Describing the Hazards



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Pacific Disaster Center

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Asia-Pacific Economic Cooperation

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Session Overview

- Provide an overview of key hazards and their characteristics
- Discuss hazard profiling
- Identify data and information sources for hazard assessment.
- Discuss anticipated influence of climate change and variability on hazard impacts.
- *Activity*

Describing the Hazards

KEY HAZARDS & THEIR CHARACTERISTICS

Describing Hazards

- Hazard Strength and Severity
  - Intensity or magnitude is assigned to many hazards to describe strength or severity and to assist in characterizing the types of impacts or damages that may result

Describing Hazards

- Hazard Frequency and Probability of Occurrence
  - Describes how often a hazard has occurred in the past
  - Describes how often a hazard of a specified intensity or magnitude is likely to occur
  - Probability of occurrence is based largely upon historical record
  - Probability is different from seasonal predictions or forecasts

Describing Hazards

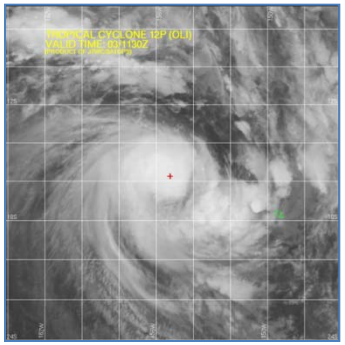
- Hazard Zones
  - Each hazard has unique characteristics that determine where they might occur
  - Topography or proximity to geographic features can influence where hazards occur
  - May be defined by historical records, expert opinion, community mapping or numerical modeling

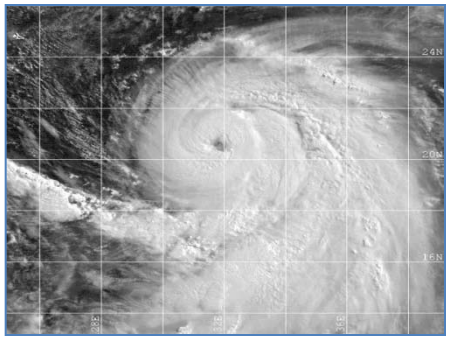
Overview of Hazards

- Tropical cyclones
- Floods
- Earthquakes
- Landslides

Tropical Cyclones

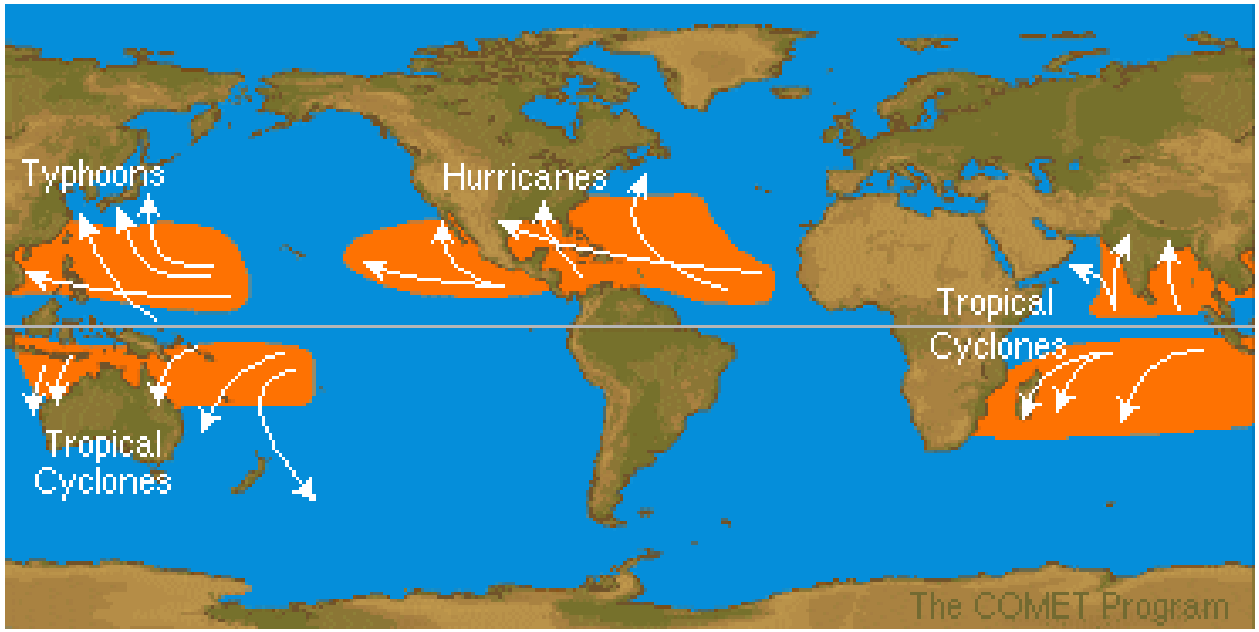
- “Tropical cyclone” – a general term referring to all cyclonic circulations that originate over tropical waters.
- Warm ocean water (26°C or 80°F) supplies thermal energy.
- Rotational circulation around a low pressure center.





Tropical Cyclone Formation (Continued)

- The terms “typhoon,” “hurricane,” and “cyclone” are regionally specific names for a severe tropical cyclone with sustained winds of 119 km/hr (74 mph, or 64 knots) or greater.



http://www.comet.ucar.edu/nsflab/web/hurricane/312.htm

Tropical Cyclone Designations

- Designations vary according to maximum sustained wind speeds:

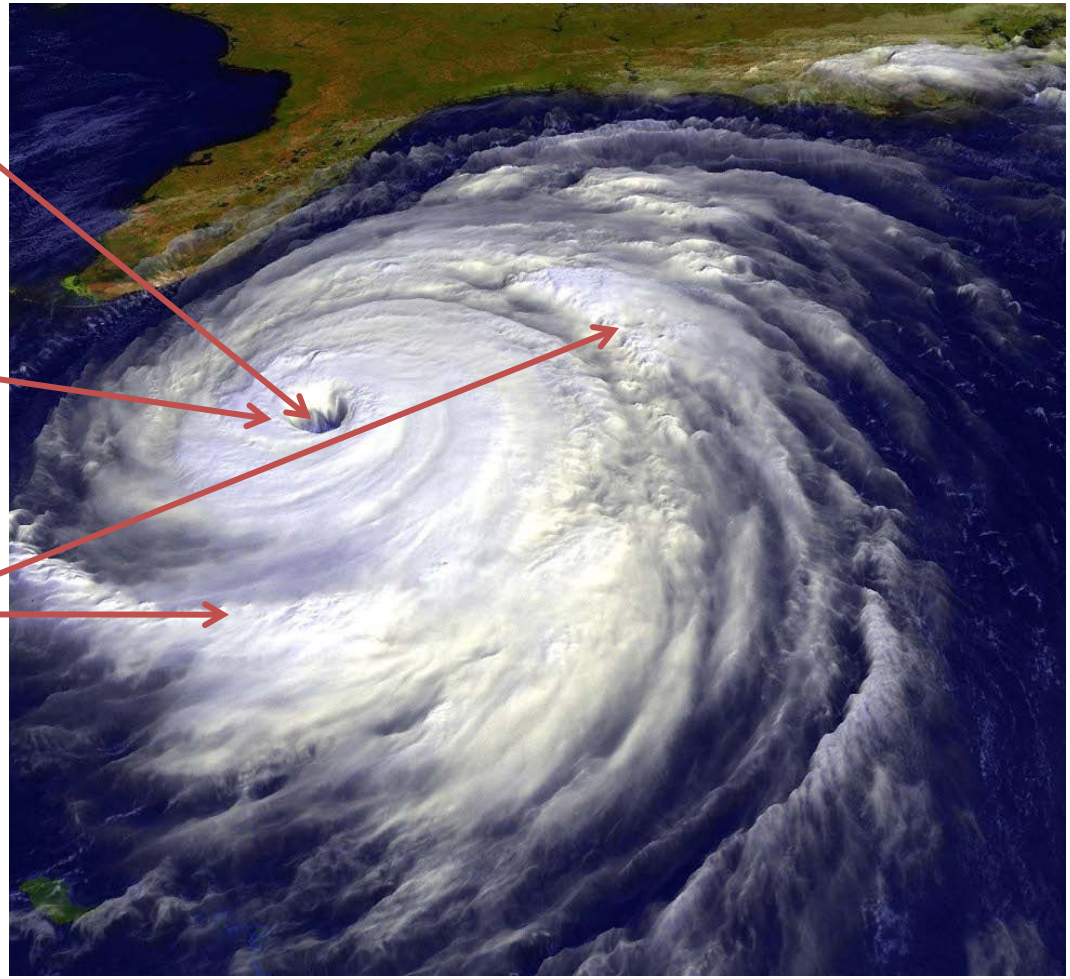
Tropical Cyclone Designations	Maximum Sustained Wind Speeds
Tropical Depression	Less than 34 knots
Tropical Storm	34 knots to 64 knots (assigned a name)
Typhoon / Hurricane	64 knots to 130 knots
Super Typhoon	130 knots and higher

