Scientists Issue Indonesia Earthquake Warning

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The stresses in the earth's crust which have resulted from the Sumatra-Andaman earthquake have significantly increased the risk of another large earthquake in the already-devastated Indonesian island of Sumatra, according to new research findings by scientists from the University of Ulster's School of Environmental Sciences.
According to their calculations, published in this week's edition of leading scientific journal Nature, the Christmas 2004 earthquake which generated the massive tsunami which hit Indonesia, Thailand, India and Sri Lanka and killed 300,000 people, has significantly increased the stress on two other fault zones in the area - one of them running directly under the city of Banda Aceh which was so badly effected by the Boxing day event - the other under the sea off the west coast of Sumatra.

The latter could generate another tsunami.

The University of Ulster team, led by Professor John McCloskey of the School of Environmental Sciences, analysed data from the 2004 Sumatra-Andaman earthquake to look at its impact on other faults in the area. The analysis process is described in the Notes For Editors below.

The analysis found two zones showing significantly increased levels of stress - one in the Sunda trench, a 50km-long underwater zone off the northern tip of Sumatra, and the other in the Sumatra fault, which runs for 300km along the centre of the island of Sumatra, ending under the city of Banda Aceh.

“Our results show a stress increase of up to 5 bars in the Sunda trench next to the rupture zone, and a strong positive loading of 9 bars for 300km of the Sumatra fault,” said Professor McCloskey.

These levels of seismic stress indicate significantly increased risk of an earthquake, said Professor McCloskey. Previous work on the earthquakes on the Sunda trench show that it has produced large (up to M8.5) earthquakes and two in 1833 and 1861 produced fatal tsunamis.

An earthquake in the Sumatra fault might be expected to have a magnitude up to about M7.5, but because it is not underwater, would not cause a tsunami.

“We have all heard that lightning does not strike twice in the same place -but earthquakes do’ he said. ‘One of the strongest observations in seismology is that earthquakes cluster in space and time. Where you have one earthquake you are likely to have others.”

How sure are we that another event will occur? “We do know that the increase in stress is real and that ultimately it is stress that causes earthquakes. This much is sure. There is a strong relationship between these results and the probability of another earthquake in Indonesia.

“Unfortunately, we do not yet know how this relationship works out in detail. The mapping is certainly not one-to-one.’ said Professor McCloskey.

But we can learn a lot from other examples, he said.

“The recent destructive earthquake at Izmit in Turkey (magnitude 7.4) was probably triggered by stress increases of less than two bars over an area of about 50km. It in turn triggered another earthquake (magnitude 7.1) at Düzce, just three months later. Again, the stresses were on the

order of a couple of bars. Our calculations show that the stresses on the Sumatra fault increase to about 9 bars near the city of Banda Aceh. The stress remains positive for about 300 km to the south. These stresses are big and extensive," he said.

In the wake of their findings, the UU team have added their voices to the calls for a tsunami early-warning system to be put in place in the Indian Ocean as a matter of urgency. "The loss of much of the life in the December earthquake was avoidable. The science is well understood, the warning systems are in place in the Pacific region The levels of preparedness, public awareness and education in this region are high and do save lives. Unfortunately the people of the Indian Ocean region have neither benefited from this knowledge nor from the available technology," said Professor McCloskey.

"Our results indicate unambiguously that there is a real danger of another earthquake in the region. It is vital that disaster fatigue does not delay the implementation of the Circum Indian Ocean Tsunami Warning System."

Recent information indicates that the German government has allocated €40m to putting this system in place.

Stress analysis details

The analysis technique used in the University of Ulster research involves three stages:

Firstly, the exact displacements which occurred in the earthquake are calculated by repeatedly trying to reproduce the earthquake waves which were generated by the earthquake around the world.

When these synthetic waves have a very similar form to the observed

waves then scientists know that their model for the slip distribution closely resembles what actually happened. This process, known as waveform inversion, has been shown to give very dependable results.

It was carried out very quickly after the earthquake by scientists at the California Institute of Technology (Caltech) who posted their results on the Web at the end of December.

Any movement in a three dimensional solid body, like the displacement on an earthquake in the earth's crust, is felt as a change in force everywhere within the body. The team from the School of Environmental Sciences took the results from Caltech and have estimated the effect of the earthquake in whole Indonesian area. This involves calculating the amount of stress at any point which is caused by the slip on the earthquake.

The final stage is to examine geological maps of the area to identify active faults in the region which are liable to give large earthquakes. Two such structures are the Sunda trench and the Sumatra Fault. The stresses calculated in the second step above are then resolved onto these faults. They are coloured red where a future earthquake has been made more likely and blue where a future earthquake has been made more likely. "We don't see blue anywhere on our map," said Professor McCloskey.

Source: University of Ulster