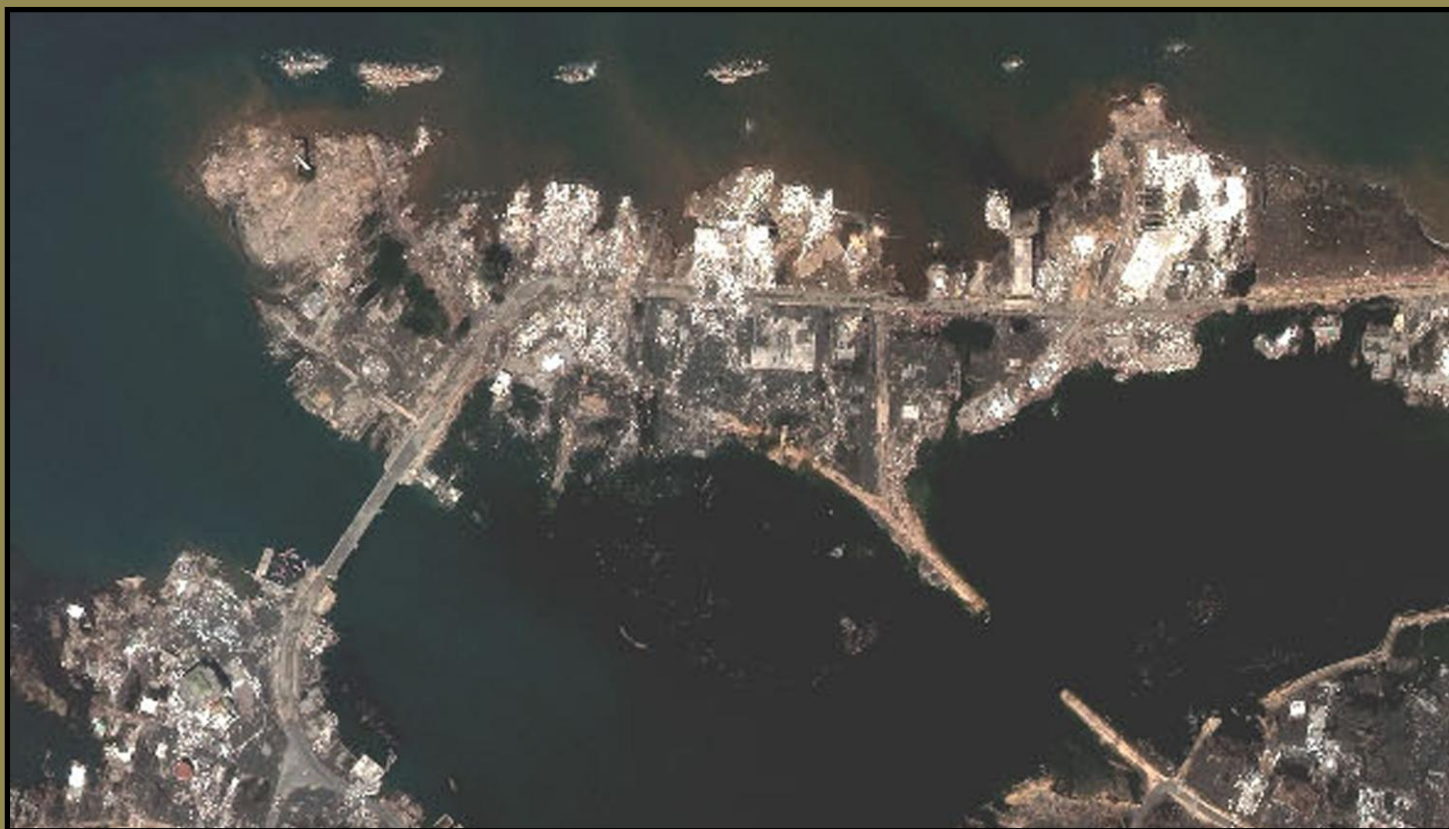


Banda Aceh Tsunami 2004



June 23, 2004



December 28, 2004

Tsunami 2004 – Banda Aceh

Location: Banda Aceh, Indonesia; Northern-most Province on the Island of Sumatra.
Images Dates: Before: June 24, 2004 After: Dec 28, 2004
Images Source: QuickBird Satellite Image: Natural Color
Inset Image: Location of Banda Aceh on the Island of Sumatra

The Event



On December 26, 2004, the World experienced a major natural disaster when a large tsunami hit extensive coastal areas around the Indian Ocean, tragically killing over 155,000 people and reshaping many coastal environments. A megathrust (9.0 magnitude or higher) earthquake occurred off the west coast of northern Sumatra, generating a massive tsunami. It occurred at the convergence of two tectonic plates—the Indian plate and the Burma microplate. The Indian plate slid approximately 35m (115 ft) beneath the Burma microplate, releasing tension from the microplate and causing it to spring suddenly upward by about 6m (20 ft). It was this abrupt, upward movement that produced a tsunami.

