SL IB Geography

Your notes

7.3 Hazard Risk & Vulnerability

Contents

7.3.1 Case Study: Volcanoes

Your notes

Case Study: Mount Merapi

Mount Merapi earthquake facts

- Name – Mount Merapi
- Location – Java, Indonesia
- Date – 25th October–30th November 2010
- Magnitude – VEI 4
- Plate boundary – Destructive plate boundary where the Indo-Australian plate is subducting below the Eurasian plate
- Type of volcano – Stratovolcano or composite

Location of Mount Merapi

Location of Mount Merapi

Impacts of the 2010 Eruption of Mount Merapi, Indonesia

	Primary impacts	Secondary impacts
Social	353 deaths	Nearly half of the people affected by the eruption suffered mental health issues e.g. stress, anxiety, depression

Your notes

	Injuries and illness e.g. sulphur dioxide gas caused skin irritation and breathing problems Damage to over 19,000 homes and properties Displacement of 350,000 people	Disruption to services such as healthcare and education Disruption to religious and traditional practices
Economic	Economic losses of £450 million due mainly to impact on farming, tourism and manufacturing Destruction of property and infrastructure e.g. 30 bridges were damaged Disruption of trade and economic activity e.g. about 2500 flights cancelled	Food prices increased due to destruction of crops and livestock Slower economic growth and development due to closure or relocation of businesses, decline in tourism, damage to crops etc. Tourism fell by 30% (domestic tourists) and 70% (international tourists)
Environmental	Destruction of biodiversity, habitats and ecosystems e.g. over 200 hectares of forest were damaged Poor air and water quality	Acid rain damaged ecosystems Long-term pollution of land and rivers
Political	Pressure on government to co-ordinate emergency response Social unrest, looting and political instability	Conflicts over government response and food shortages e.g. some residents claimed that the compensation scheme was inadequate and unfair

Factors affecting vulnerability

- The number of deaths, injuries and displacement of population was high during and after the eruption
- People were vulnerable to the impacts of the hazard
- People refused to leave their homes, which made them more vulnerable to the impacts of the eruption
- The reasons people stayed included:
  - Caring responsibilities for elderly parents
  - Responsibilities for livestock
  - Long-term residency and a subsequent unwillingness to leave
  - Cultural beliefs
- Population density in the area has increased
- Local people don't always believe that scientific monitoring is accurate, relying instead on traditional warning signs

- Communication regarding the dangers of the eruption was slow and ineffective

Your notes

Case Study: Cumbre Vieja

Your notes

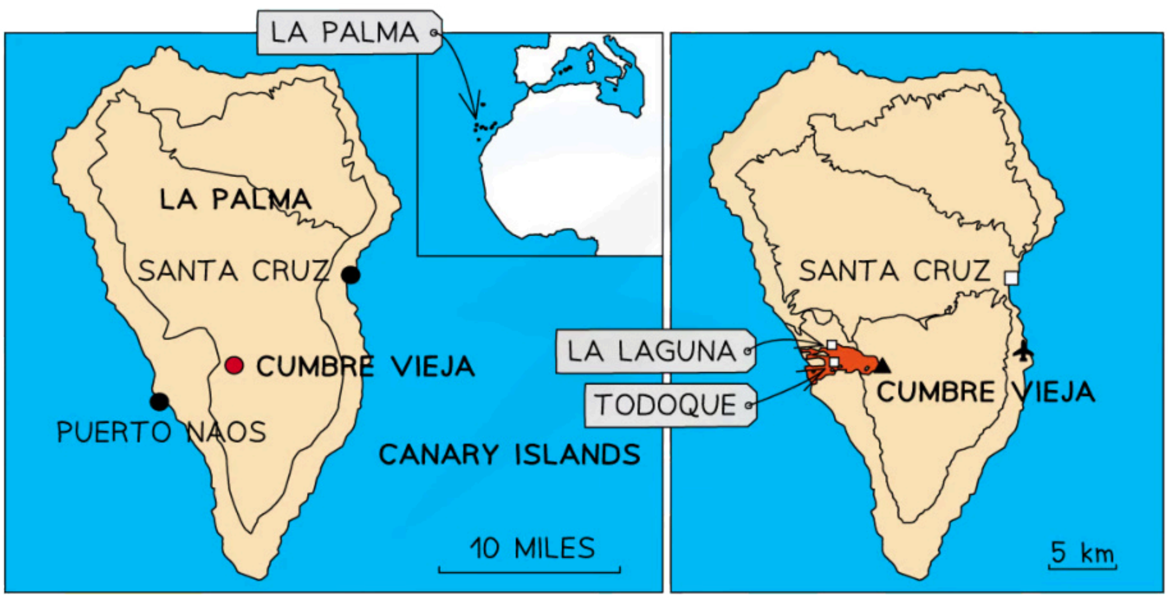
La Palma, Spain

- Part of the Canary Islands, La Palma is located in the Atlantic Ocean off the coast of North Africa
- The Canary Islands are an [popover id="RAr2r~3MbVY7biGB" label="autonomous region"] of Spain
- There are 33 volcanoes across the Canary Islands, 10 of which are in La Palma

