



COLLEGE OF
**ENGINEERING, ARCHITECTURE
AND TECHNOLOGY**



西南交通大学
Southwest Jiaotong University

INTRODUCTION TO ENGINEERING (ENGR 1111)

Joint Bachelors Degree Program of Oklahoma State University & Southwest Jiaotong University

Dr. M. HASSAN

Title: Associate Professor

INTRODUCTION TO ENGINEERING

Environmental Engineering Case Studies-II



Environmental Engineering Case Studies

- Environmental Disasters
 - Anthropogenic
 - Environmental pollution and pollutants originating in human activity
 - Naturally Occurring Disasters



Environmental Engineering Case Studies

- Environmental Disasters
 - Naturally Occurring
 - Global Epidemics
 - 2004 Earthquake and Tsunami
 - Hurricanes Katrina, Sandy, Harvey, Irma and Maria
 - 1999 Turkish Earthquakes
 - 1953 Dutch Flood Disaster
 - Wildfires
 - Mount Pinatubo Volcanic Eruption
 - Ellington, Missouri Tornado



Environmental Engineering Case Studies

- **Global Epidemics** (全球流行病)
 - **Plague** 瘟疫
 - In the **14th century**; **Europe, Asia & Africa** were hit with a serious **outbreak of the plague**, now commonly **known as The Black Death**.
 - The disease is **caused by** the **bacterium** *Pasteurella pestis* or *Yersinia pestis*, which is **transmitted from rodents to humans by a flea**.
 - **Symptoms** include **fever, delirium, pneumonia**.

Environmental Engineering Case Studies

Global Epidemics (全球流行病)

Plague 瘟疫

- (1347 – 1351), 75 million people died of the plague, destroying the European social structure.
- Death tolls caused the disappearance of law enforcement, religious ceremonies and medical practice in the plague-hit areas.
- Plague epidemics ceased and are controlled by better hygiene and medication

Environmental Engineering Case Studies

- Global Epidemics (全球流行病)
 - Spanish Flu
 - The Spanish Flu, also known as the Great Influenza Epidemic, was an epidemic that **killed some 50 to 100 million people worldwide** in **1918 -1919**.
 - It was one of the **deadliest global epidemics in human history**.
 - The disease was called '**Spanish Flu**' because it received the greatest **media attention in Spain**.

Environmental Engineering Case Studies

Global Epidemics (全球流行病)

Spanish Flu

- Spain suffered one of the worst early outbreaks of the disease, with some **8 million people infected** in May of 1918.
- **Symptoms:** included a **blue tint to the face** and **coughing up blood** caused by severe **obstruction of the lungs**.
- **Reason:** **Rapid movement of soldiers during WW1** and **weakened immune systems** because of **chemical warfare** contributed to the spread of the **Spanish Flu**
- . The epidemic eventually killed at least as many people as the war itself.