Saffir-Simpson Scale

Category	Wind Speed	Storm Surge	Description of Damages
Cat 1	74-95 mph (64-82 kt or 119-153 km/hr).	Storm surge generally 1.2 – 1.5 m (4-5 ft) above mean sea level.	No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Some damage to poorly constructed signs. Some coastal road flooding and minor pier damage.
Cat 2	96-110 mph (83-95 kt or 154-177 km/hr).	Storm surge generally 1.8 – 2.4 m (6-8 feet) above mean sea level.	Some roofing material, door, and window damage of buildings. Considerable damage to shrubbery and trees. Considerable damage to mobile homes, poorly constructed signs, and piers.
Cat 3	111-130 mph (96-113 kt or 178-209 km/hr).	Storm surge generally 2.7 – 3.7 m (9-12 ft) above mean sea level.	Some structural damage to small residences and utility buildings. Damage to shrubbery and trees with large trees blown down. Mobile homes and poorly constructed signs destroyed. Flooding near the coast destroys smaller structures with larger structures damaged by battering from floating debris.
Cat 4	131-155 mph (114-135 kt or 210-249 km/hr).	Storm surge generally 4 - 5.5 m (13-18 ft) above mean sea level.	More extensive curtain wall failures with some complete roof structure failures on small residences. Shrubs, trees, and signs are blown down. Complete destruction of mobile homes. Extensive damage to doors and windows.
Cat 5	Greater than 155 mph (135 kt or 249 km/hr).	Storm surge generally greater than 5.5 m (18 ft) above mean sea level.	Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. All shrubs, trees, and signs blown down. Complete destruction of mobile homes. Severe and extensive window and door damage.

Typhoon/Hurricane Characteristics

- Eye of the storm
  - Low pressure
  - Calm winds
- Eye wall
  - Strongest winds
- Spiral rain bands
  - Heaviest precipitation



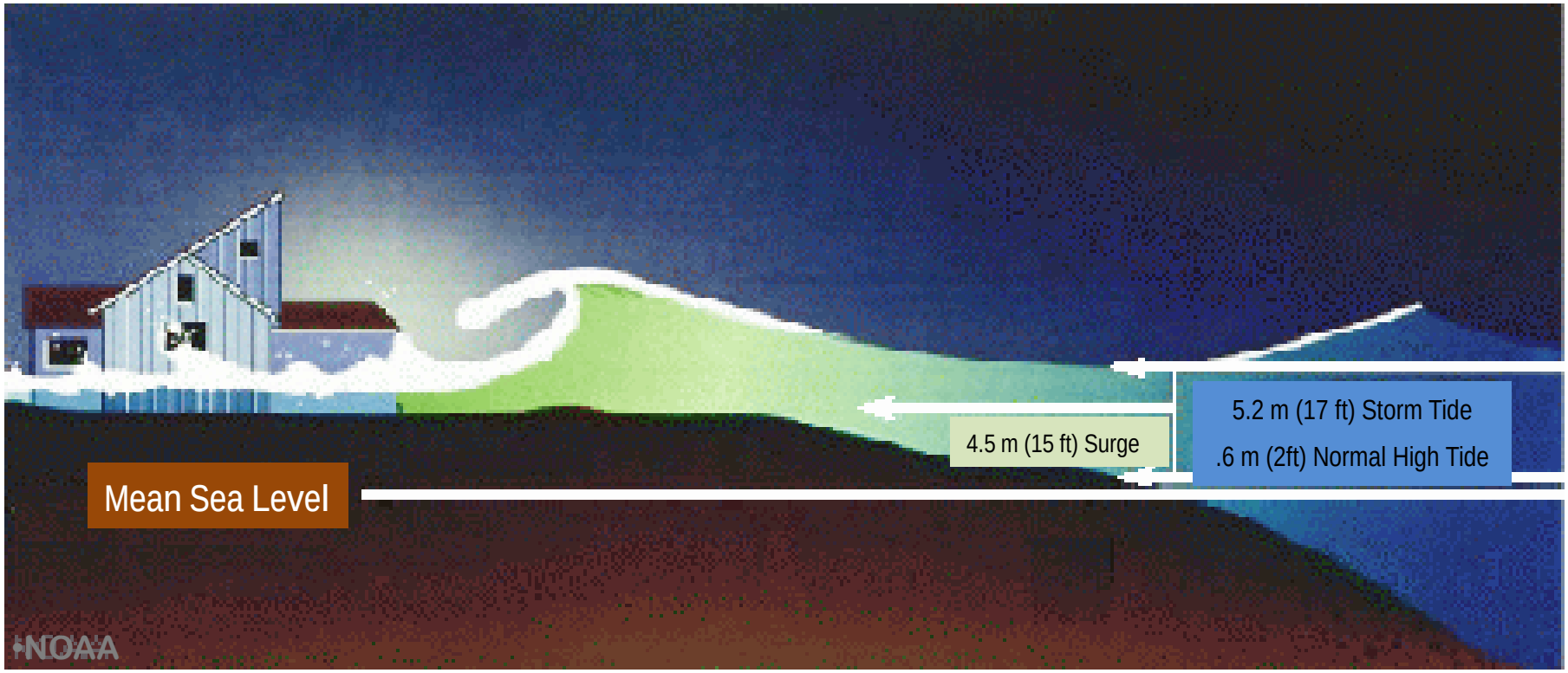
Typhoon/Hurricane Characteristics

- Movement is guided by surface winds, other weather systems, and warm ocean currents.
- Typhoons lose strength due to a number of factors:
  - Landfall
    - loses source of warm water
    - friction with terrain features
  - Wind shear, or strong winds at high altitudes.
  - Movement into region of cooler water.
  - May pull in drier, cooler air from its surroundings.

Tropical Cyclone Impacts

- Damage and losses due to:
  - high winds
  - heavy rainfall
  - flooding
  - large breaking waves and high seas
  - storm surge

Tropical Cyclone Impacts



Storm Surge Illustration

Tropical Cyclone Impacts

Before…

A.

…After

B.

Storm Surge

Flooding

- Flooding
  - Generally defined as the overflow of water into areas that are typically dry; a natural and recurring event for a river or stream.

Describing the Flood Hazard

- Type of flood
- Magnitude
- Cause of flooding

Describing the Flood Hazard

- Types of Floods
  - Flash floods
  - Dam break or Levee failure
  - Urban flooding
  - Riverine flooding
  - Coastal flooding
- Magnitude
  - often expressed as “10-year,” “25-year,” or “100-year flood;” (100-year flood terminology describes a flood that has a 1% chance of occurring in any given year).