Cumbre Viejo earthquake facts

- Name – Cumbre Viejo
- Location – La Palma, Spain
- Date – 19th September–December 2021
- Magnitude – VEI 2 or 3
- Plate boundary – Magma plume (hotspot)
- Type of volcano – Cinder cone (basaltic lava)

Location of Cumbre Vieja Volcano



Location of Cumbre Vieja Volcano

Primary impacts

- Almost 1500 houses were destroyed by the lava flow
- Over 1500 other buildings such as churches, shops and schools were destroyed
- The lava flow cut across the coastal highway and covered 1000 hectares
- The water supply was cut off for almost 3000 people
- 400 hectares of banana farms were destroyed
- Almost 1300 hectares of land were affected

- There was one death

Secondary impacts

- Air traffic was suspended on a number of occasions due to ash in the atmosphere
- Over 1000 people were evacuated after the eruption began on the 19th September
- A further 5600 people were evacuated over the next few weeks
- About 20,000 people were exposed to the eruption and its effects

Factors affecting vulnerability

- Although many buildings were impacted by the eruption, deaths and injuries were minimised as a result of:
  - Evacuation plans
  - Suspension of air traffic
- La Palma also has a **Local Hazard Mitigation Plan**, which aims to reduce the impacts of any hazard event
- People are encouraged to have an emergency kit ready in case of eruptions
- Insurance cover means that recovery from a hazard event is more rapid
- La Palma has well-trained and equipped emergency services

