Indian Institute of Technology, Kanpur

Department of Earth Sciences

ESO213A: Fundamentals of Earth Sciences

Lecture 31. Natural Hazards - Introduction

Santanu Misra
Department of Earth Sciences
Indian Institute of Technology, Kanpur
smisra@iitk.ac.in ● *http://home.iitk.ac.in/~smisra/*

Aims of this lecture

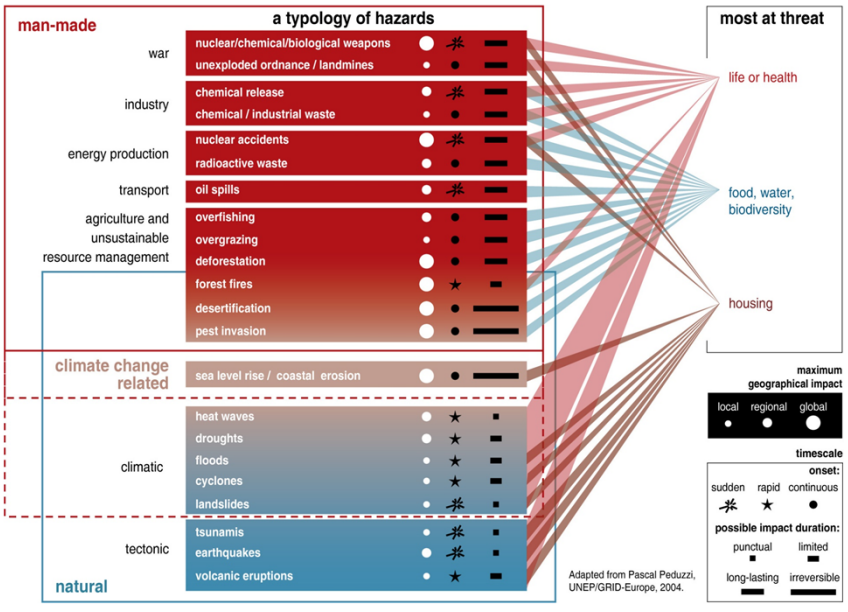
- What is Natural Hazard?
- Some data and Statistics

The concept of Natural Hazards

- "Events associated with normal geological or biological processes and widespread technological accidents that cause death, injury or loss of home, property or income".

The intensity of the hazard may be influenced by human modifications of the landscape (*e.g., deforestation and urbanization influence flood frequency and magnitudes*) or climate (*e.g., heat waves in urban areas*).

The concept of Natural Hazards



Source: Emmanuelle Bournay; UNEP/GRID-Arendal

Classification of Hazards

Natural and anthropogenic accidents may be classified by the inducing factors

Atmospheric factors
Hydrologic factors
Geological factors
Biological factors
Technological Factors
Social violence
Complicated danger factors

The concept of Risk

RISK = HAZARD X VULNERABILITY

Hazard: Natural processes capable of causing death and/or destruction;

Vulnerability: Social or economic sensitivity to the effects of hazards

The concept of Risk

Example 1: same hazard; contrasting vulnerabilities

Magnitude 6.5 earthquake in south-central California, on Dec. 22, 2003: 7 dead, ~50 injured because the event occurred in a thinly inhabited area (low risk event).

Magnitude 6.5 earthquake in city of Bam (Iran) on Dec. 26, 2003: ~40,000 dead, ~30,000 injured; much of the city destroyed (very high risk event).

The concept of Risk

Example 2: contrasting hazards; same risk

Severe snowfall in the Lower Mainland, British Columbia

Annual risk ($) = $P_{blizzard}$ X Cost*
= 0.1 X $10 M? = $1 M

"Tunguska" asteroid impact in the Lower Mainland, British Columbia (1908)

Annual risk ($) = P_{impact} X Cost*
= 0.000001 X $100 M? = $1 M

*Costs = deaths, injuries, building collapse, rescue, cleanup, lost production, rebuilding, etc.
(often very difficult to assign a dollar value).

