

2004 Indian Ocean Tsunami

Google Earth Assignment Sheet

On the morning of December 26, 2004, at 0058 UTC a 9.2 magnitude earthquake occurred off the northern coast of Sumatra. This initial quake, the second largest in recorded history, triggered a 10-minute cascade of tremors along the plate boundary in the Indian Ocean for 1200km. It is estimated the plates shifted 10m laterally and 5m vertically resulting in a release of energy and water displacement equal to 100 gigatons of TNT. The tsunami that followed affected 14 countries and killed over 200,000 people. It completely circled the globe and is believed to have caused the Earth's rotation to wobble 1 inch.

In this assignment, you will calculate the speed these tsunami waves traveled to 18 different locations across the Indian Ocean. To find information regarding these locations, and other included sites of interest, select or double-click on the placemark's icon on the map or in the sidebar menu. Universal Coordinated Time (UTC) is given in 24-hour time format, and wave measurements are in meters. The region of the Indian Ocean from where the tsunami originated from is indicated on your map as a red area. Within this region, the plate boundary believed to have caused the tsunami is marked with a bold red line.

Directions:

- 1) **View the Placemark:** Double-click on the placemark's icon or listing in the sidebar menu for a close up view of the location. A pop-up screen will provide you with information on when the tsunami arrived in UTC and wave measurements in meters. Record the arrival time rounded to the nearest quarter of an hour on the *Tsunami Travel Log*.
- 2) **Calculate the Travel Time:** Find the elapsed time in which the tsunami traveled, keeping in mind that you are working with time. Express the elapsed time in decimal hours (15minutes = 0.25hours) on the *Tsunami Travel Log*.
- 3) **Measure the Distance:** Use the ruler tool to measure the most direct path in miles from the red line (within the red tsunami-generating region) to the location's placemark. You may need to zoom in or out, or turn the globe to accurately measure the distance. Record the distance on the *Tsunami Travel Log*.
- 4) **Calculate the speed:** Find the unit rate of speed in miles per hour by dividing the distance by the travel time. Record the speed on the *Tsunami Travel Log*.

Example:

Nagapattinum, Tamil Nadu, India

- measured distance of 879 miles
- elapsed time of 0100-0330 UTC = 2.50 hours
- 879 miles/2.50 hours = ??? mph

Discussion Questions

- ❖ Did you find the tsunami waves traveled at the same rate to each location? Which locations had the slowest waves? What could account for this?
- ❖ The tsunami took hours to reach locations around the Indian Ocean and yet most people were caught unaware. Almost 300 people died in Africa from the tsunami. Why do you think they weren't warned in time?
- ❖ Wave heights varied from location to location. Some measures given in the assignment were estimated wave heights, others were observed water heights on land, and others were tide gauge measurements. The distance the water reaches inland, or inundation, is also measured. What do you think are some factors that influence these numbers?
- ❖ Besides a better warning system, what are some other steps the affected countries could take to lessen the damage future tsunamis pose.

Explore

There are additional layers available for Google Earth for further studies of this tsunami and other natural disasters.

The National Geophysical Data Center (NGDC) offers a download of historic earthquake and tsunami data which can be added to your Google Earth files. Available at <http://www.ngdc.noaa.gov/hazard/>

The U.S. Geologic Survey (USGS) offers a Google Earth file that provides plate boundaries and real time earthquake data. Available at http://earthquake.usgs.gov/research/data/google_earth.php

The final two placemarks in your file provides links for further exploration of tsunamis and also links to images, simulations, and movies of the 2004 tsunami disaster.