Describing the Flood Hazard

- Causes of flooding
  - Heavy rainfall (due to weather systems including monsoon, tropical cyclones)
  - Snow melt
  - Dam or levee break
  - Stream overflow
  - Wave action in coastal areas

Conditions Contributing to Floods

- Seasonality
- Rate of precipitation
- Topography
- Ground conditions
- Vegetation

Impacts of Flooding

- Damage to infrastructure, homes and property.
- Loss of life.
- Landslides
- Mudslides
- Levee breaks
- Saltwater intrusion

Earthquakes

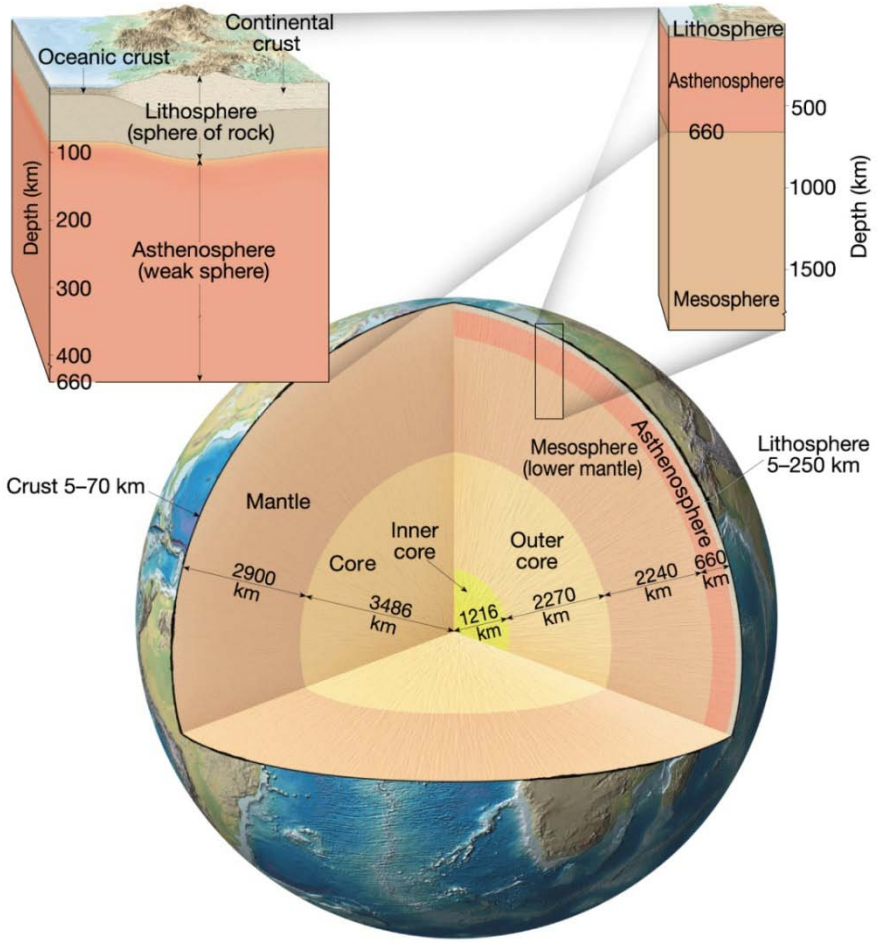
- Earthquakes
  - Defined as *a trembling or shaking of the ground caused by the sudden release of energy stored in the rocks beneath the earth's surface*.
  - Occur on a daily basis
    - Many not felt; some highly destructive
  - *Seismology* is the study of earthquakes, a science that seeks to understand the nature, effects, and prediction of this hazard.

Earthquakes

Earth's Layered Structure

• Most earthquakes originate in the earth's *lithosphere*:

- The solid, rocky, outer part of the earth, approximately 100 kilometers thick.



Causes of Earthquakes

- Through the action of geologic forces, strain builds up in the lithosphere and causes fracturing of rock formations. These fractures are referred to as *faults*.
- Movement along faults occurs suddenly, as the friction between rock faces is overcome.
- Some faults are more active than others.

Causes of Earthquakes (Continued)

- Fault movement is especially active along *plate boundaries* (narrow zones between plates)
  - Volcanic activity is also prevalent along plate boundaries.

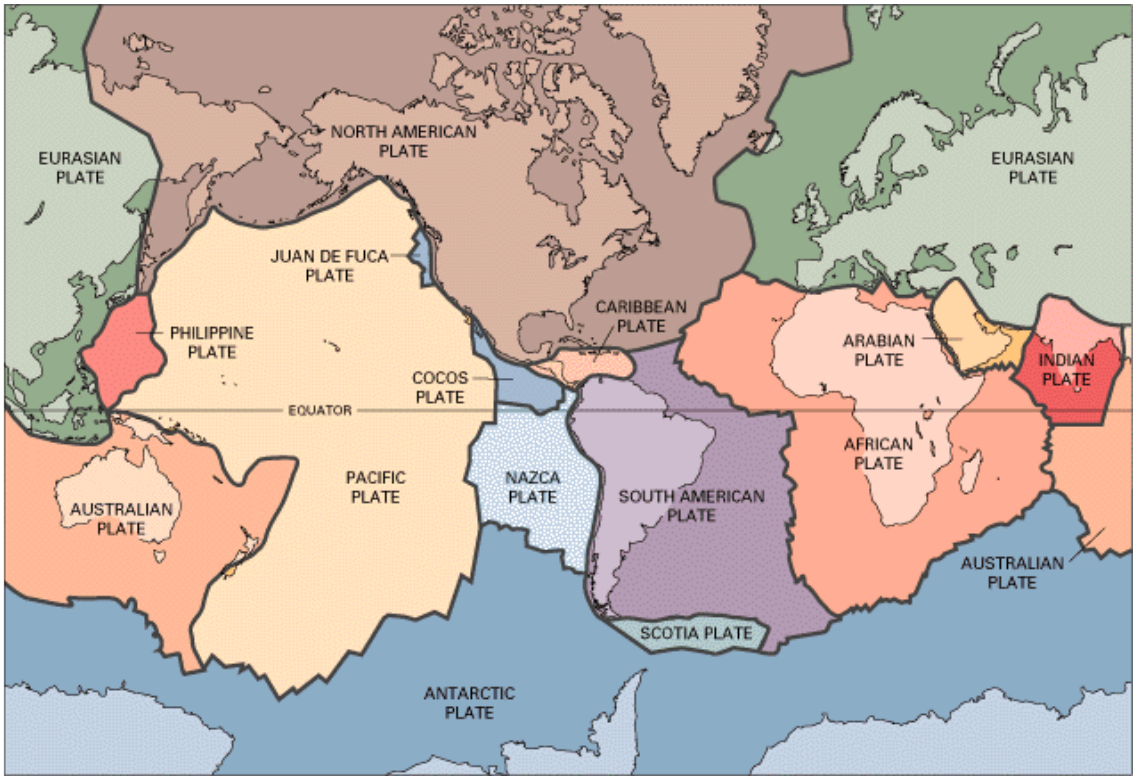
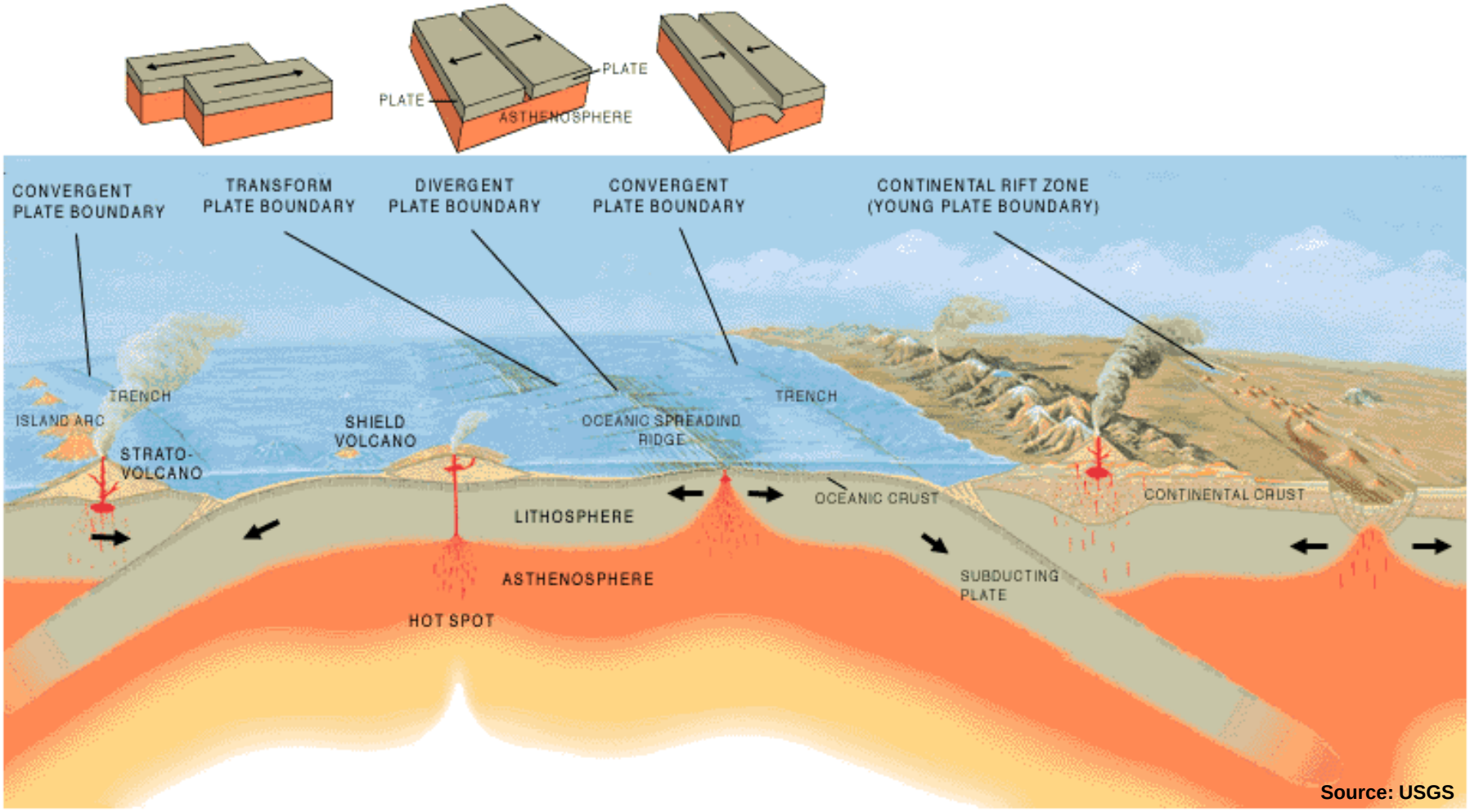