Your notes

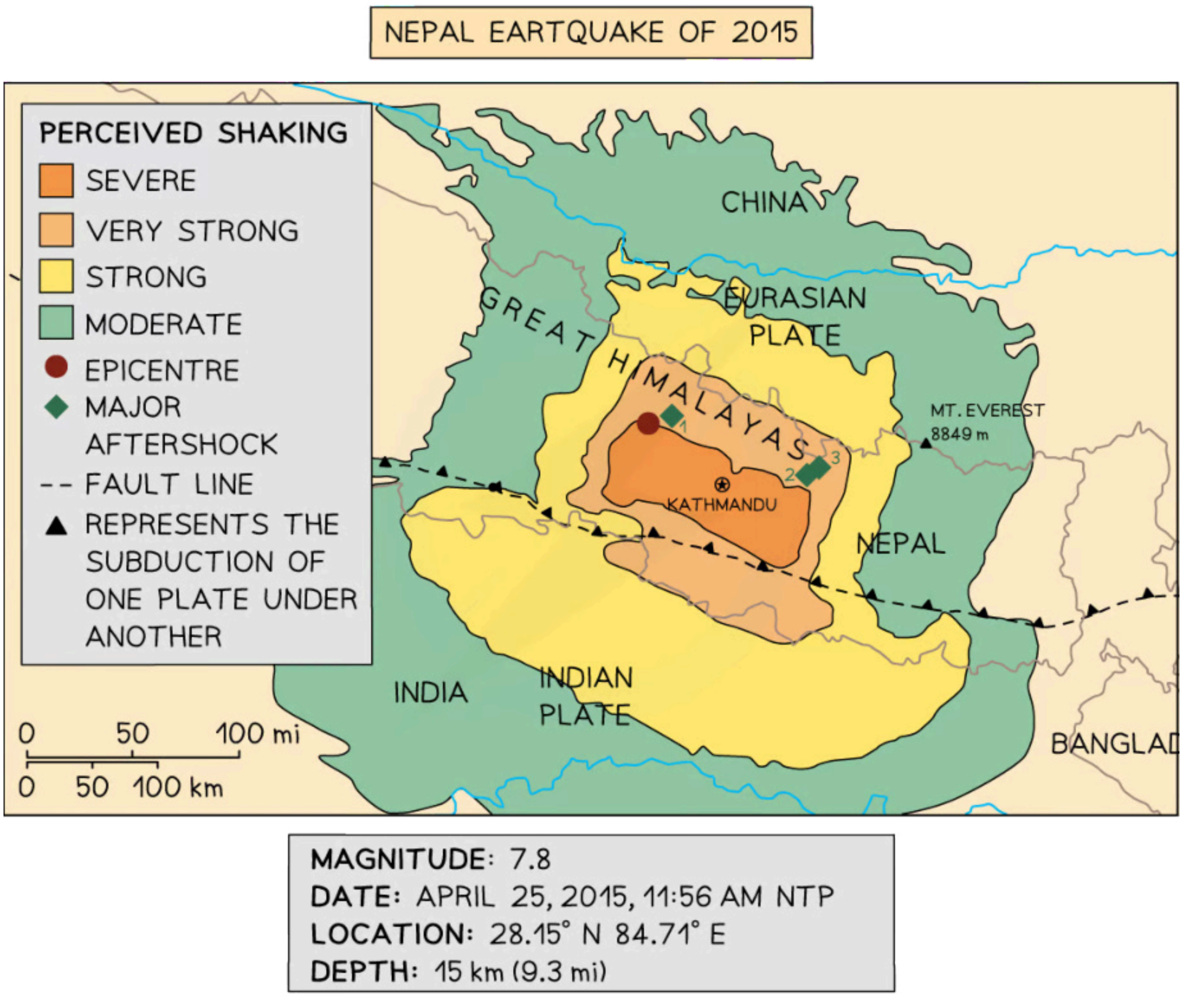
7.3.2 Case Study: Earthquakes

Your notes

Case Study: Nepal

- Nepal is one of the poorest countries in the world with a Gross Domestic Product (GDP) per capita of under $1000 in 2015
- Located between China and India, Nepal is a landlocked country
- In 2015, 80% of the population lived in rural, often remote, communities
- In April 2015 at 11.26 a.m., Nepal was struck by an earthquake of magnitude 7.8
- The epicentre was 80km northwest of **Kathmandu** in the **Gorka district**
- The focus was shallow at only 15km beneath the surface
- Over 300 aftershocks followed the main earthquake

Location of the Nepal earthquake



Location of the Nepal earthquake

Cause

- Nepal is located on a collision boundary between the Indian and Eurasian plates

Effects

- Approximately **9000 deaths**
- Over **20,000 people injured**
- Electricity and water supplies cut
- **7000 schools** and **1000 health facilities** damaged or destroyed
- Almost **3.5 million** people made homeless
- Offices, shops and factories destroyed, meaning people unable to make a living
- UNESCO world heritage sites destroyed, as well as many temples

Your notes

- A loss of tourist income, which Nepal is reliant on
- Avalanches on Mount Everest and in the Langtang Valley
- Landslides, which blocked roads and rivers
- Damages estimated at between $7 and $10 billion; about **35% of the GDP**

Immediate responses

- There were donations of money and aid from around the world totalling $3 billion, including $3.3 million from China and $51 million from the UK
- Many countries sent aid in the form of:
    - Temporary shelters
    - Medicines
    - Food
    - Water
    - Clothing
    - Search and rescue teams
    - Medical staff
- 90% of the Nepalese army were mobilised
- Tent cities were set up in Kathmandu for those made homeless
- **A GIS crisis-mapping tool** was used to co-ordinate the response
- **A $3 million grant** was provided by the **Asian Development Bank** for emergency relief

Long-term responses

- Landslides were cleared and roads repaired to restore access to remote rural communities
- Schools were rebuilt
- Earthquake drills were introduced to provide people with education about what to do in the event of an earthquake
- Stricter building codes were introduced with more enforcement
- $200 million was provided by the Asian Development Bank for rebuilding
- A new government task force was set up to plan for future earthquake events

