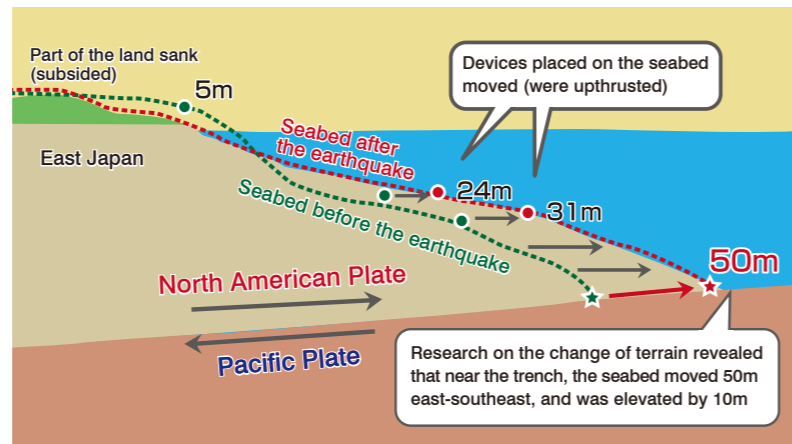


# Mechanisms

## Earthquake Generation

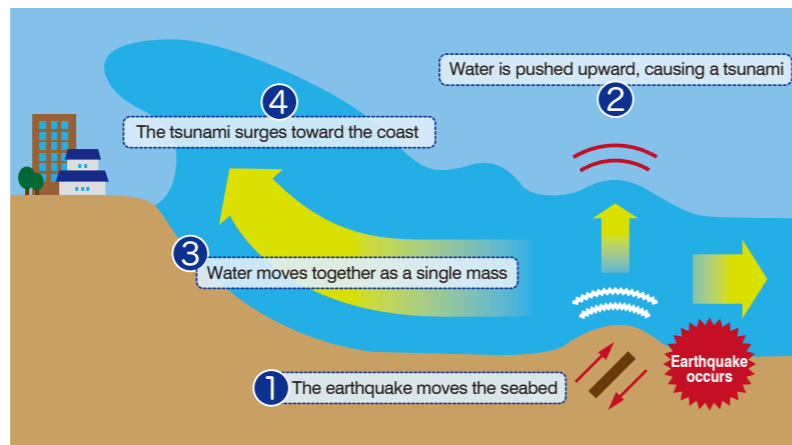
Every year, the tectonic plates covering the Earth move a few centimeters. Around Japan, when oceanic plates sink, inland plates are pulled under. When an inland plate cannot withstand this strain anymore, it springs back, causing an earthquake at the boundaries of the plates. Japan is subject to the complex movements of four plates—the Pacific Plate, Philippine Sea Plate, North American Plate, and Eurasian Plate, making it one of the world’s most active earthquake regions.



Tectonic plate movement in the main shock of the Great East Japan Earthquake by courtesy of JAMSTEC

## Tsunami Generation

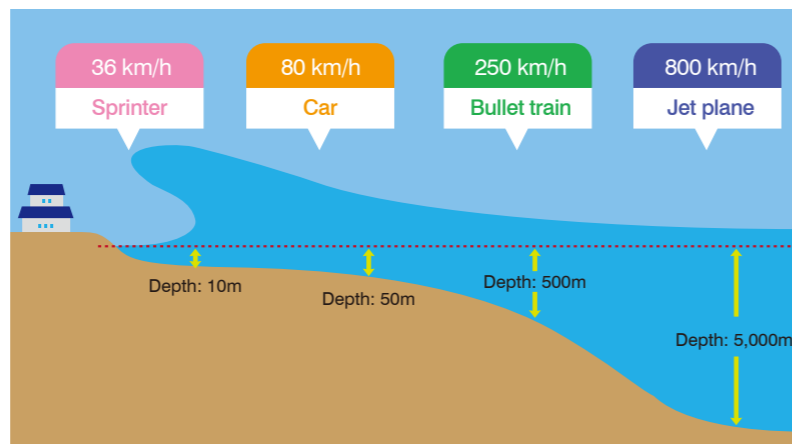
When a large earthquake occurs under the sea, the seabed is pushed up and then submerges. The sea level also changes accordingly, causing large waves to move in all directions. This is a tsunami. The commonly observed phenomenon of the tide drawing in before a tsunami is not one that is definite. There are cases where there is an initial large wave which reaches the coast without the tide receding.



Mechanisms of tsunamis, generation and propagation

## Speed and Force of Tsunamis

The deeper the ocean, the faster the tsunami will travel. As the wave nears the shore, the subsequent waves catch up and amplify the wave height, increasing the wave force. In a tsunami, the waves become a single mass capable of sweeping away homes and vehicles.



Relationship between tsunami speed and water depth

## Course of the Tsunami

How did the tsunami occur and travel during the 2011 Great East Japan Earthquake? Simulations conducted by the International Research Institute of Disaster Science (IRIDeS), Tohoku University are used to model the movement of the waves during the disaster (Simulations show the waves higher than their actual height).

### Simulated images of the tsunami reaching the coastal regions of Tohoku

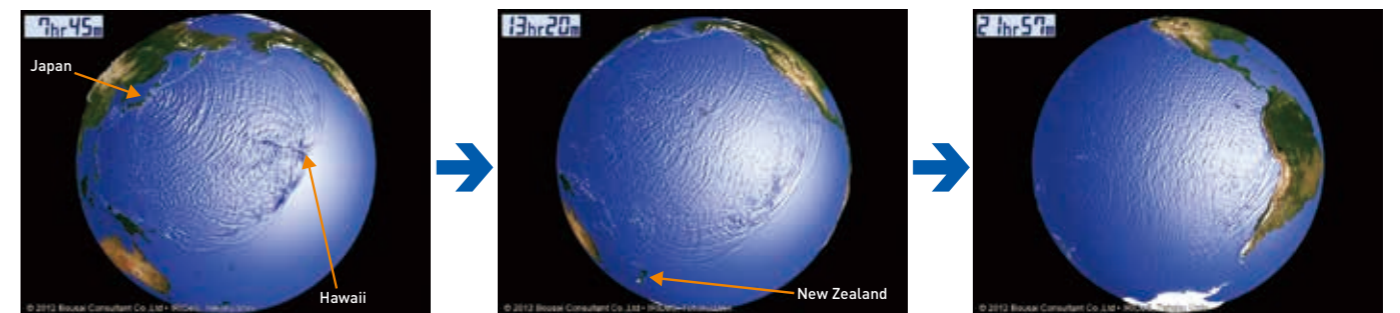


Approximately 20 minutes after the earthquake. The first large tsunami hit Japan.

Approximately 43 minutes after the earthquake. The large waves approached the coastline. The maximum estimated height was 16.7 meters.

Approximately 70 minutes after the earthquake. The estimated height of the tsunami in Sendai was about 7.1 meters. Not only around the coastline, but a wide area of the sea surface fluctuated, conveying the tsunami.

### Simulated images of the tsunami traveling across the Pacific Ocean



Approximately 7 hours and 45 minutes after the earthquake. The tsunami had reached as far as Hawaii.

Approximately 13 hours and 20 minutes after the earthquake. The tsunami had reached as far as New Zealand.

Approximately 22 hours after the earthquake. The tsunami had reached the southern tip of the South American continent.