Plate Boundaries

- Four Types:
  - *Divergent* – new crust is generated as plates pull away from each other.
  - *Convergent* – crust is destroyed as one plate dives under another.
  - *Transform* boundaries – crust is neither produced nor destroyed as plates slide horizontally past each other.
  - *Plate boundary zones* – broad belts in which boundaries are not well defined and the effects of plate interaction are unclear.

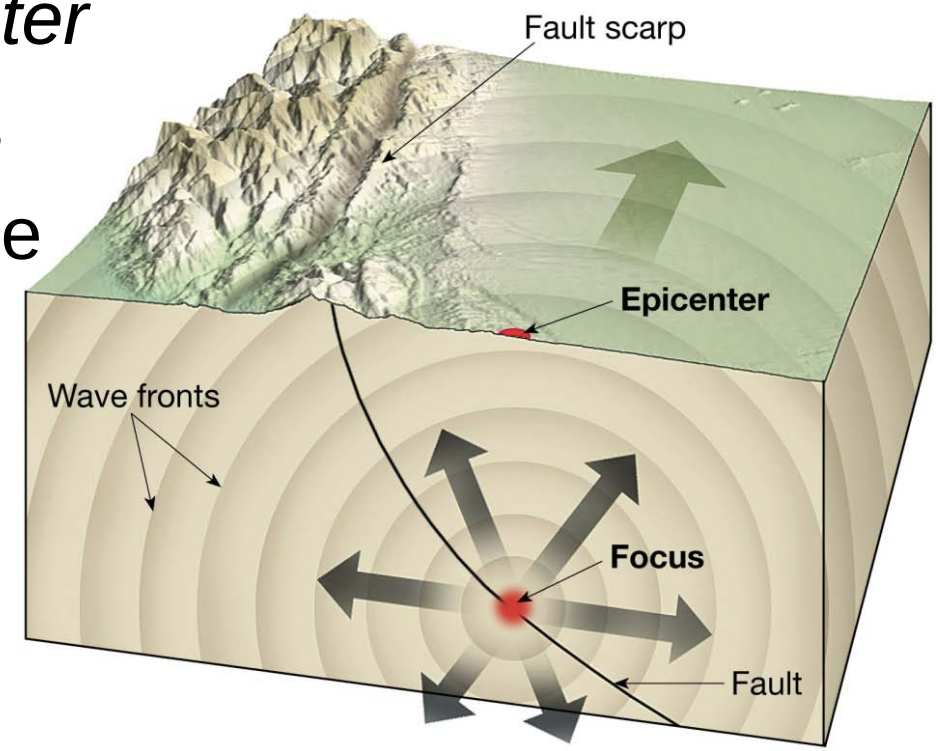
Plate Boundaries (Continued)