Environmental Engineering Case Studies

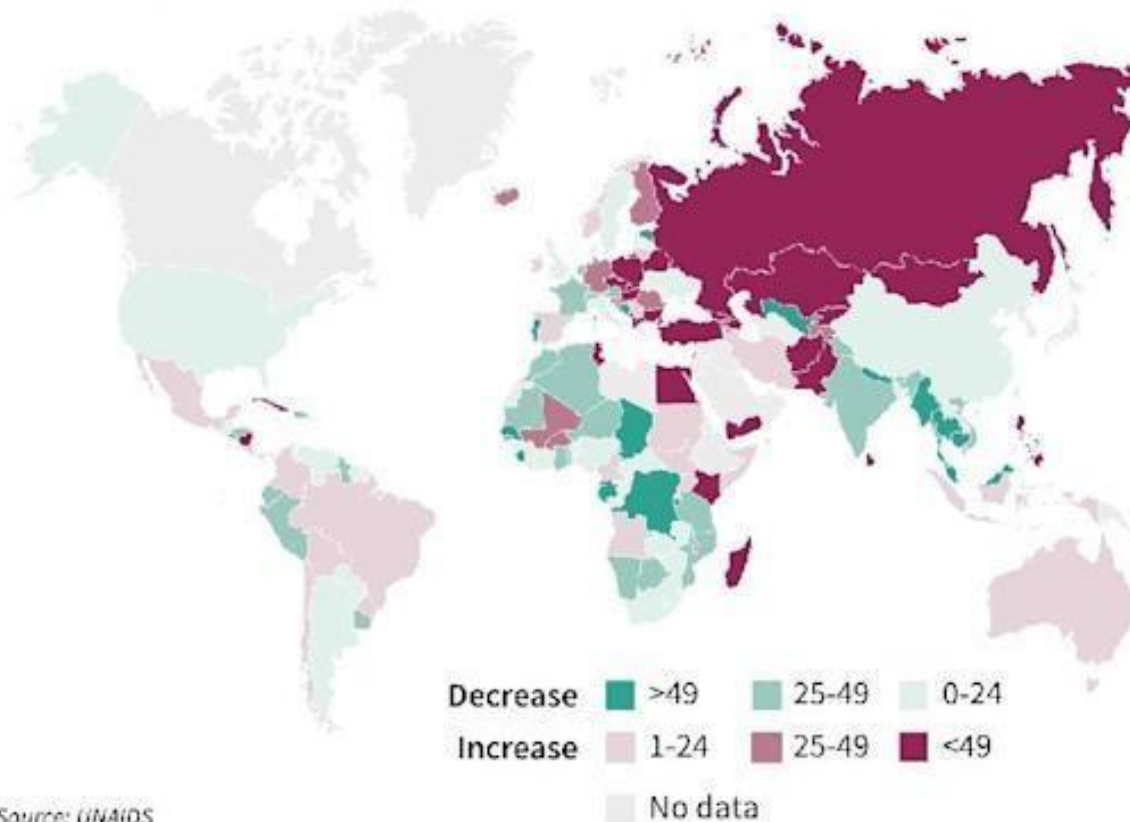
- Global Epidemics (全球流行病)
 - HIV/AIDS
 - 1980 - 2001 a 62 million people were infected with the HIV globally, which is roughly 0.5% of the world population.
 - The virus is spread through bodily fluids
 - HIV cannot be cured, but transmission to AIDS can be postponed by medication.