The concept of Risk

Combating Risk

Pre-Event

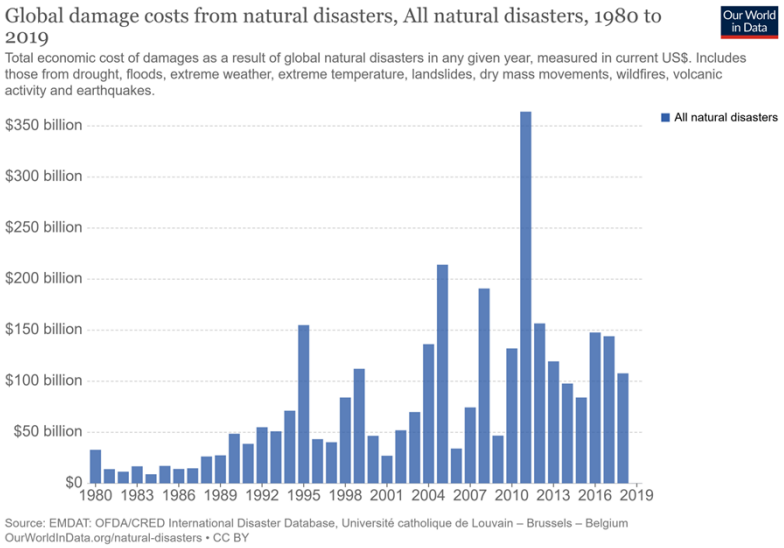
Assess: characterize the hazard regime;
Mitigate: reduce vulnerability;
Prepare: educate; warn; evacuate;

Post-Event

Respond: remove bodies, locate and treat survivors, destroy unstable structures;

Recover: rebuild communities and infrastructure

Some data related to Hazard, Damage and Risk



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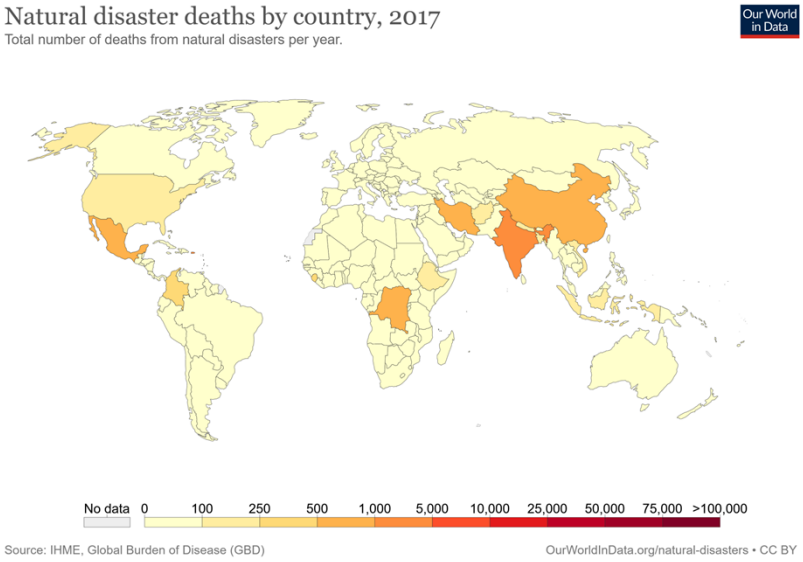

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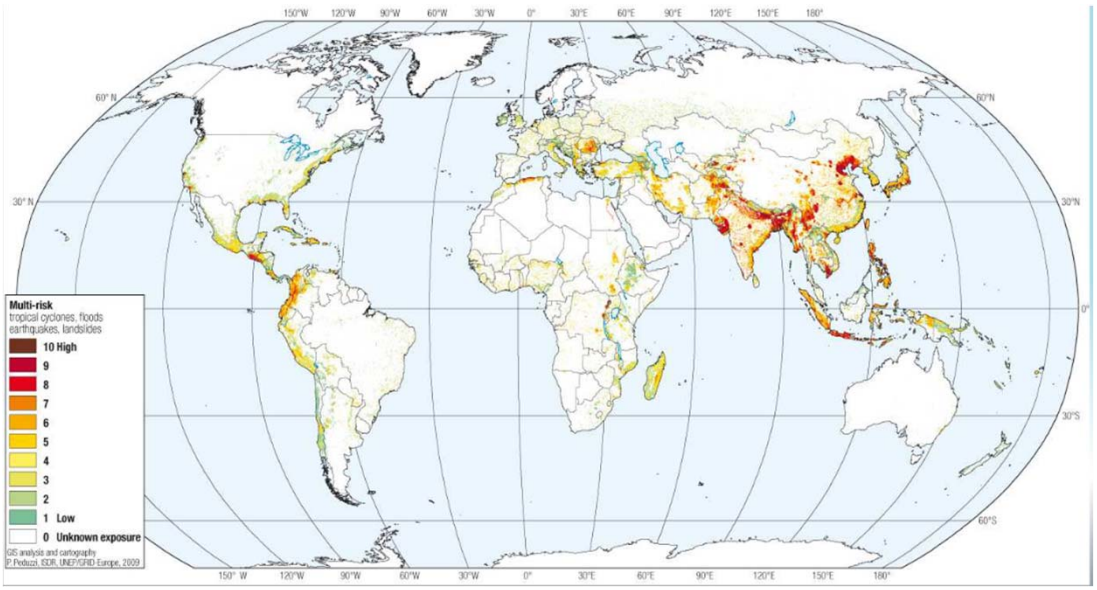
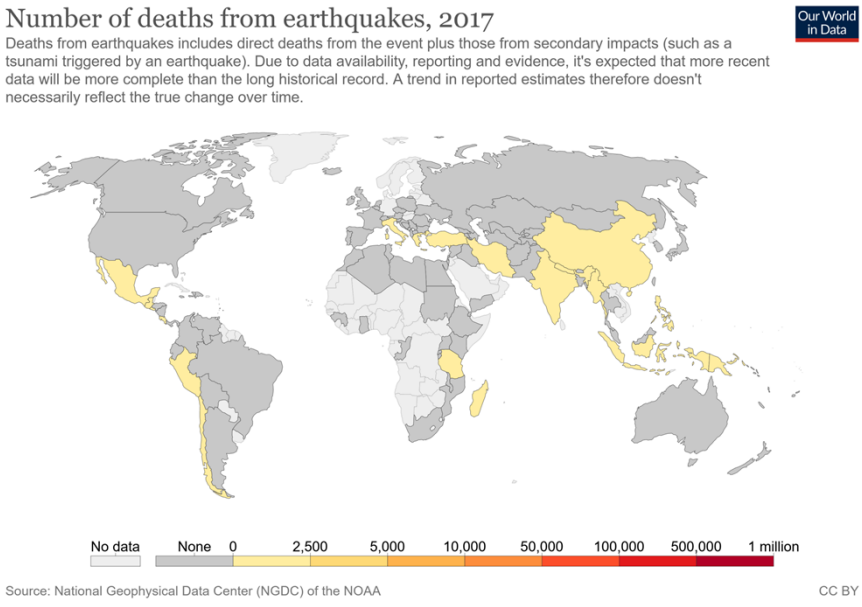