Source: USGS

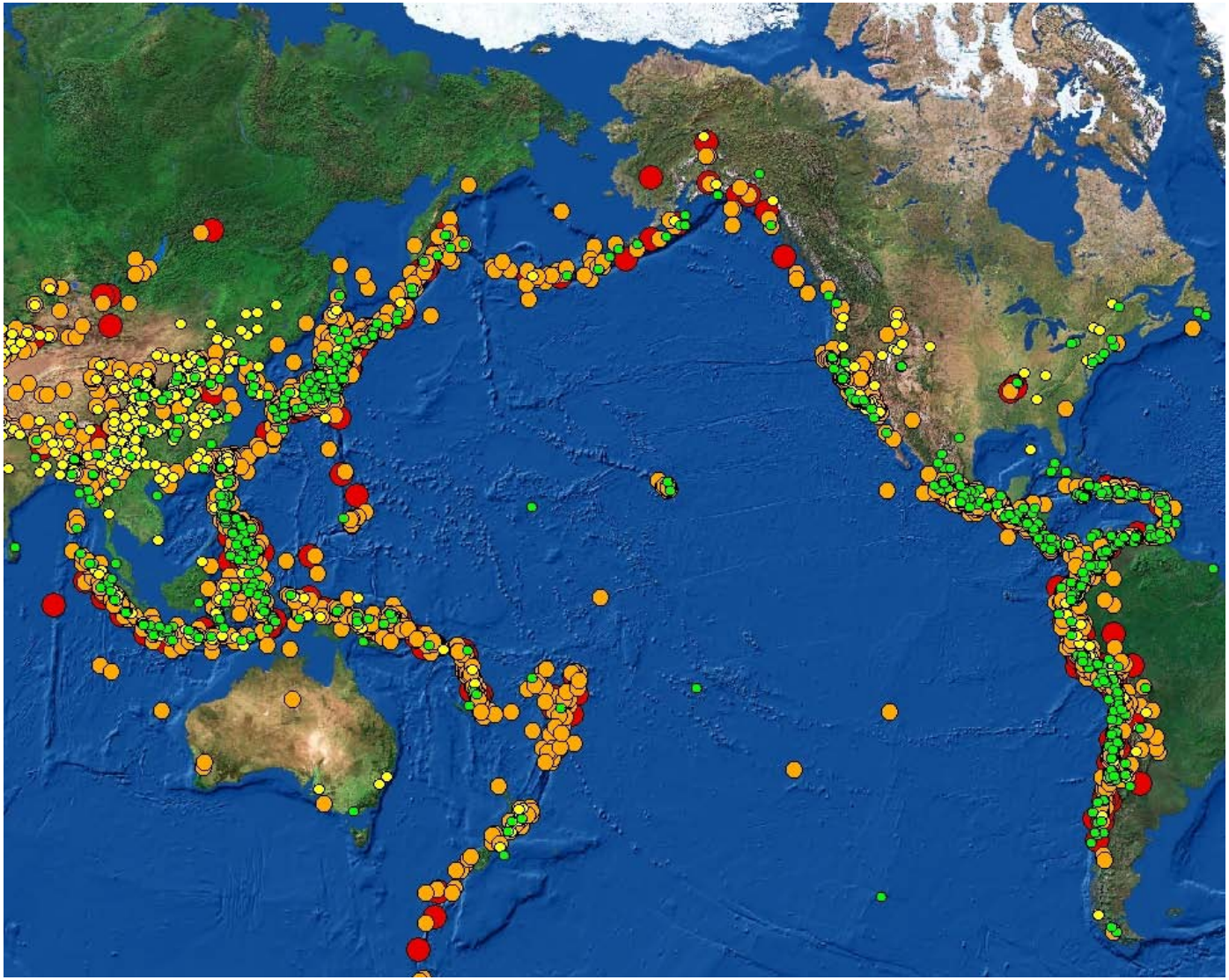
Earthquake Focus and Epicenter

- The earthquake *focus* is the point within the earth where seismic waves originate.
- The earthquake *epicenter* is the point at the earth's surface directly above the focus.



Circum-Pacific Ring

http://www.pdc.org/atlas/



Describing Earthquakes

- The “strength” of an earthquake is measured in terms of:
  - *Intensity* – the degree of shaking at a given location based on perceived damage.
  - *Magnitude* – the amount of energy released at the earthquake source.

Describing Earthquakes (Continued)

- Intensity scale:
  - Modified Mercalli Intensity (MMI) Scale
    - Tends to be more descriptive to the non-scientist than magnitude because it describes effects perceived by people and observed damage to buildings.
    - Uses Roman numerals ranging from I to XII.

MMI Scale Descriptions

MMI Level	Description
I	Not felt except by a very few persons under especially favorable conditions.
II	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing vehicles may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sounds. Sensation like heavy truck striking building. Standing vehicles rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Describing Earthquakes (Continued)

- Magnitude Scales:
  - Richter
    - Based on the amplitude of the largest seismic wave recorded.
    - Uses a base-10 logarithmic scale where each whole number increase in magnitude represents: 1) a tenfold increase in wave amplitude; and 2) an increase of approximately 31 times the amount of energy released.
  - Moment Magnitude
    - The measure of total energy released by an earthquake.
    - Calculated in part by multiplying the area of the fault's rupture surface by the distance the earth moves along the fault.

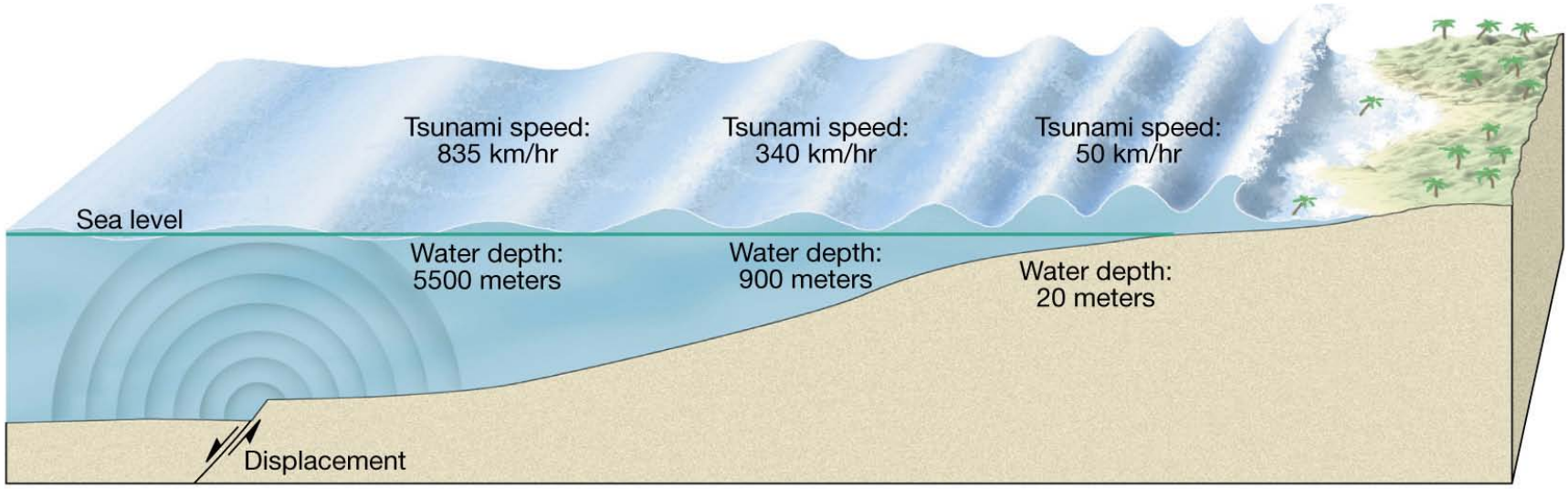
Effects of Earthquakes

- Ground motion can collapse buildings and elevated roadways, break pipes, and knock down power lines.
- Liquefaction.
- Aftershocks.
- Fires.
- Permanent displacement of land surface.
- Tsunamis (seismic sea waves).

Tsunamis or Seismic Sea Waves

- Result from vertical displacement along a fault located on the ocean floor or a large undersea landslide triggered by an earthquake.
- In the open ocean height is usually < 1 meter.
- In shallower coastal waters the water can pile up to heights over 30 meters.

Illustration of a Tsunami



Landslides

- *Landslide* – a general term used to describe the downslope movement of soil, rock, and organic materials under the effects of gravity and also the landform that results from such movement.

Landslide Triggers

- Natural causes include:
  - Water
  - Seismic activity
  - Volcanic activity
  - Flooding (precipitation, runoff, and soil saturation are key factors in the failure of steep or unstable terrain).
- Human activities include:
  - Excavation
  - Deforestation
  - Irrigation
  - Mining
  - Water leakage from utilities

Landslide Impacts

- Localized events; often secondary to, or triggered by other hazards such as floods, earthquakes, or volcanic activity.
- Impacts:
  - Physical damage to buildings and infrastructure.
  - Environmental degradation.
  - Loss of life.
  - Disruption or closure of major transportation routes.

Describing Landslides

- Landslides are classified according to *type of material* and *type of movement*:
  - Material
    - Rock
    - Earth – sand-sized, fine soil particles
    - Debris – coarse fragments of soil
  - Movement
    - Fall
    - Topple
    - Slide
    - Spread
    - Flow

Describing the Hazards

HAZARD PROFILING

Hazard Profiling

- Part of the Hazard Assessment Process
  - Step 1: Identify the Hazards
  - Step 2: Develop a Hazard Profile

Identify the Hazards

- What hazards are likely to affect your community?
  - Consider all types of hazards (natural and technological).
  - Examine historical information and existing analyses.
  - Consider influence of climate change and variability.