Environmental Engineering Case Studies

AIDS: still a major threat in the world

► Variation in new HIV infections among adults, 2005 et 2015

In percent, aged 15 and over



Source: UNAIDS

► Number of people living with HIV

Millions

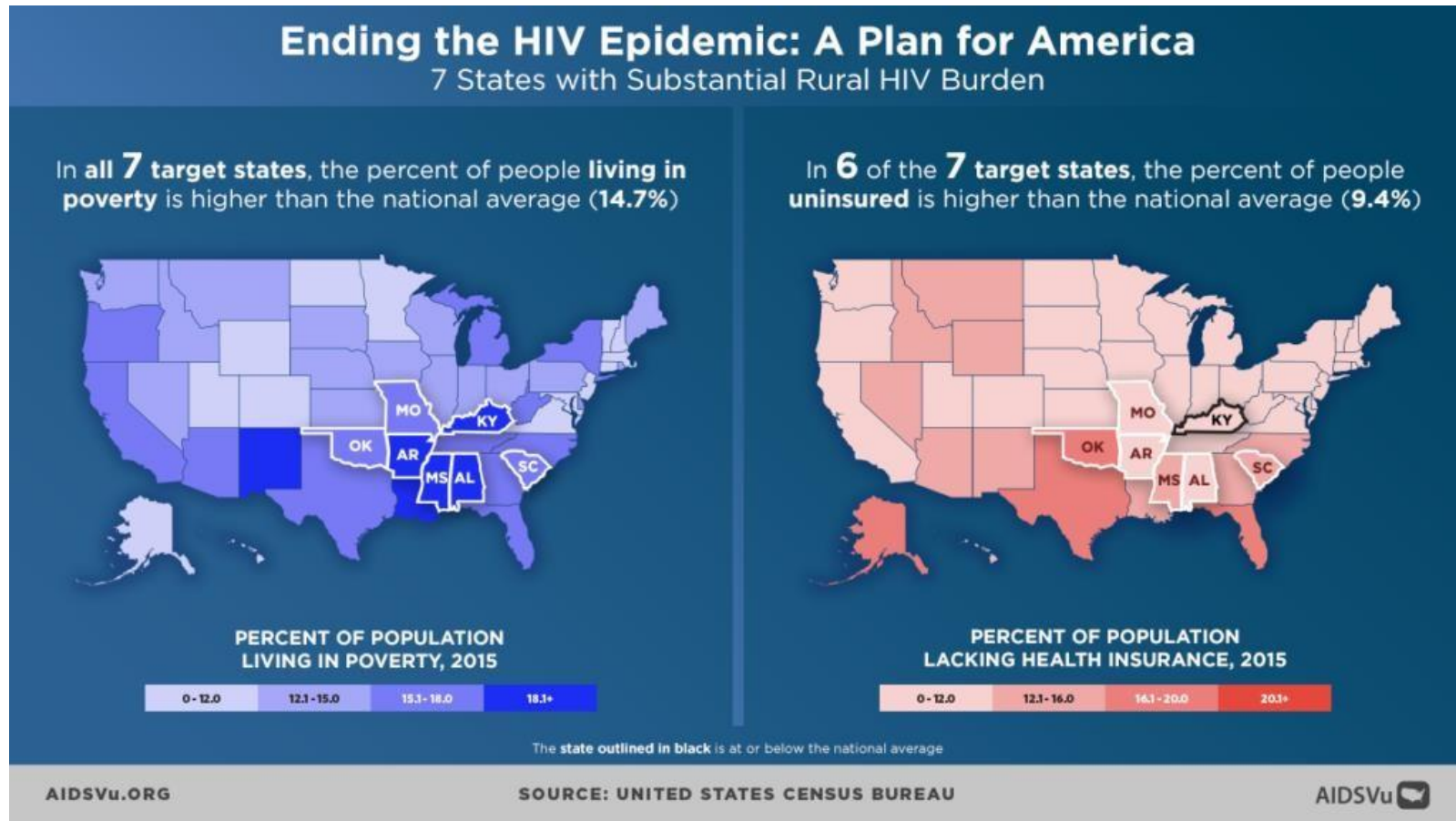


► AIDS-related deaths
In 2015, millions



© AFP

Environmental Engineering Case Studies



Environmental Engineering Case Studies

■ 2004 Earthquake and Tsunami

- In Dec **2004**, an **oceanic earthquake of 9-9.3** caused devastation in **Asian countries**.
 - Among the **10 deadliest** in history
 - It **lasted 10 min**; most major earthquakes last no more than a few seconds.
 - **Other earthquakes > 9.0 scale**
 - 1960 Great Chilean Earthquake (9.5)
 - 1964 earthquake in Prince William Sound (9.2)
 - 1957 earthquake near the Andreanof Islands (9.1).
 - All these areas were **less densely populated** than the Asian earthquake area in 2004, therefore had a much **smaller death** toll
 - The earthquake centered in the Indian Ocean off the coast of northern Sumatra, Indonesia. It caused the entire planet to vibrate at least a few centimeters. It also triggered earthquakes in entirely different regions, such as Alaska.

Environmental Engineering Case Studies

■ 2004 Earthquake and Tsunami

- The earthquake resulted in a **tsunami**, a series of **harbor waves of more than 30 meters high**.
- It caused serious damage and killed people in Sri Lanka, South India, Thailand, Indonesia, Somalia, Myanmar, Malaysia, Maldives and other countries.
- Estimated **death toll 230,000 - 310,000** people. **Tens of thousands** of people are **still missing**.
- The **death toll of 2004 earthquake is surpassed only by an earthquake in China in 1557**, which killed over **830,000** people.



Environmental Engineering Case Studies

| Magnitude | Description | Typical maximum Modified Mercalli Intensity ^[36] | Average earthquake effects | Average frequency of occurrence globally (estimated) |
|-----------------|-------------|---|--|--|
| 1.0–1.9 | Micro | I | Microearthquakes, not felt, or felt rarely. Recorded by seismographs. ^[37] | Continual/several million per year |
| 2.0–2.9 | Minor | I | Felt slightly by some people. No damage to buildings. | Over one million per year |
| 3.0–3.9 | | II to III | Often felt by people, but very rarely causes damage. Shaking of indoor objects can be noticeable. | Over 100,000 per year |
| 4.0–4.9 | Light | IV to V | Noticeable shaking of indoor objects and rattling noises. Felt by most people in the affected area. Slightly felt outside. Generally causes zero to minimal damage. Moderate to significant damage very unlikely. Some objects may fall off shelves or be knocked over. | 10,000 to 15,000 per year |
| 5.0–5.9 | Moderate | VI to VII | Can cause damage of varying severity to poorly constructed buildings. Zero to slight damage to all other buildings. Felt by everyone. | 1,000 to 1,500 per year |
| 6.0–6.9 | Strong | VII to IX | Damage to a moderate number of well-built structures in populated areas. Earthquake-resistant structures survive with slight to moderate damage. Poorly designed structures receive moderate to severe damage. Felt in wider areas; up to hundreds of kilometers from the epicenter. Strong to violent shaking in epicentral area. | 100 to 150 per year |
| 7.0–7.9 | Major | VIII or higher | Causes damage to most buildings, some to partially or completely collapse or receive severe damage. Well-designed structures are likely to receive damage. Felt across great distances with major damage mostly limited to 250 km from epicenter. | 10 to 20 per year |
| 8.0–8.9 | Great | | Major damage to buildings, structures likely to be destroyed. Will cause moderate to heavy damage to sturdy or earthquake-resistant buildings. Damaging in large areas. Felt in extremely large regions. | One per year |
| 9.0 and greater | | | At or near total destruction – severe damage or collapse to all buildings. Heavy damage and shaking extends to distant locations. Permanent changes in ground topography. | One per 10 to 50 years |

