THE TIMES
HIGHER
EDUCATION SUPPLEMENT

Published: 14 January 2005

Self-centred West's narrow focus puts lives at risk

The study of tsunamis has been neglected because the national priorities of developed countries drive the international research agenda, says Costas Synolakis

By Costas Synolakis

Before 1946, little was known of tsunamis apart from the one triggered by the volcanic eruption of Santorini (or Thera) 3,500 years ago. The Lisbon tsunami of 1755 and that of Krakatoa in 1883 were virtually uncharted territory.

The US has led the study of modern tsunamis and the efforts to mitigate their impact. The Pacific Tsunami Warning Center was established in Hawaii after the 1946 tsunami that wiped out the Scotch Cap lighthouse in Unimak, Alaska and killed 173 people in Hawaii. After the 1960 Chilean tsunami that killed 1,000 people in Chile, 61 in Hawaii and 199 in Japan, the International Tsunami Information Center, sponsored by the United Nations, was formed to coordinate tsunami warning for Pacific countries.

Initially, US research focused on a distant threat and ignored the local tsunamis. But after an Alaskan tsunami killed 120 people in 1964, the Alaska Tsunami Warning Center was set up in Palmer to confront the problem in North America. Four years later, Unesco formed the International Coordination Group for the Tsunami Warning System in the Pacific - including 26 countries linked to the PTWC and ITIC. No contributions are required, but members must identify local emergency management officers who can interpret tsunami warnings.

In 1992, a 7.2 magnitude earthquake in California generated a tsunami but killed nobody. It was the first subduction earthquake (where one tectonic plate moves under another causing a rupture) recorded on the US West Coast by modern instruments. Soon after, Nicaragua suffered its first tsunami of modern times, which laid bare the deficiencies in understanding - models underestimated

coastal flooding by a factor of ten.

Both events triggered concern that larger earthquakes could generate big tsunamis along the heavily populated West Coast. The National Science Foundation began funding field surveys and the development of new models to predict tsunami behaviour; the US National Tsunami Hazard Mitigation Program was formed a few years later.

At the time, it was clear that forecasting expertise and general education about tsunamis were needed to protect populous US coastlines and to create a mitigation model for other nations to follow. Forecasting requires taking tsunami measurements from the deep ocean and the transmission of data to a warning centre in real time. It took 30 years to achieve this and to come up with the tsunameter, an instrument that gives researchers and practitioners the basic information to understand and predict tsunamis.

Mathematical models of tsunami dynamics are also necessary, and these, combined with the tsunameter, have allowed scientists to move from detection to forecasting and will lead to accurate predictions that save lives.

The NTHMP introduced the concept of tsunami-resilient communities.

Scientists working with emergency managers prepared educational materials for schools in places deemed at high risk. Inundation maps were drawn up to help planners understand the geographic extent of future tsunami inundation and plan evacuation routes. The system apparently worked, at least for the US, Japan and possibly Chile and a few other PTWC/ITIC members.

As we have painfully found out, it has not worked for anybody else. The images from Sri Lanka, Thailand and Indonesia that have filled our TV screens, along with survivors' accounts, are all too familiar to those of us who have conducted tsunami field surveys. At times, some of us thought that we were seeing images from Flores in Indonesia in 1992, East Java in 1994, Irian Jaya in 1996, Papua New Guinea in 1998 or Vanuatu in 1999 - catastrophes in countries with similar landscape and coastal construction.

But the response of residents and tourists was unfamiliar, at least to scientists working on post-Nineties tsunamis. In one report, swimmers felt the current of the leading depression wave approaching the beach but hesitated because the fear that an earthquake was coming suggested they would be safer away from buildings. They had to be told by Japanese tourists (for whom an understanding of tsunamis is now almost hard-wired) to run to high ground. And holiday-makers on Phi Phi Island, Thailand, were taken back to nearby Phuket an hour after the event started, oblivious to the fact that tsunamis often persist for several hours after the initial wave.