Why Develop a Hazard Profile?

- Hazard profiles answer the:
  - What?
  - Where?
  - How often?
  - How bad could it be?
- Assist you in developing codes and policies to better manage your resources.

What Does a Hazard Profile Contain?

- For *each* hazard:
  - Frequency of Occurrence
    - *How often does it, or is it likely to occur?*
  - Probability of occurrence of particular event magnitudes
    - *Are some occurrences more severe than others? How often might these occur?*
  - Maximum Likely Magnitude and Potential Intensity
    - *How bad could it be?*

What Does a Hazard Profile Contain? (Continued)

- Location
  - *Where is it likely to occur?*
- Probable Spatial Extent of particular event magnitudes
  - *Where might worst affected areas be?*
  - *How large of an area is likely to be affected?*
- Duration
  - *How long can it be expected to last?*

What Does a Hazard Profile Contain? (Continued)

- Seasonal Pattern (if any)
  - *At what time of year is it more likely to occur?*
- Speed of Onset
  - *How fast or slow is the hazard likely to develop?*
- Potential Impacts and Associated Hazards
  - *What impacts are likely to occur?*

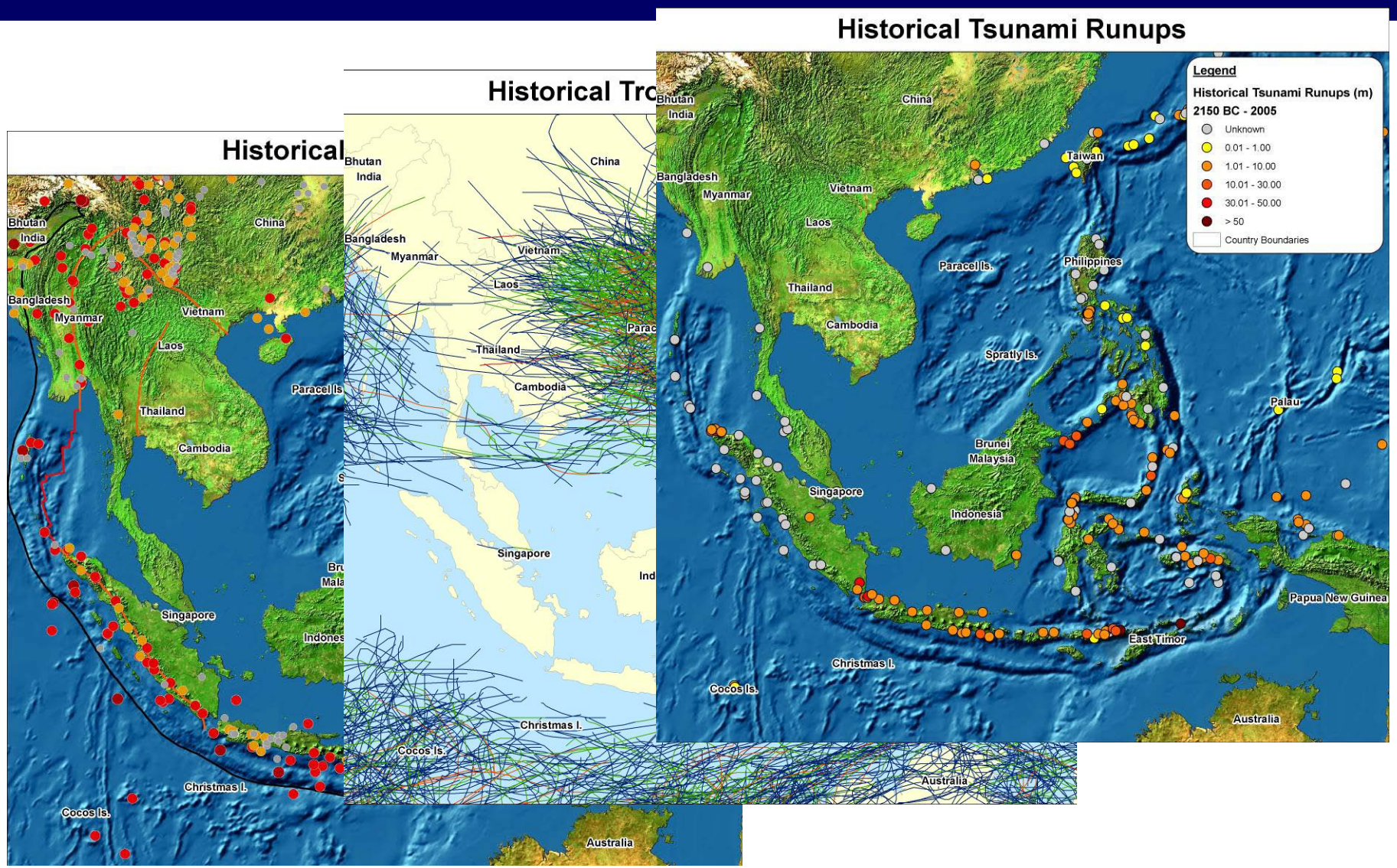
Hazard Profiles

- Provide useful summaries of historical hazard information
- Assist with planning processes
- Justify mitigative actions
- Promote hazard awareness
- Inform communities of specific hazard preparedness actions

Hazard Profile Example

Hazard Type	Potential Impacts	Count	Time Period (years)	Frequency (% chance per year)	Probability of Occurrence	Estimation of Accumulated Losses ($)
Droughts	• Water rationing • Food shortage • Cannery closures • School closures • Groundwater depletion • Depletion of wells and catchment • Economic recession	3	24	12.5%	High	
Earthquakes	• Damage to infrastructure and buildings • Injuries, loss of life	1	450	0.2%	Low	
Floods	• Damage to roads, homes, businesses • Loss of access to emergency services • Inundation of urban and low-lying areas • Erosion • Landslides • Power failures	4	36	11%	High	$9,525,000
Landslides	• Injuries, loss of life • Loss of access to emergency services • Property loss • Blocked or damaged roads, buildings • Liquefaction of fill soil types. • Amplified ground shaking of unconsolidated soils.	5	24	20.8%	High	
Tropical Cyclones (including storm surge)	• Flooding rainfall • High wind damage to infrastructure and buildings • High surf, storm surge, coastal erosion	8	32	25%	High	$105,000,000
Tsunamis	• Inundation of low-lying areas • Injuries, loss of life • Damage to buildings and infrastructure • Coastal erosion	2-3	50	4% to 6%	Medium	

Developing a Hazard Profile



Describing the Hazards

CLIMATE CHANGE INFLUENCE ON HAZARDS

Terms and Concepts

- *Climate Change*
  - Defined by the Inter-governmental Panel on Climate Change (IPCC) as, “a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forces, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.” (UNISDR)

Terms and Concepts (Continued)

- Put in simpler terms, *climate change* is:
  - "A change in the climate that persists for decades or longer, arising from either natural causes or human activity." (UNISDR)

Terms and Concepts (Continued)

- *Climate Variability*
  - Refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability). (IPCC)

Observable Changes in Earth's Global Environment

- Oceans absorbing more CO_2 (↑pH).
- Increase in global average surface air temperature.
- Change in amount, intensity, frequency, and type of precipitation.
- Increased rate of sea level rise.
- Global decline of glaciers and ice sheets.

