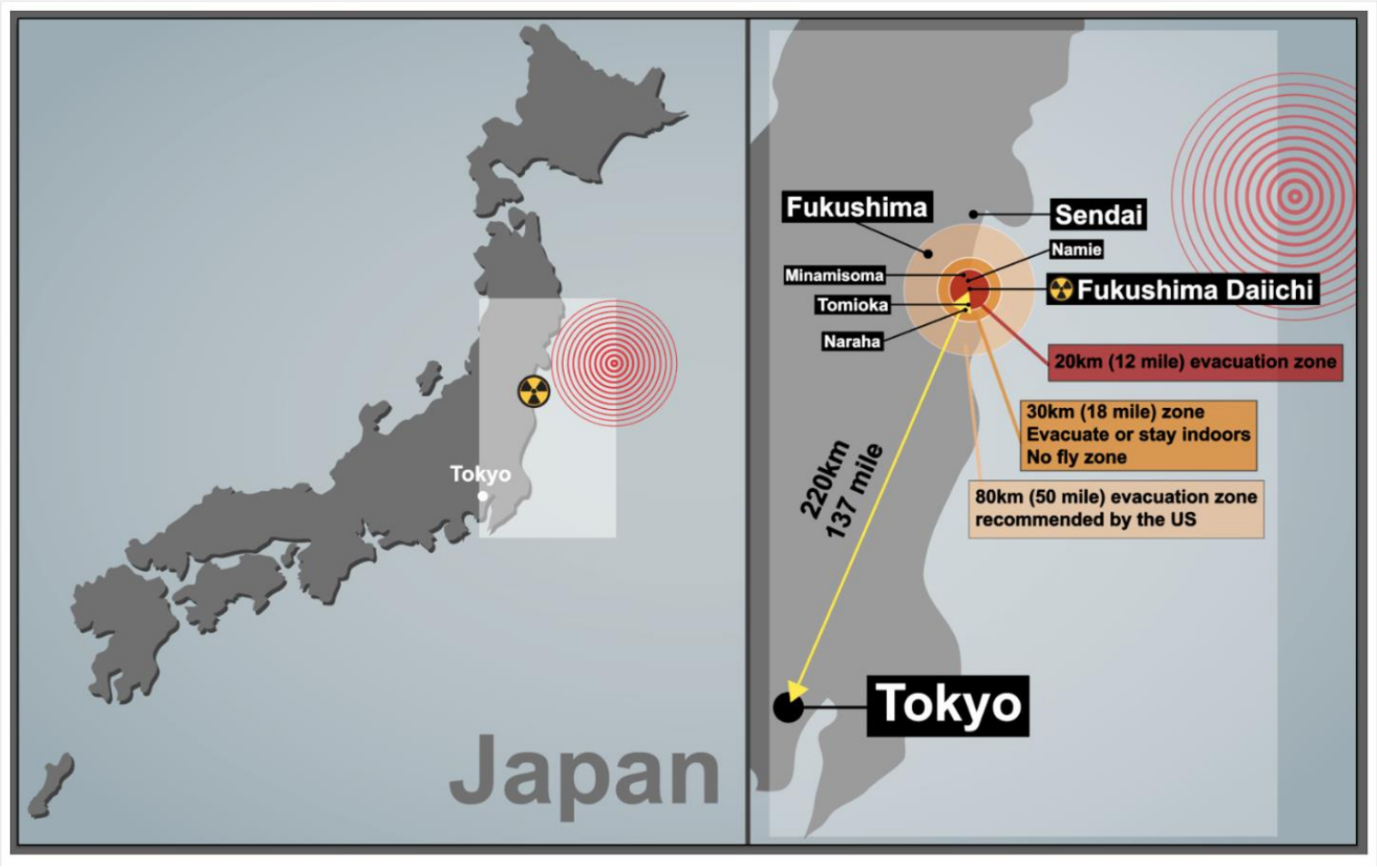
Case Study – The 2011 Japan Earthquake

Background Information

Location: The earthquake struck 250 miles off the northeastern coast of Japan's Honshu Island at 2:46 pm (local time) on March 11, 2011.



Magnitude: It measured 9.1 on the Moment Magnitude scale, making it one of the most powerful earthquakes ever recorded.

Japan is a highly developed country with advanced infrastructure, technology, and a robust economy. The nation has a high GDP, an efficient healthcare system, and extensive education. However, it's also located in the Pacific Ring of Fire, making it prone to earthquakes.

WHAT CAUSED THE 2011 JAPAN EARTHQUAKE?

Japan is located on the eastern edge of the Eurasian Plate. The Eurasian plate, which is continental, is subducted by the Pacific Plate, an oceanic plate forming a subduction zone to the east of Japan. This type of plate margin is known as a destructive plate margin. The process of subduction is not smooth. Friction causes the Pacific Plate to stick. Pressure builds and is released as an earthquake.

Friction has built up over time, and when released, this caused a massive 'megathrust' earthquake. The enormous tension released as the plates shifted caused the seafloor to uplift, triggering the earthquake and subsequent tsunami.

The amount of energy released in this single earthquake was 600 million times the energy of the Hiroshima nuclear bomb.

Scientists drilled into the subduction zone soon after the earthquake and discovered a thin, slippery clay layer lining the fault. The researchers think this clay layer allowed the two plates to slide an incredible distance, some 164 feet (50 metres), facilitating the enormous earthquake and tsunami.