According to the probability of death rates

Some data related to Hazard, Damage and Risk



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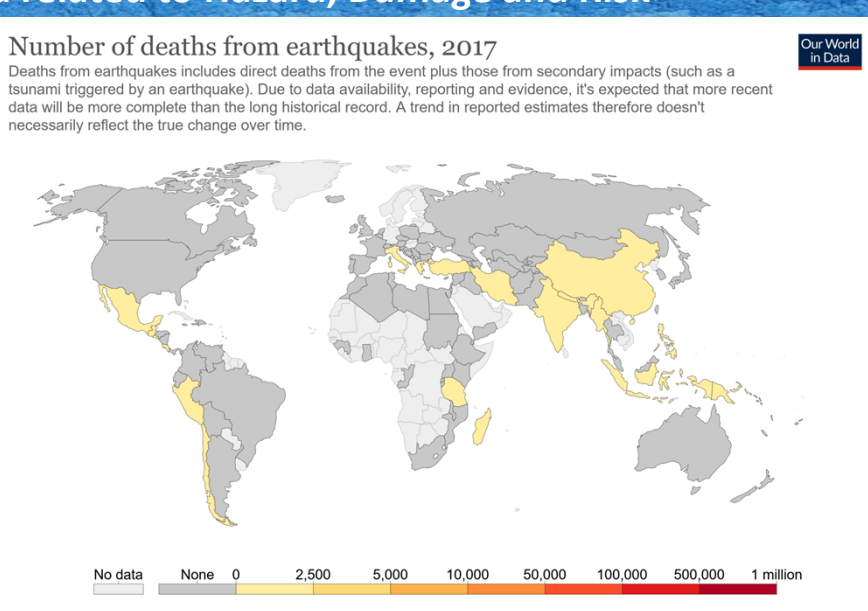

Physical Expressions of Hazards

Direct effects are effects that appear immediately after the disaster

Indirect effects appear later and sometimes can be difficult to identify and link up with a disaster

Tangible effects are those for which it is possible to estimate losses in monetary terms, such as the damaged property to restore the necessary resources

Undetectable effects are actual effects, but impossible to determine in monetary expression (loss of life can be detectable medically and legally, but economical or financial loss value calculation is very complex)

Some common Natural Hazards

Earthquakes

Earthquakes' primary effects are associated with the earth shake, and vertical or horizontal ground movements.

This leads to a strong impact on people and structures.

Secondary effects of earthquakes are associated with rock mass movement, such as **Rock falls** & **Landslides**.

Tsunami **Flood** **Biological Hazards (pandemics etc.)**

Some common Natural Hazards

Volcanoes

Fire

Infectious diseases

Heat Waves

Drought

Thunderstorms, Hurricanes, Tornados

Next Lecture

Earthquakes