Climate Modeling

- Climate modeling: How will climate change impact the future global environment?
  - Incorporates observational data
  - Scenario development
    - IPCC Special Report on Emissions Scenarios (SRES)
    - Represents a starting point…

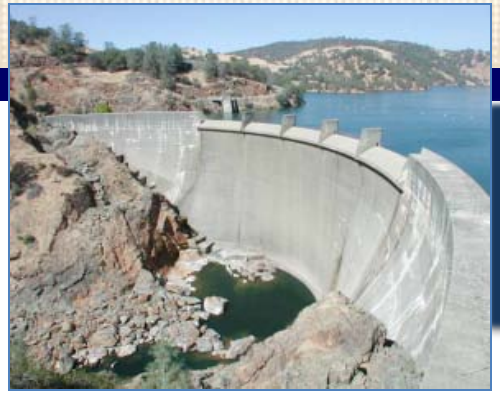
Climate Modeling Predictions

- Human-caused emissions of heat-trapping gases will cause further warming in the future.
- Substantial shifts in the patterns of precipitation are expected.
- Currently rare events will become more common. Intensity of certain events will increase.

Climate Modeling Predictions (Continued)

- Sea level in the world's oceans is projected to rise "from 8 inches to 2 feet by the end of this century."
- Abrupt climate changes may occur, particularly with respect to drought, ice sheet collapse, release of methane from thawing frozen soils, and changes in ocean circulation.

Why Climate Change Matters



Impacts

- Air Quality
  - Water
- Ocean Life & Ecosystems
  - Weather (Extreme Events)
- Sustainable Food
  - Security
- Coastal Inundation
  - And Many Others

Courtesy: E. Shea

Climate Change Influence on Hazard Occurrences

- Temperatures are rising
  - Increased risk of more intense, more frequent, and longer-lasting heat waves.
- Precipitation patterns are changing
  - Shifts in where and how precipitation falls.
    - Changes in drought frequency and duration.
    - Changes in flood frequency and severity.
    - Impacts to water resources.

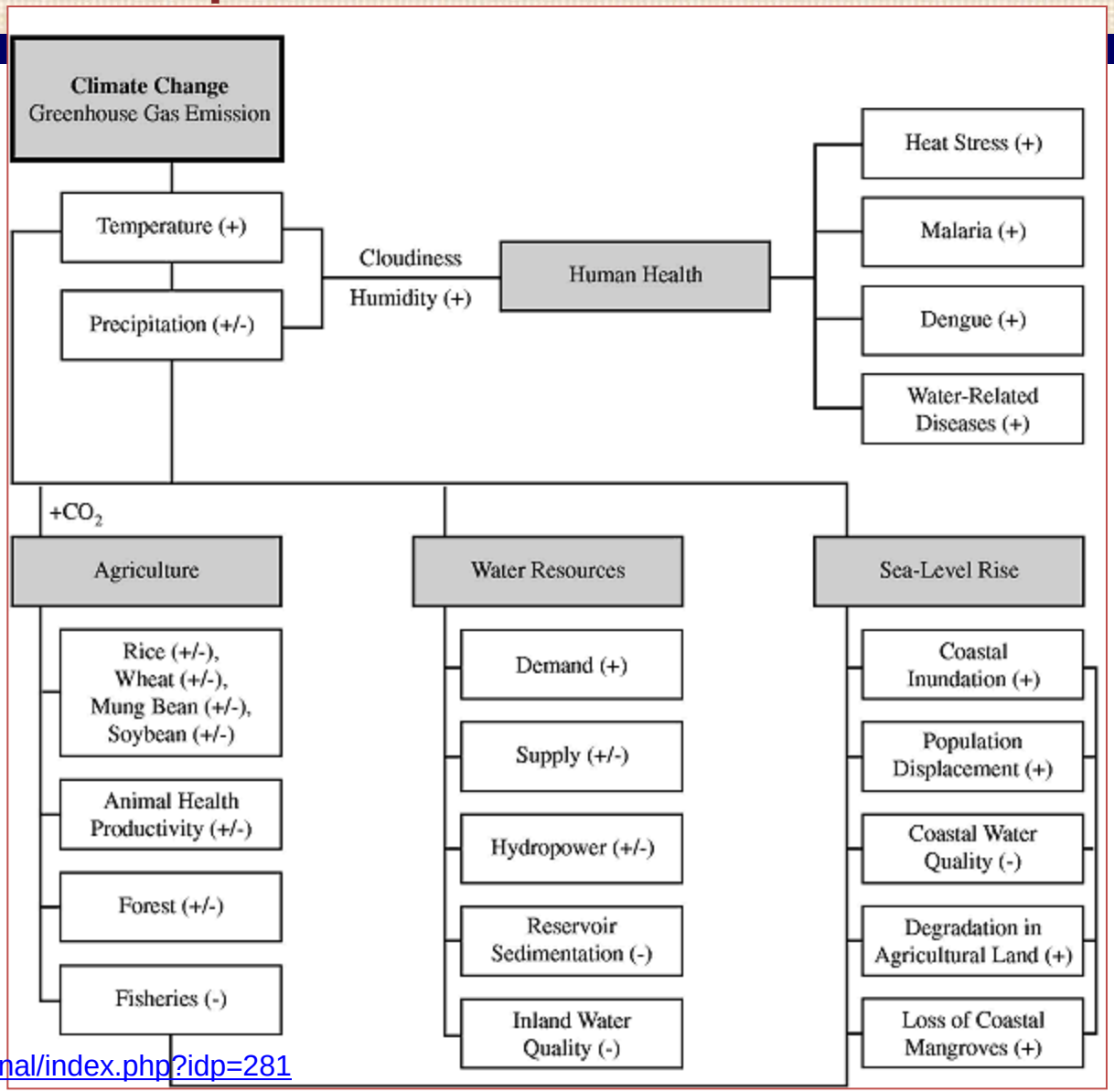
Climate Change Influence on Hazard Occurrences (Continued)

- Sea level is rising
  - Inundation of low lying coastal areas
  - Saltwater intrusion
- Currently infrequent “extreme” events are becoming more common
  - Projections:
    - Tropical cyclones more intense, more rainfall.
    - Storms outside tropics, less prevalent, but more intense wind and waves.

Possible Climate Change Related Impacts in Tropical Asia

+ = projected increase

– = projected decrease



Source: IPCC

http://www.ipcc.ch/ipccreports/sres/regional/index.php?idp=281

Describing the Hazards

DATA COLLECTION & INFORMATION SOURCES

Hazard Related Attribute Data

- Hazard Accounts (past, present and future)
- Location / Affected Area(s)
- Magnitude or Intensity
- Timing and Duration
- Associated Losses and Impacts

Hazard Information Sources

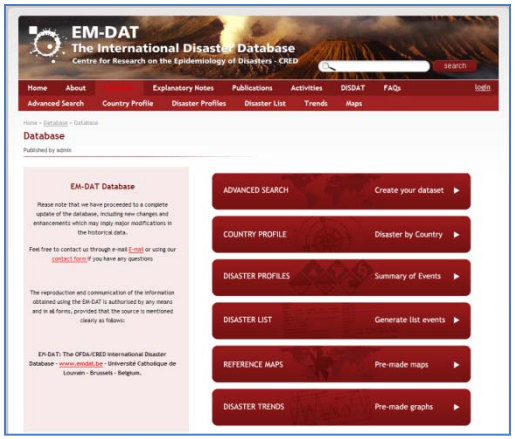
- Hazard Mitigation Plans
- Newspapers
- Regional reports/studies
- Personal interviews
  - Government agency representatives
  - Subject matter experts
  - GIS User Groups
  - Residents (oral history)