Environmental Engineering Case Studies

- **Hurricanes 飓风**
- Those with maximum sustained winds of **39 mph** or higher are called **tropical storms**.
- When a storm's maximum sustained winds reach **74 mph**, it is called a **hurricane**.

| Category | Wind Speed (mph) | Damage at Landfall | Storm Surge (feet) |
|----------|------------------|--------------------|--------------------|
| 1 | 74-95 | Minimal | 4-5 |
| 2 | 96-110 | Moderate | 6-8 |
| 3 | 111-130 | Extensive | 9-12 |
| 4 | 131-155 | Extreme | 13-18 |
| 5 | > 155 | Catastrophic | 19+ |






Environmental Engineering Case Studies

■ Hurricanes

WEATHER

What is the Saffir-Simpson scale?

The Saffir-Simpson Hurricane Wind Scale rates hurricanes from 1 to 5 based on sustained wind speeds, providing an estimate of potential property damage.

| | | | |
|--|-------------------------------------|--|---|
| Category 1 hurricane | 119-153KM/H (74-95MPH) | Very dangerous Winds will cause some damage to tree branches, power lines and poles. |  |
| Category 2 hurricane | 154-177KM/H (96-110MPH) | Extremely dangerous Winds will cause extensive damage, uprooting some trees and blocking roads. Near-total power cut for several days. |  |
| Hurricanes classified as Category 3 or higher are considered major ones due to serious threat to life and potential for severe damage. | | | |
| Category 3 hurricane | 178-208KM/H (111-129MPH) | Devastating Trees get uprooted, causing roadblocks; electricity and water supply cuts for days after the storm passes. |  |
| Category 4 hurricane | 209-251KM/H (130-156MPH) | Catastrophic Severe damage to roof structures or exterior walls of homes; power cuts to possibly last for weeks to months. |  |
| Category 5 hurricane | 252KM/H or more (157MPH or more) | Catastrophic Total roof failure and wall collapse in more homes; power cuts to last for weeks to months. |  |

Environmental Engineering Case Studies

■ Tornadoes 龙卷风

- A tornado is a **rapidly rotating column of air** extending from a thunderstorm to the surface of the Earth.

