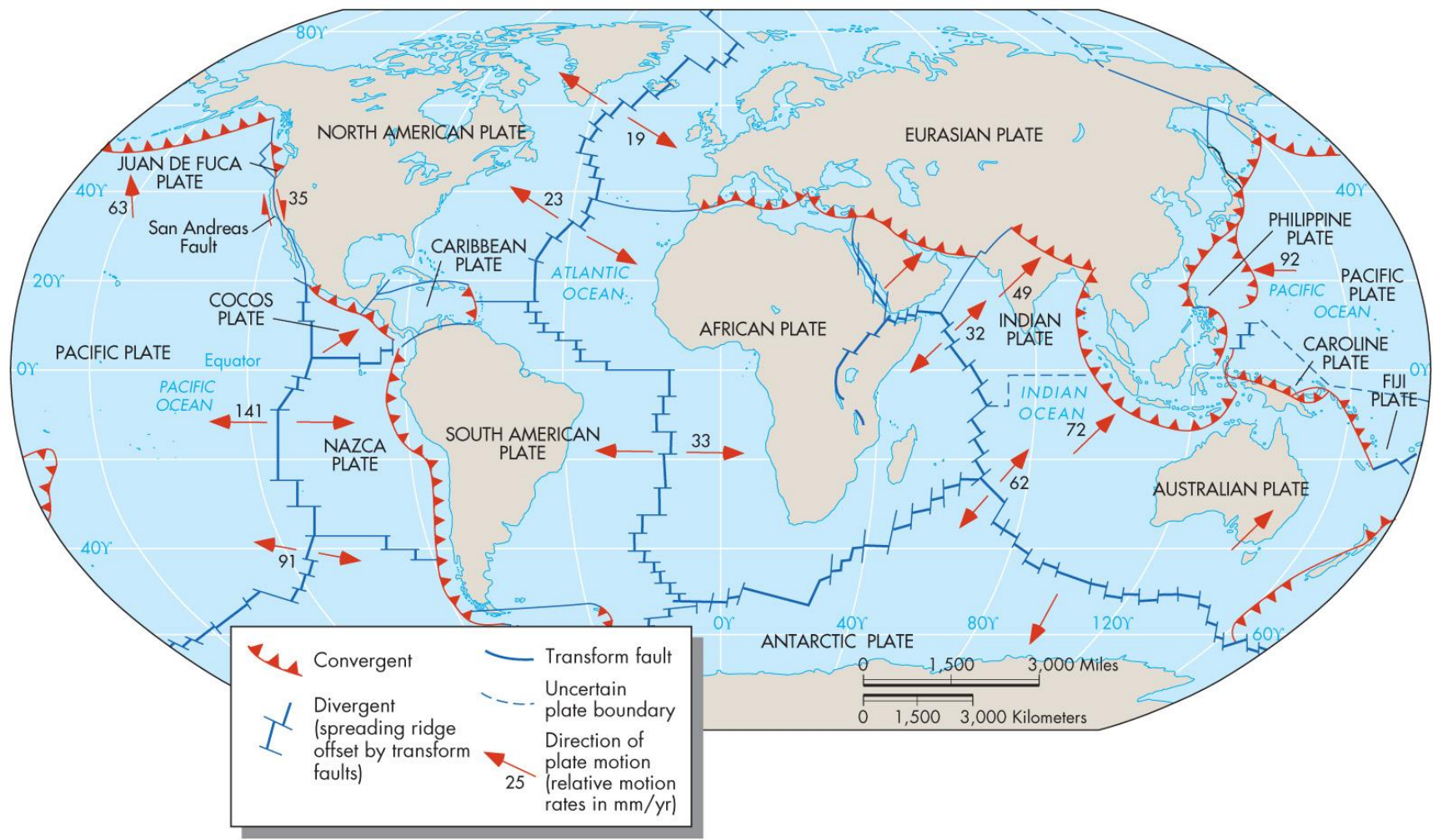
**TABLE 1.1** Effects of Selected Hazards in the United States

Hazard	Deaths per Year	Occurrence Influenced by Human Use	Catastrophe Hazard Potential
Flood	86	Yes	High
Earthquake <sup>1</sup>	50 + ?	Yes	High
Landslide	25	Yes	Medium
Volcano <sup>1</sup>	<1	No	High
Coastal erosion	0	Yes	Low
Expansive soils	0	No	Low
Hurricane	55	Perhaps	High
Tornado and windstorm	218	Perhaps	High
Lightning	120	Perhaps	Low
Drought	0	Perhaps	Medium
Frost and freeze	0	Yes	Low
Heatwave	10s to 100s	Yes	High
Wildfire <sup>2</sup>	<10	Yes	High
Extraterrestrial impact	0	No	Very High

<sup>1</sup>Estimate based on recent or predicted loss over 150-year period. Actual loss of life and/or property could be much greater.

<sup>2</sup>Deaths mostly firefighters.

Source: Modified after White, G. F., and Haas, J. E. 1975. Assessment of research on natural hazards. Cambridge, MA: MIT Press.



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Figure 1.8

# Fundamental Concepts for Understanding Natural Processes as Hazards



1. Hazards are predictable from scientific evaluation.
2. Risk analysis is an important component in our understanding of the effects of hazardous processes.
3. Linkages exist between different natural hazards as well as between hazards and the physical environment.
4. Hazardous events that previously produced disasters are now producing catastrophes.
5. Consequences of hazards can be minimized.

# 1. Hazards are Predictable



- Basis of science is explanation.
- Geologists observe hazardous events and form a possible explanation.
  - From this explanation, a hypothesis is formed.
  - Data is taken to test a hypothesis.
- This is the basis of the **scientific method**.

# Hazards are Natural Processes



- They are a result of natural forces.
- They become hazardous when they interfere with human activity.
- These process are NOT within our control.
  - Or maybe *should* not be
- Best solution is preparation.

# Forecast & Prediction



- **Prediction**
  - Specific date, time, and magnitude of event (ex: hurricane)
- **Forecast**
  - Range of probability for event (ex: ice storm)
- Some hazards can be predicted, most can be forecasted.

# Hazard Reduction



- Identify the location of probable event
- Determine probability of event
- Observe precursor events
- Forecast or predict event
- Warning the public

## 2. Risk Assessment



- **Risk** = (probability of event) x (consequences)
- Consequences: damages to people, property, economics, etc.
- **Acceptable risk** is the amount of risk that an individual or society is willing to take.

# 3. Links



- Hazards are linked to each other.
  - Some events may cause others.
    - Example: Earthquakes and landslides
- Physical environment is linked to hazards.
  - Example: Some rock types are prone to subsidence.

# 4. Disasters are Now Becoming Catastrophes



- Concentration of population creates greater loss of life in disaster (ex: Bangladesh and typhoons)
- Human population growth puts greater demand on Earth's resources (ex: water scarcity and drought)
- Land use affects magnitude and frequency of events (ex: New Orleans – large population below sea level)

# 5. Consequences Can Be Minimized



- Move from **reactive response**: Recovery and restoration (worst-case example = Katrina)
- To an **anticipatory response**: Avoiding and adjusting to hazards
  - Land-use planning
  - Building codes
  - Insurance
  - Evacuation
  - Disaster preparedness
  - Artificial control

# Benefits of Hazards



- There are some benefits to hazards.
- Examples:
  - Flooding provides nutrients for soil.
  - Landslides form dams to create lakes.
  - Volcanoes create new land.

**End**

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The Science of Natural Disasters  
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