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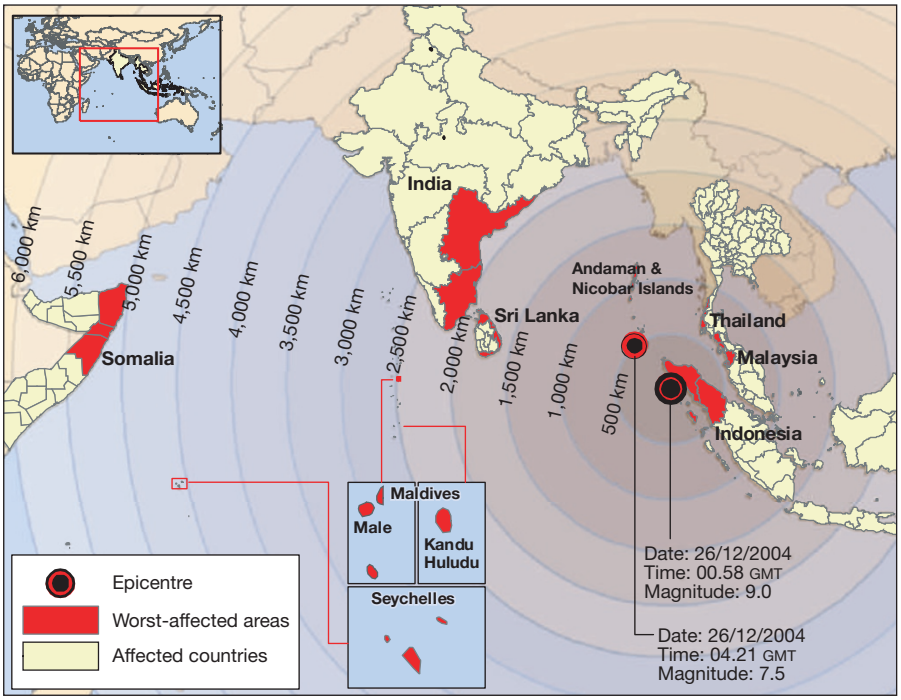

DIGITALGLOBE

The tsunami driven by an oceanic earthquake caused widespread destruction, as shown by these views of Banda Aceh, Indonesia, before and after the disaster.

always on the agenda," says Vasily Titov, a tsunami researcher at the Pacific Marine Environmental Laboratory in Seattle, Washington. But he says that it has been difficult to raise the money for a monitoring system. "Only two weeks ago it would have sounded crazy," he says. "But it sounds very reasonable now. The millions of dollars needed would have saved thousands and thousands of lives."

The most recent comparable event in the region took place in 1883 (see 'Tsunamis: a long-term threat', right). In contrast, earthquakes in Chile in 1960 and Alaska in 1964 led to the creation of a reasonably sophisticated tsunami warning system in the Pacific Ocean. Two international tsunami warning bodies exist under UNESCO's Intergovernmental Oceanographic Commission (IOC): the International Coordination Group for the Tsunami Warning System in the Pacific, known as ITSU, and the International Tsunami Information Center based in Hawaii. They get by on annual budgets from the IOC of about US$40,000 and $80,000, respectively, which are supplemented by grants from nations on the Pacific rim.

Displacement data

To predict a tsunami with any useful time advantage, researchers say, data on small changes in sea level and pressure have to be collected directly from the floor and surface of the ocean. The strength of the event depends on the displacement of the ocean floor, not on the strength of the earthquake.

Some buoys that could provide such data are already in place in the Indian Ocean. And only a few weeks before the tsunami struck, members of ITSU were talking about how these could be adapted for use in a tsunami-warning system, says Peter Pissierssens, head of ocean services at the IOC.

Within 20 minutes of the earthquake, at least three monitoring stations in the United States had detected it, initially estimating its magnitude to be around 8. The United States Geological Survey (USGS) circulated the information to about 100 people, mostly its own researchers and senior officials, within 16 minutes, and sent a more detailed bulletin to a list of external contacts, including the US Department of State, after an hour. The USGS has no responsibility for tsunami monitoring and its statement did not mention the risk of such an event.

The Hawaii-based Pacific Tsunami Warning Center (PTWC), meanwhile, sent out a bulletin to its regular circulation list, noting that the event presented no tsunami risk in the Pacific. According to Laura Kong, director of the International Tsunami Information Center, "let's keep an eye on it" was the prevalent attitude that night. "At that point, none of us expected anything like what we have seen," says Charles McCreery, director of the PTWC and deputy chair of

Tsunamis: a long-term threat

Last month's tsunami tragedy, shocking as it was, had ample historical precedent. On 1 November 1755, for example, a fire following an earthquake destroyed two-thirds of Lisbon, Portugal. In panic, the population sought shelter near the shoreline, only to be hit by waves said to be as high as houses. More than 60,000 people died.

Devastating tsunamis are known in historical times to have affected the populated coasts of Papua New Guinea, Japan, Hawaii, Crete, Sicily and the Crimea — to name just a few. In the Pacific region, where 80% of all tsunamis occur, a 1947 analysis indicated that seismic sea waves higher than 7.5 metres occur on average every 15 years[1]. Records going back to 684 BC refer to four Pacific tsunamis higher than 30 metres.

Outside the Pacific, tsunami frequencies have been studied in some detail only for the Aegean and Black Sea regions. Records there reveal that the coastal and surrounding areas of Turkey have been affected by more than 90 tsunamis over the past 3,000 years[2].

For most other areas, information concerning the return periods of tsunamis is scarce. A rough comparison of tsunami frequencies in different parts of the globe was done in 2000 by the London-based Benfield Hazard Research Centre, as part of its Tsunami Risks Project. The resulting risk analysis estimates the return periods of 10-metre waves to be about 1,000 years for the North Atlantic and Indian oceans, southern Japan and the Caribbean, 500 years for the Philippines and the Mediterranean Sea, 250 years for Alaska, South America and Kamchatka in eastern Siberia, and less than 200 years for Hawaii and the southwest Pacific.

The south Asian disaster will have a "huge effect" on instigating more thorough risk assessments, predicts Bill McGuire, a volcanologist and director of the London research centre, as well as encouraging preventive measures in threatened regions.

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www.nerc-bas.ac.uk/tsunami-risks

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