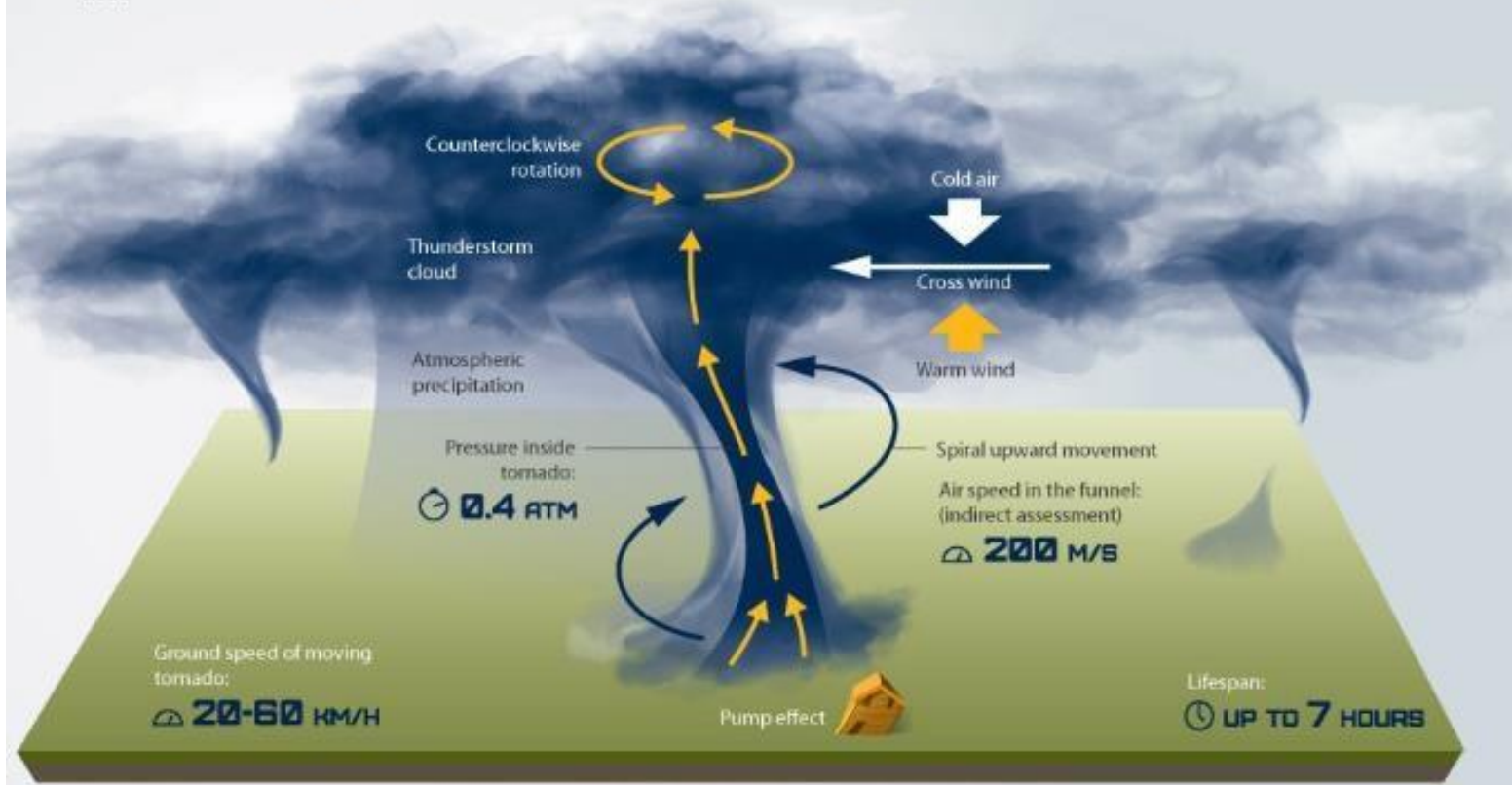


Environmental Engineering Case Studies

TORNADO FORMATION

Tornadoes form when two large air masses of varying temperature and humidity collide, with warm air in the lower layers and cold air in the upper layers

- 1 The initial funnel, which hovers over the surface, grows from a thunder cloud
- 2 If conditions are favorable (temperature swings, wind etc.) a tornado takes shape and reaches Earth
- 3 When the conditions start to change, the funnel narrows and starts to rise gradually toward the cloud



Environmental Engineering Case Studies

Enhanced Fujita Scale

| | | |
|-----|-------------|---------------------|
| EF0 | 65–85 mph | Light damage |
| EF1 | 86–110 mph | Moderate damage |
| EF2 | 111–135 mph | Considerable damage |
| EF3 | 136–165 mph | Severe damage |
| EF4 | 166–200 mph | Devastating damage |
| EF5 | >200 mph | Incredible damage |

Environmental Engineering Case Studies

- Dutch Flood Disaster
 - Jan 31 of 1953 the Dutch weather service gave out a warning of an approaching northwester storm on the North Sea. The storm than included heavy winds of 150 km/h.
 - In 1916, strong dikes were built that gave people a false sense of safety.
 - Communication was limited, causing storm warnings to pass over many people. Most people did not have television, there were no nocturnal radio broadcasts and most people did not own telephones, causing many to be unaware of the danger ahead.

Environmental Engineering Case Studies

■ Dutch Flood Disaster

- The storms caused a change in the water level. The expected ebb tide stayed out and spring tide was reached somewhere in the middle of the night.
- At 2:00 the Netherlands started flooding, causing dikes to break through at more than 60 locations in three provinces.
- The southern islands were almost completely flooded, causing thousands of houses and farms to be ruined or dragged into sea.
- People were fleeing to higher places, such as dikes and attics and were trapped there.
- On Sunday afternoon the flood increased and water levels were even higher than the previous night.

Environmental Engineering Case Studies

■ Dutch Flood Disaster

- The floods caused a total of **1835 deaths**.
- In some villages up to 10% of the population was killed.
- More than 47.000 cows and pigs and more than 140.000 pieces of poultry drowned during the flood.
- A total of more than 200.000 hectares was flooded and 72.000 people were evacuated from their homes.
- The **1953 flood** became the **largest natural disaster** since the **1570 flood**.



COLLEGE OF
**ENGINEERING, ARCHITECTURE
AND TECHNOLOGY**



西南交通大学
Southwest Jiaotong University

Thank you