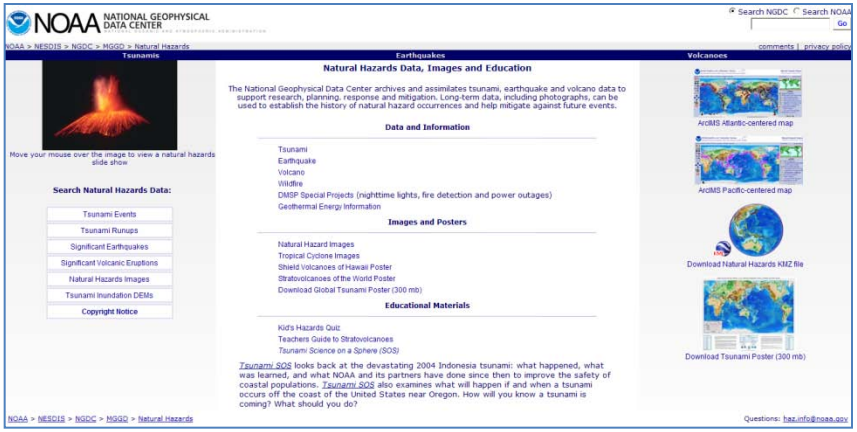
Hazard Information Sources

- Internet resources
  - Online Databases
    - EMDAT/CRED:

      http://www.emdat.be/database
    - NOAA/NGDC:

      http://www.ngdc.noaa.gov/hazard/hazards.shtml





Hazard Information Sources

- Internet resources
  - Map viewers
    - PDC: http://www.pdc.org/atlas/

Source	Description	Link
CIESIN Columbia University World Data Center for Human Interactions in the Environment	Provides access to geophysical and environmental data to all scientists free of charge or for the cost of reproduction. Promotes the development, dissemination, and preservation of high-quality global data sets related to population, sustainability, poverty, health, hazards, conservation, governance, and climate.	http://sedac.ciesin.columbia.edu/wdc/about.jsp
CRED/EM-DAT	EM-DAT contains essential core data on the occurrence and effects of over 18,000 mass disasters in the world from 1900 to present. The database is compiled from various sources, including UN agencies, non-governmental organizations, insurance companies, research institutes and press agencies.	http://www.emdat.be/
National Geophysical Data Center (NGDC) Natural Hazards	The National Geophysical Data Center archives and assimilates tsunami, earthquake and volcano data to support research, planning, response and mitigation.	http://www.ngdc.noaa.gov/hazard/
Prevention Web Global Risk Data Platform	Global Risk Data Platform is a multiple agencies effort to share spatial data information on global risk from natural hazards. Users can visualize, download or extract data on past hazardous events, human & economical hazard exposure and risk from natural hazards.	http://www.preventionweb.net/english/maps/index.php
UNEP GEO Data Portal	The GEO Data Portal is the authoritative source for data sets used by UNEP and its partners in the Global Environment Outlook (GEO) report and other integrated environment assessments.	http://geodata.grid.unep.ch/

Describing the Hazards

PERSONAL APPLICATION

QUESTIONS?

Acknowledgements

Describing the Hazards

- **Contributing Authors**
  - Sharon Mielbrecht, Pacific Disaster Center
  - Heather Bell, PhD, Pacific Disaster Center

- **Published Source Materials**
  - Pacific Disaster Center. 2010. Course materials developed for the Ministry of Agriculture and Rural Development (MARD) Natural Disaster Risk Management Project: Education and Training Program. Hanoi, Vietnam, March-May 2010.
  - Karl, Thomas R., Jerry M. Melillo, and Thomas C. Peterson, (eds.), *Global Climate Change Impacts in the United States*. Cambridge University Press, 2009.
  - Intergovernmental Panel on Climate Change (IPCC) website (accessed September 2010): http://www.ipcc.ch/ipccreports/sres/regional/index.php?idp=281
  - Shea, Eileen. 2009. Keynote presentation. First workshop of the International Program on Climate Change and Variability Risk Reduction (IP-CVR), Kihei, Hawaii, October 2009.

Hazard Assessment Worksheets

APEC Workshop on Hazard Mapping and Risk and Vulnerability Assessment

October 19-21, 2010
Grand Formosa Regent Taipei
Chinese Taipei

Part 1: Hazard Identification

This activity is intended to help you begin the hazard assessment process, and is divided into two parts. The first is designed to help you identify the hazards in your community or region and assign a general likelihood of occurrence. The second part offers an opportunity to develop a more detailed profile for one particular hazard (one of those most likely to occur). This activity will require you to work from your current base of knowledge; you are not expected to conduct outside research at this time. Feel free to consult with other participants.

In the table below, list the hazards experienced in your community or region. Next to each listed hazard, place a checkmark or X in the column that best represents the general likelihood of that hazard occurring in your chosen location: likely, possible, or less probable. Select only one answer for each hazard.

HAZARD IDENTIFICATION & PRELIMINARY ASSESSMENT			
Community Name:			
Hazard	**Likely**	**Possible**	**Less Probable**
EXAMPLE: SNOW STORM / BLIZZARD			**x**

Part 2: Hazard Profile

The second step of a hazard assessment is the hazard profile. Ideally, you would create a profile for each hazard identified in Part 1.

Some considerations to keep in mind when conducting research for hazard profiles:

- Have all possible hazards been considered?
- Is any type of information missing from the hazard profiles?
- Have the characteristics of any of the hazards changed since any previous analyses were done?

When possible, hazard profiles should include the following information about each hazard:

- Frequency of Occurrence (how often the hazard is likely to occur).
- Probability of occurrence of particular event magnitudes.
- Maximum Likely Magnitude and Potential Intensity (how severe the hazard might be).
- Location (where the hazard is likely to occur).
- Probable Spatial Extent of particular event magnitudes (how large an area is likely to be affected).
- Duration (how long the hazard is expected to last).
- Seasonal Pattern (time of year during which the hazard is more likely to occur – remember, not all hazards have seasonal patterns).
- Speed of Onset (how fast the hazard is likely to occur).

In addition, you would ideally want to obtain some information about the losses associated with each hazard. You will need to compile and analyze the data from individual historical events in order to produce these general hazard profiles. Models can help you estimate some of this information as well. The quality of your profiles depends on the quantity and quality of your data. Your results will never exactly represent reality.

Task A: Using the information just completed in the Hazard Assessment above, identify one hazard that is most likely to occur in your chosen area. Complete the sample Hazard Profile Worksheet for the selected hazard.

HAZARD PROFILE WORKSHEET	
COMMUNITY NAME:	
HAZARD MOST LIKELY TO OCCUR:	
POTENTIAL MAGNITUDE *(Percentage of the community that can be affected):* ☐ **Catastrophic:** More than 50%. ☐ **Critical**: 25 to 50%. ☐ **Limited**: 10 to 25%. ☐ **Negligible**: Less than 10%.	
FREQUENCY OF OCCURRENCE: ☐ **Highly likely:** Near 100% probability in next year. ☐ **Likely**: Between 10 and 100% probability in next year, or at least one chance in next 10 years. ☐ **Possible**: Between 1 and 10% probability in next year, or at least one chance in next 100 years. ☐ **Unlikely**: Less than 1% probability in next 100 years.	***SEASONAL PATTERN:***
AREAS LIKELY TO BE MOST AFFECTED (BY GEOGRAPHIC REGION): ***DESCRIBE EFFECTS TO MAJOR SECTORS (e.g., Communications, Transportation, Utilities, Agriculture, Vulnerable Populations, etc.):***	
PROBABLE DURATION:	

POTENTIAL SPEED OF ONSET (Probable amount of warning time): ☐ Minimal (or no) warning. ☐ 6 to 12 hours warning. ☐ 12 to 24 hours warning. ☐ More than 24 hours warning.
EXISTING WARNING SYSTEMS:

Task B: If time permits, when you have completed the Hazard Profile Worksheet, identify other training participants who focused on the same hazard and discuss results to identify anything you may have missed. As a group, discuss the possible secondary hazards associated with your chosen hazard and the impacts these hazards have had on your community. Record your discussions, and be prepared to share your results with the entire group.