Earthquakes off Sumatra

Indonesia's tsunami-warning system is scheduled to enter full operational mode by March 2010. The sooner it runs, the better: the threat of a tsunamigenic earthquake in the region is still imminent.

Indonesia has had no shortage of natural disasters over the past few years. Since the devastating earthquake and tsunami on Boxing Day 2004, the Sunda megathrust has not come to rest. The megathrust marks the line where the Australian plate sinks beneath the Eurasian plate, and traces the chain of Indonesian islands (except Borneo) to the west of the archipelago. As a result of ruptures along the Sunda megathrust, Indonesia has been subject to what has been termed an 'earthquake storm', a cluster of large earthquakes within a relatively short period of time. The latest catastrophe occurred near the Sumatran city of Padang on 30 September 2009, with a moment magnitude of M_W 7.6, and a loss of over 1,000 lives.

The Sumatran quake occurred just within the Mentawai segment of the Sunda megathrust. This section has been intact for about 200 years, unlike most of the length of the megathrust that ruptured in the chain of quakes since 2004. As a consequence, the Mentawai segment has built up stress over two centuries, and had been highlighted as a hotspot for earthquake and tsunami-generation risk (*Nature Geosci.* **2,** 87–88; 2009). But a Correspondence on page 70 of this issue concludes that the September 2009 Padang earthquake was not the one that seismologists had been waiting for: last year's quake did not rupture the Sunda megathrust. The dreaded quake is still to come, and it may well generate a tsunami.

It is high time, then, that the gap in the detection and warning of tsunamis in the Indian Ocean was closed. The poor state of tsunami monitoring and the necessity for improvement in this part of the world became unquestionable after the 2004 disaster. In the aftermath of the catastrophe, three regional centres for tsunami warnings were established in Indonesia, India and Australia**.** Any warnings are communicated to national focal points in all countries with a coastline facing the Indian Ocean, where national alarms can be triggered. The international community provided scientific, technical and financial support to Indonesia to rapidly build a comprehensive tsunami-warning system.

Formally launched in November 2008, the German–Indonesian tsunami early-warning system (GITEWS) relies on seismographs to detect earthquakes in the region, satellites that monitor the seabed to identify tsunami potential, and deep-sea recorders, buoys and coastal stations to measure the actual tsunami. The seismic component of the system has been operational for some time, and proved itself in two earthquakes in September 2007, when a tsunami warning was issued correctly less than five minutes after the shaking.

The complete decision-support system, taking in additional data from satellites, buoys and seabed recorders, is at present running in test mode. When the seismographs registered the earthquake last September, the system issued a note to the Indonesian administration within three minutes that no tsunami was expected. Although a mini-tsunami with a wave height of 20 cm was later registered by a coastal station, the response was perfectly adequate. Full operational mode is expected to start by March 2010, but the training of local staff is likely to continue.

As a consequence of the small distance between the Sunda megathrust and the Indonesian coastline, a tsunami generated on the Mentawai segment could reach densely populated land within 15 to 20 minutes. Under these conditions, a reliable warning going out as soon as 5 to 10 minutes after the shaking may come too late to warn the population nearby, who will, in addition, be affected by the earthquake itself. Getting the message out quickly enough is likely to remain the system's weak point.

While the memory of the 2004 catastrophe is fresh in everyone's minds, alerts are likely to be acted on appropriately and without delay. But when several hundred years lie between devastating tsunamis, as has been documented for Indian Ocean coastlines before 2004 (*Nature* **455,** 1228–1231, 1232–1234; 2008), local knowledge and alertness are lost.

For the moment, however, a long wait for the next event and a consequent loss of the sense of danger is unlikely. The cluster of earthquakes that started on the Sunda megathrust in 2004 is not yet complete. The new Indonesian tsunami-warning system will need to prove its ability to save lives when the Mentawai section of the Sunda megathrust breaks, probably within the next decade or two. ❐

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GFZ DEUTSCHES GEOFORSCHUNGSZENTRUM

Components of the German–Indonesian tsunami early-warning system (GITEWS). From left to right: an ocean buoy, a deep-sea seismic recorder and a coastal tide-gauge station.

Correction

In the Editorial 'Earthquakes off Sumatra' (*Nature Geosci.* **3,** 69; 2010), the word 'immanent' in the standfirst should have been 'imminent'. This error was corrected online in the HTML and PDF versions of the text on 7 February 2010.