March 18 | News breaks. We analyze. You invest. Get Barron's Take.
FedEx, UPS Can Still Deliver
FedEx's better-than-expected quarterly earnings suggest that the shipping ... More
BARRON'S

Dow Jones Reprints: This copy is for your personal, non-commercial use only. To order presentation-ready copies for distribution to your colleagues, clients or customers, use the Order Reprints tool at the bottom of any article or visit www.djreprints.com
▪ See a sample reprint in PDF format. ▪ Order a reprint of this article now

THE WALL STREET JOURNAL.
WSJ.com

OPINION EUROPE | DECEMBER 22, 2009, 5:20 P.M. ET

How Prepared Are We for Another Tsunami?

Five years after the deadly wave in the Indian Ocean, our ability to forecast and warn of a dangerous tsunami has increased considerably.

By JULIAN HUNT

It is now estimated by the United Nations that the devastating Indian Ocean Tsunami of Boxing Day 2004 killed around 187,000 people, with approximately 43,000 still missing. The tsunami was the largest in the Indian Ocean for more than 700 years, triggered by the fourth-largest earthquake in the world since 1900.

As well as the terrible human cost, the physical and environmental devastation wrought was truly massive, with the impact disproportionately felt by the poor. In Aceh alone, hundreds of thousands of homes were flattened, around 800 kilometers of coastline was destroyed, and approximately 3,000 hectares of land were washed away, taking roads, ports, bridges and other vital infrastructure with it.

Five years on, there remains much left to learn about tsunamis, but our understanding of their risks and how to reduce them through forecasting, warnings, and better tsunami-resistant construction and design has advanced considerably.

• *Warning systems.* One reason the Indian Ocean tsunami proved so catastrophic was the fact that warning systems in the region were virtually nonexistent. Since then, there has been progress in most aspects of warnings across the world, and the Indian Ocean itself now has a regional system in place.

The value of warning systems was underlined yet again this month when they were used very successfully after the Dec. 4 Samoa tsunami.

However, other countries around the world have not benefited in this same way. Warning systems tend to be more effective and reliable where natural hazards recur on a regular basis. Tsunamis are an example of an infrequent and variable type of secondary geophysical hazard, and thus warning systems are still not in place in all areas.

The further complication is that, even with a warning system in place, some communities close to epicenters still may not receive the relevant information in time. Indeed, had the current Indian Ocean warning system been in place in 2004, it may not have helped many of those who were earliest to be hit by the tsunami.

This is why 80% of tsunami casualties tend to occur before any official or technically based warning actually arrives, unlike the case of more slowly evolving and propagating hazards such as hurricanes or flood waves, which generally have limited numbers of casualties.

However, for more distant communities (e.g. the Kenyan fishermen community, where the tsunami arrived six hours after its initiation off Sumatra in December 2004), warnings can be communicated effectively. These warnings (which came through community groups, mobile phones and TV in Kenya) save many lives, as was shown most recently in Samoa. Research shows that the key is to distribute data quickly, openly and locally, so that it is available in the right form, at the right place and at the right time to prevent loss of life.

• *Forecasting.* The tsunami warning systems in the ocean, which are currently coordinated by the Intergovernmental Oceanographic Commission, are not integrated between countries. However, there will be discussions about enhanced exchange of the data and forecasts as warning systems become more reliable. This will place a premium upon better forecasting.

Although early indicators of tsunamis have been identified, this has usually been after the event, and these are still not reliable enough to be widely used. Certainly, the standard seismic models did not predict the December 2004 earthquake that caused the tsunami and might not have predicted other tsunami sources such as submarine landslides or volcanic eruptions.

Perhaps the most promising research for enhancing our predictive capability is holistic geophysical forecasting. This makes use of the fact that the sizes of tsunami-related disturbances are so large and so powerful that they disturb the solid earth, the oceans and the atmosphere. These disturbances do not just lead to mechanical forces and release of heat, as in storms, but they also affect electrical, magnetic and molecular processes, especially higher up in the atmosphere.

Modern instruments have become so sensitive that they can measure magnetic fields one millionth of the strength of the earth's magnetic field, so that tremors in the lithosphere can be detected long before large earthquakes and tsunamis actually occur. Research at the Geoelectromagentic Research Center in Moscow also confirms that the motions in tsunami waves, once initiated, can be detected over many hundreds of kilometers from distant measurements of weak, slowly changing magnetic fields.

• *Resilient infrastructure.* Even with better prediction and warnings, the Indian Ocean tsunami underlined the need for more resilient infrastructure and community planning. Since 2004, for instance, many people near coastlines in the region sleep at higher elevations to avoid surprise tsunamis at night.

Research is now leading to more ambitious solutions for building resilient infrastructures. At several research institutes, including Delft University of Technology, University College London, the University of Arizona, and HS Wallingford, work is under way to explain why, in December 2004 when the waves approached beaches, the sea retreated and then roared up the beach in a huge surge that drowned thousands of people and destroyed many buildings.

With specially constructed laboratory wave-makers, these events have been reproduced; but mathematical models and computations are now needed to turn the experiments into reliable estimates for engineers and for community planners to build tsunami proof-structures and plan more resilient communities. With global warming, these calculations also take account of the increasing danger as the sea level rises—which is happening three times faster in tropical seas where tsunami risk is greatest.

Lord Hunt is a visiting professor at Delft University and former director-general of the U.K. Meteorological Office.

Copyright 2009 Dow Jones & Company, Inc. All Rights Reserved
This copy is for your personal, non-commercial use only. Distribution and use of this material are governed by our Subscriber Agreement and by copyright law. For non-personal use or to order multiple copies, please contact Dow Jones Reprints at 1-800-843-0008 or visit www.djreprints.com