New tsunami early warning system stands guard

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(PhysOrg.com) -- The 2004 Boxing Day tsunami killed 230,000 people. The next time a tsunami threatens Indian Ocean nations, a lifesaving early warning system spearheaded by the EU will be in place.

Starting a few seconds before 1am universal time on 26 December, 2004, a 1600km segment of the Indian tectonic plate jolted downward just off the coast of Indonesia, lifting the seafloor by several metres and displacing some 30 cubic kilometres of water. With a magnitude of 9.2, it was the second strongest earthquake ever measured. The resulting tsunami waves - some of them 30m high - began to hit just 20 minutes later. They wreaked massive destruction and killed an estimated 230,000 people in Indonesia, Sri Lanka and 12 other countries.

This disaster, one of the deadliest in recorded history, brought home the urgent need for an effective system to give at-risk populations around the Indian Ocean as much warning as possible the next time a tsunami strikes.

Europe quickly rose to the challenge. Germany was the first to take action with the joint German-Indonesian tsunami detection and warning system called GITEWS.

Building on the infrastructure and experience developed through GITEWS, the EU funded and launched DEWS (Distant Early Warning System) in 2007 to include and provide protection to all the nations of the Indian Ocean region.

DEWS has now created and started to deploy a sustainable system to detect and analyse seismic events in the Indian Ocean, quickly assess their potential to unleash a tsunami, and warn all of the at-risk countries in time to save lives.

“It’s almost impossible to give numbers,” says Andreas Küppers, researcher in charge of the DEWS demonstrator, “but if DEWS had been in place in December, 2004, a very large number of lives could have been saved.”

Detect, model, warn - in time

An effective tsunami warning system starts with a network of strategically deployed detectors. In the case of DEWS, these include broadband seismometers, land and ocean-surface based GPS instruments, tide gauges and ocean bottom pressure control devices. The different kinds of sensors provide complementary information that allows more accurate assessment of the risk of a tsunami.

The data generated by this suite of instruments is streamed via communication satellites to a central station in Jakarta, Indonesia for processing. State-of-the-art open source software called SeisComP3 developed by the German Research Centre for Geosciences (GFZ), the lead institute for the DEWS project prototypes, rapidly determines the magnitude and location of a seismic event.

“The former systems needed 11 or 12 minutes to detect a signal and locate the source,” says Küppers. “The same can now be done in four minutes.”

Once the system detects an earthquake powerful enough to create a tsunami, it begins to analyse and model the risk of a tsunami. If waves are detected from ocean bottom pressure sensors or newly developed GPS buoys at the sea surface, it’s possible that a tsunami has been generated and will strike somewhere. The next question is where and with what run-up height.

Even with powerful computing capabilities, modelling an event as complicated as a tsunami in real time would take far too long. An earthquake along the Sunda arc - the source of the Boxing Day quake - can generate tsunami waves that hit the coast of Indonesia within 20 minutes.

The DEWS researchers solved that problem by using libraries of temblors of different magnitudes and source locations, coupled with detailed simulations of the waves they would create around the entire Indian Ocean coastline.

When an actual earthquake shakes the region, the DEWS system automatically finds the simulation that best fits the event, and uses that to determine which coastal areas are at risk.

“It’s not possible to do all the modelling of wave propagation and direction immediately after the event,” says Küppers. “But the system works well with our prefab models.”

With 20 countries to warn and a Babel of languages to deal with, the DEWS team has to put as much effort into the linguistic challenges and politics of how to warn all these countries and their at-risk population as into the technological and computational infrastructure.

The system has a component to compose and distribute messages and another to control if messages have been properly received or not. In addition, it is a multilingual system that can distribute different messages to different people in different languages, says Küppers. “It was even more difficult politically to get all the players together at one table,” he adds, ”but we are well on our way to overcoming those problems as well.”

The working system has been demonstrated in association with DEWS project conference. Decision-makers in local and regional authorities have expressed interest in the DEWS project working system.

Bringing the benefits back home

Building on the success of DEWS in the Indian Ocean basin, the focus shifts to Europe, where a tsunami may occur at any time either in the Mediterranean Sea or in the North-East Atlantic.

Greece, Turkey and Portugal are the countries at greatest risk, but all the nations bordering the Mediterranean could be safer once DEWS is implemented there as well. Many preliminary steps toward that goal will be taken by other EU-financed projects such as TRANSFER, NERIES and SAFER.

Perhaps the single greatest innovation flowing from DEWS is the realisation that minimising infrastructure damage and loss of life from a natural or manmade disaster requires an enormous amount of technical knowledge and a high degree of coordination. As a result, the consortium is advocating the development of a new profession - that of the 'early warning engineer'.

"If you want to tackle these problems properly, you have to take the time and effort to involve everybody," says Küppers. "So we'd like to see people acquiring a new full-scale profession and be able to take care of the whole early warning field."

More information: DEWS project - www.dews-online.org/

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