The United States Geological Survey reported that due to the earthquake the eastern edge of the Indian plate slipped a length of nearly 1,200 kilometers (746 miles) along the extensive subduction fault zone. The rupture was greater than 100 kilometers (62 miles) wide and the average vertical displacement of the fault was 15 meters (49 ft). Within a few minutes of the quake, the tsunami slammed into the northwest coast of Sumatra with three to six waves of more than 30 meters (98 ft) in height.

The waves that hit the northern tip of Sumatra were lower, about 10-12 meters (33-39 ft) high but the large, low-lying, alluvial plain situated here allowed the waves to penetrate far inland, overwhelming and flooding the large urban area of Banda Aceh. This flat plain ranges between -0.45 meters (-1.47ft) and +4.5 meters (14.76ft) in elevation, making it vulnerable to any large ocean waves. The ground consists mainly of sandy soil that can be easily eroded and scoured. Structures on such soil can be damaged by ground shaking from the quake and aftershocks as well as from the tsunami.

Before and After

The two images were acquired from the Quickbird satellite and have ground resolution of 61cm (27 in.) by 61cm (27 in.). The two images show the community of Ulee Lheue (Ulee Lheue), located 7 kilometers (4.5 miles) west of Banda Aceh. Ulee means “head” and Lheue indicates “little peninsula.” Sitting on the west end of a peninsula and facing the Indian Ocean, Ulee Lheue received the initial and full force of the tsunami as the waves rapidly moved toward Banda Aceh. This coastal town was protected on its ocean side by a revetment built using 2000–3500 kilograms (4409-7716lb) rubble stones. Some of these large stones were tossed, like pebbles, by the waves across the landscape. The small islands shown at the top of the post-tsunami image represent the remnants of the revetment. Nearly 100 percent of the community behind the revetment was washed away and almost 40 percent of the land is gone. The white rectangular shaped features in the post-tsunami image are the concrete surfaces on which buildings were constructed. The inside waterway is the Arasan River. Its mouth can be seen on the west side of the images. The pre-tsunami image shows a high density of residential structures floating along the edge of the river near some aquatic vegetation. This entire area disappeared. The only recognizable human structure still

standing after the tsunami is a white tower at the west end of the peninsula. It is a sentry tower for boats entering the river. Dock facilities can be detected on the pre-tsunami image, just west of the large bridge. Just east of the area covered by the two images was a large modern port, now destroyed. This port linked Banda Aceh to communities on the west side of Sumatra. Without this port the cost of transporting vital building materials to Banda Aceh and other nearby communities has increased significantly and slowed down the rebuilding of the region.

Interpretive Learning...

- 1) Describe the differences between a normal tidal wave and a tsunami. A physical geography textbook might help.
- 2) Draw on the pre-tsunami image the boundaries of the areas washed away.
- 3) Discuss why people might want to rebuild in Banda Aceh after so much damage.
- 4) Identify what areas of the United States might experience large tsunamis.

Explore More...

Baumann, P. R., and M.D. Nellis. 2005. Remote Sensing Images of a Tragic Natural Disaster: The 2004 Indian Ocean Tsunami. *Geocarto International*, 20(1), 75-80.

National Geographic (Producer). 2005, January 7. The Deadliest Tsunami in History?. *National Geographic News*. Retrieved from:

http://news.nationalgeographic.com/news/2004/12/1227_041226_tsunami.html

United States Geological Survey. 2005. *Earthquake and tsunami in the Indian Ocean, 26 December 2004*. Pacific Coastal and Marine Science Center. Retrieved from:
<http://walrus.wr.usgs.gov/tsunami/indianocean.html>

Sources:

http://www.jsce.or.jp/committee/2004sumatra/chapter_10.pdf

http://www.adb.org/Documents/Resettlement_Plans/INO/39127/39127-07-INO-RP.pdf

<http://walrus.wr.usgs.gov/tsunami/sumatra05/>

Acknowledgements:

Content prepared by Paul R. Baumann, Professor Emeritus, State University of New York, College at Oneonta for CNL World.

Images courtesy of DigitalGlobe, Inc. Permission to use images granted by DigitalGlobe, Longmont, Colorado.

IcEarth is a program of CNL World • CNL World is a nonprofit, scientific education and professional outreach organization dedicated to providing educational opportunities.