Factors affecting vulnerability

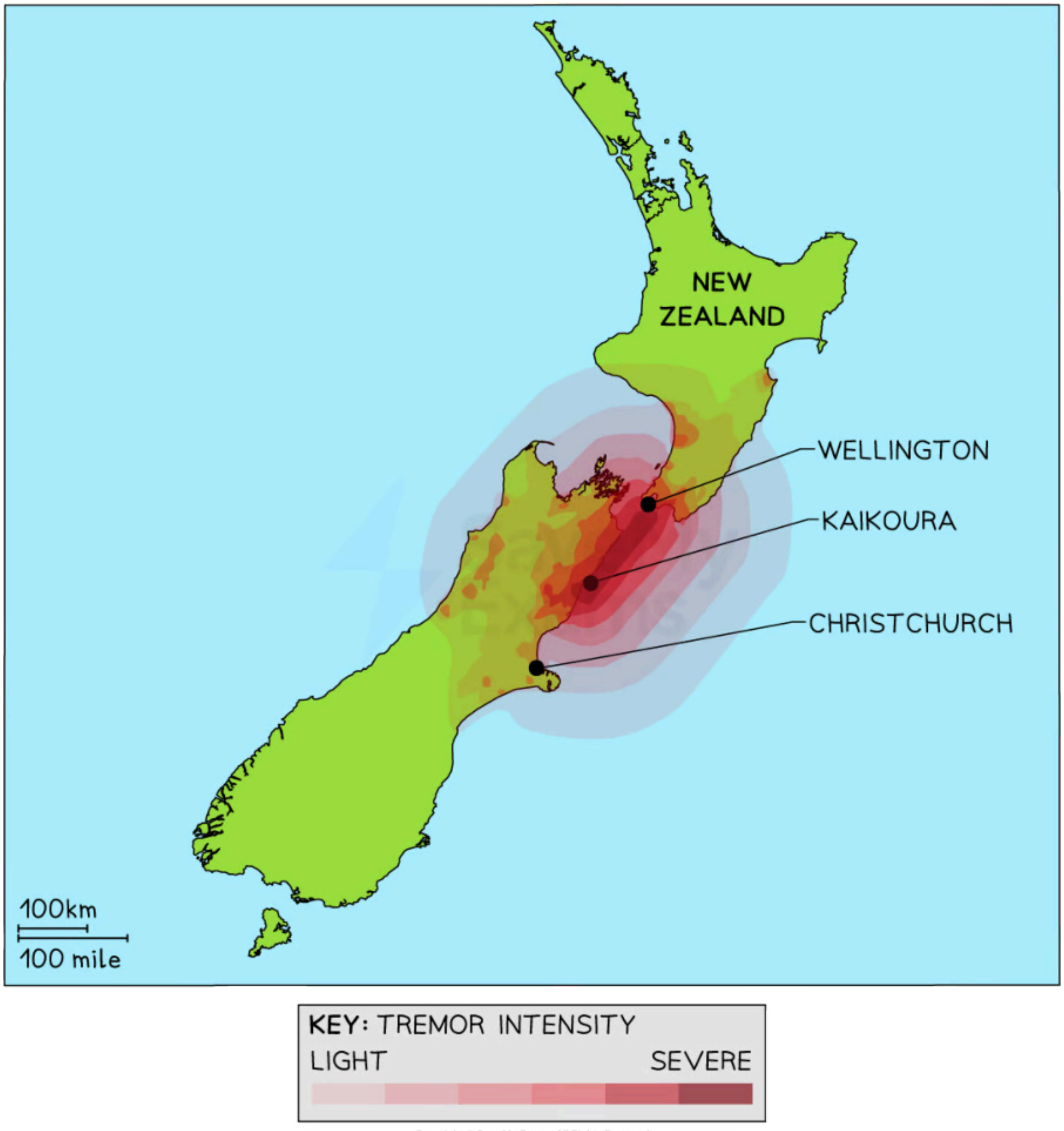
- Vulnerability is higher in Nepal due to a range of factors:
    - Many people affected live in remote, rural areas, which means:
        - Communication and education about the risks of earthquakes are limited
        - In the event of a hazard these areas are difficult to reach
    - The city of Kathmandu is densely populated, so more people are affected
    - There were building codes but these were not always enforced or followed:
        - Buildings are often built using low-quality materials and are usually not earthquake-resistant
    - Nepal is a mountainous area, which increases the risk of landslides and avalanches
    - There is a lack of education regarding the risks of earthquakes

Your notes

Case Study: New Zealand

- New Zealand is one of the wealthiest countries in the world, with a **Gross Domestic Product** of US$40,058 in 2016
- It is located to the south-east of Australia
- On 14th November 2016, it was struck by a magnitude 7.8 earthquake
- The epicentre was 15km north-east of Culverden and 60km south-west of Kaikōura
- The focus was shallow, only 15km below the surface
- By the 17th November, there had been over 2000 aftershocks

Location of the New Zealand earthquake



Location of the New Zealand earthquake

Your notes

Cause

- New Zealand is located on a destructive boundary between the Indian-Australian and Pacific plates

