- **Introduction to Volcanic Hazards**
  - Focus on hazards associated with volcanoes and eruptions.
  - Case studies will illustrate different types of hazards.
  - Importance of volcano monitoring to reduce risks.
- **Types of Volcanic Hazards**
  - Not all volcanic hazards impact the same way; some are more severe.
  - Hazards vary from local to global impacts.
  - Excluded from this lecture: debris avalanches and tsunamis (covered in separate modules).
- **Case Study: Eruption of Kilauea, 2018**
  - Kilauea is an active shield volcano in Hawaii.
  - Eruption began on May 3rd, continuing for several weeks.
  - Damage to Leilani Estates: 2,000 residents evacuated, $800 million in damages, 24 injuries, no fatalities.
  - Lava flows characterized by smooth pahoehoe and viscous a’a types.
- **Pyroclastic Flows**
  - Very deadly volcanic hazard associated with several eruption types.
  - Contains ash and gases; can travel at high speeds (up to 700 km/h).
  - Example: 1902 eruption of Mount Pele killed 30,000 residents of Saint-Pierre.
  - Formation can occur through:
    - Collapse of a lava dome.
    - Spillover from a lava lake.
    - Lateral blast from an eruption.
    - Collapse of a volcanic plume.
- **Case Study: Mount Unzen, 1991**
  - First pyroclastic flow caught on film led to 43 deaths.
  - Pyroclastic flows can be unpredictable; prior knowledge has improved monitoring strategies.
- **Phreatic Eruptions**
  - Occur when magma contacts groundwater, resulting in explosive steam.
  - Example: Mount Ontake eruption in 2014 with no warning, killing 63 people.
  - Example: Whakaari/White Island eruption in 2019 killed 22 tourists and injured many others.
- **Limnic Eruptions**
  - Sudden release of lake gases can be deadly.
  - Example: Lake Nyos disaster, 1986, killed over 1,700 due to CO_2 release.
  - Degassing programs have been initiated in response to past eruptions.
- **Lahars**
  - Volcanic mudflows formed from pyroclastic material, water, and debris.

  - Can follow existing channels and vary in speed from 1 to 40 m/s.
  - Example: Nevado del Ruiz lahar in 1985, killed 23,000 people.

- **Volcanic Ash Hazards**

  - Ash from eruptions can damage aircraft and cause extensive travel disruptions.
  - Example: Eyjafjallajökull eruption in 2010 led to significant air traffic shutdown.
  - Ash can also harm local farms and infrastructure.

- **Climatic Effects of Eruptions**

  - Volcanic gas emissions can cause acid rain, harming ecosystems and infrastructure.
  - Sulphur aerosols from eruptions can lead to short-term global cooling.
  - Example: Mount Tambora's eruption in 1815 caused global temperature drops, known as "the year without a summer."

- **Conclusion**

  - Understanding volcanic hazards is crucial for risk management and public safety.

1980 Plinian-type Eruption of Mount St. Helens

Overview of the Cascade Volcanic Arc

- Stretching from Lassen Peak (northern California) to Mount Baker (Washington).
- Comprises approximately 15 tall stratovolcanoes and hundreds of smaller volcanoes.
- Fed by northeastward subduction of the Juan de Fuca Plate beneath the North American Plate.
- Most present-day Cascade volcanoes are less than 2 million years old.

Eruption History & Activity

- Major eruptions in the Cascades occur on average twice per century over the past 4,000 years.
- Mount St. Helens is the most active volcano in the Cascades and has the highest likelihood of future eruptions.
- Prior to 1980, significant volcanic episodes included:
  - Rhyolitic lava dome (Goat Rocks) in 1843 CE.
  - Smaller Strombolian-type eruption in 1857.
  - Minor steam-driven phreatic eruptions in 1898, 1903, and 1921.

Pre-eruption Indicators (1980)

- Swarm of small to moderate earthquakes began mid-March 1980, indicating unrest.
- USGS monitored the volcano closely due to the significant seismic activity.
- On March 27, 1980, steam venting began through phreatic eruptions.
- Notable bulging observed on the north side, growing by several meters per day.

Mitigation Efforts and Eruption Context

- On April 30, 1980, a no-go zone was ordered, but logging companies influenced the radius size.
- Major eruption occurred on May 18, 1980, following a landslide and a magnitude 5.1 earthquake.

- The landslide decreased pressure in the magma chamber, triggering a lateral blast.

Eruption Dynamics

- The lateral blast occurred, blowing pyroclastic material and producing massive pyroclastic flows.
- Eruption characterized by an explosive lateral blast, creating a caldera and a vertical eruption column.

Impact and Damage

- Major destruction extended beyond the 5-mile evacuation zone.
- Affected areas documented with LiDAR 30 years later; landslide and pyroclastic deposits indicated eruption sequence.
- Casualties included four fatalities from the observation post and up to 40 additional deaths from the blast.

Long-term Consequences

- Estimated 2.3 billion cubic meters of material deposited in the North Fork of the Toutle River.
- Notable economic impact: significant timber losses and damage to the Port of Portland due to sediment deposition.
- Ash fallout reached up to 60,000 km^2, causing health hazards and extensive logistical issues including flight cancellations.

Summary of Casualties and Volcanic Hazards

- Total fatalities: 57 (three inside the no-go zone, majority outside).
- Lateral blast casualties extended significantly beyond the evacuation zone.
- Continuous volcanic activity persisted post-1980; smaller eruptions occurred between May and October 1980.

Continued Monitoring and Volcano Hazards

- Importance of volcano monitoring emphasized, following lessons from past eruptions.
- The Volcano Disaster Assistance Programme aims to assist in volcano monitoring and hazard mitigation.
- Increasing monitoring techniques include gas emissions, surface deformation, and seismic activity detection.

This structured format provides key points and detailed information to aid in studying the eruption of Mount St. Helens in 1980 and related volcanic phenomena.