The earthquake occurred at a relatively shallow depth of 20 miles below the surface of the Pacific Ocean. This, combined with the high magnitude, caused a tsunami (find out more about how a tsunami is formed on the BBC website).

WHAT WERE THE PRIMARY EFFECTS OF THE 2011 JAPAN EARTHQUAKE?

1. **Ground Shaking**: Extensive damage to buildings and infrastructure.
2. **Landfall:** Some coastal areas experienced land subsidence as the earthquake dropped the beachfront in some places by more than 50 cm.

WHAT WERE THE SECONDARY EFFECTS OF THE 2011 JAPAN EARTHQUAKE?

1. **Tsunami**: A giant tsunami wave resulted in widespread destruction along the coast.
2. **Fatalities**: Around 16,000 deaths were reported, mainly resulting from the tsunami.
3. **Injuries**: 26,152 were injured, mainly as a result of the tsunami.
4. **Nuclear Crisis**: The Fukushima Daiichi nuclear power plant was damaged, leading to radiation leaks.
5. **Economic Loss**: Estimated at over $235 billion.
6. **Displacement**: Around 340,000 people were displaced from their homes.
7. **Damage:** The tsunami destroyed or damaged 332,395 buildings, 2,126 roads, 56 bridges, and 26 railways. Three hundred hospitals were damaged, and 11 were destroyed.
8. **Environmental Damage**: Coastal ecosystems were heavily impacted.
9. **Blackouts:** Over 4.4 million households were left without electricity in North-East Japan.
10. **Transport:** Rural areas remained isolated for a long time because the tsunami destroyed major roads and local trains and buses. Sections of the Tohoku Expressway were damaged. Railway lines were damaged, and some trains were derailed.

WHAT WERE THE IMMEDIATE RESPONSES TO THE 2011 JAPAN EARTHQUAKE?

Tsunami Warnings and Prediction:

- The Japan Meteorological Agency issued tsunami warnings three minutes after the earthquake.

- Scientists predicted where the tsunami would hit using modelling and forecasting technology.

Search and Rescue Operations:

- Rescue workers and 100,000 members of the Japan Self-Defence Force were dispatched within hours.
- Some individuals were rescued from beneath rubble with the aid of sniffer dogs.

Radiation Protection Measures:

- The government declared a 20 km evacuation zone around the Fukushima nuclear power plant.
- Evacuees from the area around the nuclear power plant were given iodine tablets to reduce radiation poisoning risk.

International Assistance:

- Japan received help from the US military.
- Search and rescue teams from New Zealand, India, South Korea, China, and Australia were sent.

Access and Evacuation:

- Access was restricted to affected areas due to debris and mud, complicating immediate support.
- Hundreds of thousands were evacuated to temporary shelters or relocated.

Health Monitoring:

- Those near the Fukushima Daiichi nuclear meltdown had radiation levels checked and their health monitored.
- Measures were taken to ensure individuals did not receive dangerous exposure to radiation.

WHAT WERE THE LONG-TERM RESPONSES TO THE 2011 JAPAN EARTHQUAKE?

Reconstruction Policy and Budget:

- Establishment of the Reconstruction Policy Council in April 2011.
- Approval of a budget of 23 trillion yen (£190 billion) for recovery over ten years.
- Creation of ‘Special Zones for Reconstruction’ to attract investment in the Tohoku region.

Coastal Protection Measures:

- Implementing coastal protection policies like seawalls and breakwaters designed for a 150-year recurrence interval of tsunamis.

Legislation for Tsunami-Resilient Communities:

- Enactment of the 'Act on the Development of Tsunami-resilient Communities' in December 2011.
- Emphasis on human life, combining infrastructure development with measures for the largest class tsunami.

Economic Challenges and Recovery:

- Japan's economy wiped 5–10% off the value of stock markets post-earthquake.
- Long-term response priority: rebuild infrastructure, restore and improve the economy's health.

Transportation and Infrastructure Repair:

- Repair and reopening of 375 km of the Tohoku Expressway by the 24th of March 2011.
- Restoration of the runway at Sendai Airport by the 29th of March, a joint effort by the Japanese Defence Force and the US Army.

Utility Reconstruction:

- Energy, water supply, and telecommunications infrastructure reconstruction.
- As of November 2011: 96% of electricity, 98% of water, and 99% of the landline network had been restored.

HOW DOES JAPAN PREPARE FOR EARTHQUAKES, AND WHAT WAS ITS IMPACT?

Japan has a comprehensive earthquake preparedness program, including:

1. **Strict Building Codes**: Buildings are constructed to withstand seismic activity.
2. **Early Warning Systems**: Advanced technology provides early warnings to citizens.
3. **Education and Drills**: Regular earthquake drills in schools, offices, and public places.

Impact of the 2011 Earthquake

The extensive preparation in Japan likely saved lives and reduced damage during the 2011 earthquake. However, the unprecedented magnitude of the event still led to significant destruction, particularly with the tsunami and nuclear crisis.

CONCLUSION

The 2011 Japan earthquake illustrates the complexity of managing natural disasters in even the most developed and prepared nations. The event prompted further refinements in disaster preparedness and response in Japan and globally, highlighting the need for continuous assessment and adaptation to seismic risks.