Contrast this with what happened in Vanuatu in 1999. On Pentecost Island, the locals watch television once a week when a truck with a satellite dish, VCR and TV stops by. When the International Tsunami Survey Team visited days after the tsunami struck, they heard that the villagers had previously watched a Unesco video (made after the 1998 Papua New Guinea disaster).

When they felt the ground shake, they ran to a nearby hill. The tsunami swept through, razing the village to the ground. Only three people out of 500 died, because they were unable to run like the others - and this tsunami had hit at night.

So what happened in this most recent disaster? The PTWC issued a tsunami bulletin concluding there was no

danger for the nations in its jurisdiction. Why wasn't the bulletin extended to Indian Ocean region?JClearly, the hazard had been grossly underestimated. Even the first PTWC warning reported the earthquake as magnitude 8.0 instead of 9.0. To give local governments the benefit of the doubt, the last transoceanic tsunami to hit the region was caused by the 1883 eruption of Krakatoa.

Other large earthquakes along the northern Sumatra trench had not sparked major tsunamis.

The potential for mega-thrust earthquakes has only started being discussed in conferences and has not, with hindsight, attracted the attention it deserves. Floods and damaging storms occur in the region nearly every year; less frequent natural hazards tend to be ignored. No nation can be ready for every eventuality - at least until a major disaster highlights the risk. For this reason, the Indian Ocean governments may not have felt they needed the PTWC's services or simple, inexpensive mitigation strategies such as public education - but the governments of the developed nations should have known better. The UN's decade of natural disaster reduction (1990-2000) passed with no real action being taken. Japan and the US took steps to protect their citizens but did little to extend this protection - Jthough political instability in Indonesia and elsewhere has not helped.

Another problem is the priorities of funding bodies. Any geophysicist working in the West knows how much easier it is to get funding to study hazards close to home rather than those abroad. One junior faculty member was famously advised that he might not get tenure because he was only working on the obscure Anatolian fault. Weeks later, the fault ruptured, causing the 1999 Izmit earthquake and tsunami that killed more than 17,000.

The budget of the US National Science Foundation for tsunami hazard mitigation is dwarfed by its fluid dynamics research budget (with its potential for use in military applications). The ocean floor remains largely uncharted, leaving hazard zones unidentified, and is less familiar to scientists than the surface of Venus. One brilliant Indian scientist working on the generation of tsunamis left the field to focus on more marketable studies in defence-related fluid mechanics. In the US and the UK, geology, geophysics and coastal engineering have tended to attract the smallest numbers of graduate students. In the US, only one new faculty position in tsunami hydrodynamics has been added in more than 20 years.

Nature and Science have published less than a handful of original articles on tsunamis in the past five years. Students perceive quickly what most working scientists know: the national priorities of developed countries drive international research and educational agendas. Market forces mean that only elite universities train students to think outside current paradigms. The market discourages original thinking to maximise productivity; innovation is encouraged, initiative is not. How can one blame PTWC scientists for following intergovernmental agreements and not taking non-trivial initiatives to determine if a tsunami risk existed beyond their jurisdiction (if they did not)?

International research and education priorities must reflect the reality that no nation is immune in an era of global citizenship. Globalisation must extend beyond free trade. The UN Intergovernmental Oceanographic Commission must continue its efforts to develop a long-term approach to tsunami hazard mitigation through a coordinated

programme involving assessment, warning guidance and mitigation for communities at risk.

Extensive studies to map the seafloor at high resolution, improved numerical wave-propagation models, new studies to document prehistoric tsunamis and the deployment of tsunameters will help to identify risk zones, monitor occurrences and develop inundation maps to guide evacuation plans. Indian Ocean scientists, disaster managers, policy-makers and local communities need to work together to create tsunami-resistant communities with access to accurate warnings.

A warning centre must be established as soon as practicable in the region (Indian Ocean nations need to ask the PTWC to act as an interim warning centre). Many developing countries do not have the resources to do this and will need assistance. Even among Pacific Rim nations, only three have comprehensive inundation maps, and none has maps charting the probability of tsunami flooding that reflect the realities of the past 30 years. All organisations and nations with knowhow in hazard mitigation should help implement the UN's global plan before the next tsunami strikes.

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