Effects

- **Two** deaths
- Over 50 people injured

- Temporary homelessness of 60 people
- Over 2000 buildings were damaged or destroyed, including some in the capital city, Wellington
- Power, water and telecommunication cut off to Kaikōura and surrounding communities
- Approximately **11,000 landslides**:
  - Destruction of **390km of road and railway**
  - Kaikōura and surrounding communities were completely cut off for 16 days
- Uplift of the coastline by 5.5 metres in some areas:
  - Kaikōura's harbour was affected by the uplift, meaning boats could not leave or enter the harbour
  - Disruption of the coastal breeding areas for dolphins, seals and sea birds
- A tsunami followed the earthquake, reaching up to 6.9 metres in Goose Bay
- Insurance costs reached $2.27 billion
- The cost to the government reached almost $3.5 billion

Immediate responses

- National Crisis Management Centre activated
- Tsunami warnings were issued for coastal areas via sirens, texts and social media
- Local states of emergency declared
- Helicopters and ships provided emergency supplies and evacuated vulnerable people
- Search and rescue teams dispatched

Long-term responses

- Improvements to the tsunami warning procedure
- Road routes were repaired between one month and one year after the event
- The main rail route reopened after two months but full repair took over a year
- Improvements to the building regulations made to assess existing buildings for earthquake resistance
- Kaikōura's harbour was rebuilt; taking over a year to complete

Factors affecting vulnerability

- The vulnerability of the population is reduced due to a range of factors, including:
  - Planning and preparation for earthquake events
  - Education about what to do during and after an earthquake event
  - Emergency services are well-trained and equipped
  - People at risk were rapidly evacuated from the affected areas
  - Building quality and materials are of a high standard, reducing the risk of collapse
  - As a HIC, New Zealand can afford the repairs and rebuilding, reducing recovery time
  - A tsunami warning system gives people time to evacuate from areas at risk

Your notes

7.3.3 Case Study: Mass Movement

Your notes

Case Study: Vargas, Venezuela

Vargas mass-movement facts

- Location – Vargas state, Venezuela
- Date – 15–16th December 1999
- Cause – Rainfall 40–50% above the usual average
- Events – Rainfall triggered flows of soil and debris
- Type of mass movement – Fast-moving debris flow

Hazard event

- Thousands of debris flows moved rapidly down the steep-sided mountains and narrow canyons
- The debris flow included boulders up to 10 metres in diameter
- In some places, the deposits created by the debris flow were several meters thick
- The debris flow speed was estimated at between 3 and 14.5 metres per second

Impacts

- Rain caused many mudslides, landslides and debris flows across the region
- There were between 10,000–50,000 deaths (many people were never found, and whole families were buried by the mudslides or swept out to sea)
- Over 150,000 people were made homeless
- Towns including **Cerro Grande** and **Carmen de Uria** were completely buried or swept away
- Over 70% of the population in Vargas state were affected
- The debris flow and mudslides destroyed many squatter settlements
- Bridges and roads were destroyed
- The seaport at **Maiquet** was affected, leading to hazardous material leaking from containers
- Crops were destroyed
- Economic damage was estimated at US$3.5 billion
- Communication systems were destroyed
- Supplies of food and water were affected for months
- Looting occurred across the region, meaning martial law had to be implemented for over a year

Factors affecting vulnerability

- The debris flows killed thousands of people as a result of a range of factors:
  - High population density in the coastal areas
  - Disorganised urban growth
  - Poor quality buildings – many of the areas affected were squatter settlements
  - Corruption amongst government and public officials, which allowed homes to be built in vulnerable areas
  - In 1999, the government stopped collecting rainfall information:
    - This data was used to maintain bridges, reservoirs and other infrastructure
  - Lack of warning – no evacuation orders were issued

- The government ignored a report from the Civil Defense Agency that urged them to declare a state of emergency 12 hours before the main debris flows

Your notes

Case Study: Ponzano, Italy

Ponzano facts

- Location – Ponzano, Italy
- Date – February 2017
- Cause – Combined effect of earthquakes and snowmelt leading to saturated soil and intense rainfall (81mm in four days)
- Type of mass movement – Slow-moving landslide

Hazard event

- The rate of landslide movement averaged one metre per day for two weeks
- Ponzano village in the north-east of Italy, about 30km north of Venice

Impacts

- An estimated 7 million m^3 of material moved
- Over 100 people evacuated from 35 houses
- Collapse of several buildings
- Agricultural land around the village becoming unsafe to cultivate

Factors affecting vulnerability

- Low population density
- The slow movement of the landslide made evacuation easy
- The landslide was monitored and tracked by the Civil Protection Department
- Emergency services supported people to recover property from evacuated buildings
- Psychologists were provided to support people's mental health

Examiner Tip

When considering hazard events it is important that you can explain why vulnerability varies between and within communities.