NEWS

Haiti Earthquake Underscores Need for Better Use of Seismic Information

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When Eric Calais, professor of geophysics in Purdue University's Department of Earth and Atmospheric Sciences, first learned about the 12 January strike-slip earthquake along a portion of the Enriquillo–Plantain Garden fault zone (EPGFZ) in Haiti, he knew right away that it would be a shallow event and a large event, very close to the capital city of Port-au-Prince. Having worked in Haiti, he also was aware that the poor nation lacks seismic and building construction codes. "My immediate reaction was, 'This is going to be a total nightmare and a huge disaster for Haiti,'" Calais, who also is a researcher at the French National Center for Scientific Research, told *Eos*.

The main earthquake, currently estimated at magnitude 7.0, occurred at 2153:10 UTC at a depth of 13 kilometers, just 25 kilometers outside of Port-au-Prince, the U.S. Geological Survey (USGS) reports. Since then, there have been dozens of aftershocks, many of them above magnitude 5.0; these aftershocks could continue for weeks or even months, according to USGS (see Figure 1). In recent decades, there had not been a major earthquake along the approximately 600-kilometer-long EPGFZ (named after the end points in Jamaica and the Dominican Republic), although seismologists indicate that large earthquakes in 1860, 1770, and earlier likely originated along that system.

Potential Earthquake Warning

Calais and other scientists who have been conducting seismic research in the region had warned about the potential for a major earthquake. A 2008 article he coauthored, "Interseismic plate coupling and strain partitioning in the northeastern Caribbean," published in *Geophysical Journal International* (*74*(3), 889–903), indicated that "the Enriquillo fault in Haiti is currently capable of a M_w 7.2 earthquake if the entire elastic strain accumulated since the last major earthquake was released in a single event today." The article also noted, "The model slip rate deficit, together with the dates of large historical earthquakes, indicates the potential for a large (M_w 7.5 or greater) earthquake on the Septentrional fault in the Dominican Republic."

Calais and colleagues had met with Haiti's prime minister and interior minister in May 2008. The officials "were very concerned; they believed what we said, believed the message; they understood the threat. And in the end, nothing was done," Calais said. However, he is quick to point out that the Haitian government should not be blamed for inaction, because the quake occurred just 1.5 years after the study was published, insufficient time to implement any substantial programs.

Pamela Jansma, dean of the College of Science at University of Texas at Arlington and coauthor of the 2008 paper, said she too was not surprised the earthquake occurred. She said people often do not consider the Caribbean as an earthquake-prone region because the relative motion between the Caribbean and North American plates is only about 2 centimeters per year. "It is among the slowest plate boundaries in the world," she said, comparing it with the southwestern Pacific plate's convergence of about 10 centimeters per year. "Even if the motion is slow, if you accumulate enough time, you can still have a significant rupture."

"These strike-slip plate events pack an extra punch as a result of their proximity to dense populations jammed onto relatively small island countries and poor construction practices common on steep slopes," Paul Mann, senior research scientist with the Institute for Geophysics at the University of Texas at Austin, told *Eos*. Mann, who has done research about the fault system for several decades, said the infrequency of earthquakes can lead to complacency on the part of the public, the government, and even the scientific community. "The fundamental problem in the Caribbean and many other areas of infrequent but large earthquakes is that our human life spans are much shorter than the recurrence interval on major earthquakes, which typically last for centuries."

Focus on Humanitarian Effort

Since the earthquake, scientists have been focusing on the humanitarian effort, including keeping track of damaging aftershocks and the possibility of landslides. In addition, they are concerned about the effect of the earthquake on the fault system.

Michael Blanpied, associate coordinator for the USGS Earthquake Hazards Program, said, "It is safe to say that this earthquake broke one section of a much longer fault. One of the things that is of some concern is whether other parts of that fault are prime for failure. So scientists will be taking a pretty close look at what the state of other parts of that fault are, some of which are undersea and some of which are on land, and see if we can determine more information to give an indication about whether there are particular parts of high concern."

Blanpied, who noted that about 15 earthquakes of magnitude 7 or greater occur each year, mostly away from heavily populated regions, said that as the rebuilding process begins, "that is the point at which science can really come into play in trying to inform that process." Science could help with proper rebuilding and land use planning so that the region "becomes a much more resilient community that can ride out these earthquakes and tsunamis when they come in the future," he told *Eos*.

Calais noted that the 12 January quake, which may wind up being considered closer to magnitude 7.1 or 7.2 after more analysis, was not "the big one." He said a magnitude 8 quake is "not impossible" along that fault. He added that it is possible the earthquake may trigger large events either to the east or west along the same fault, and said some scientists are making calculations to try to determine that. He cautioned that people who live in the southern part of Haiti and the Dominican Republic should be prepared for future potential large earthquakes. But, he said, "there is no time line that we can provide."

Calais added that advance understanding about the 12 January quake was a "success story" from a scientific perspective. "I'm kind of sad that we were right on this one," Calais told *Eos*, noting that scientists had a scenario but did not know when or specifically where along the fault system the earthquake would occur.

Lessons for the Future

"The lesson of this earthquake is that scientists can be right, and can provide useful information, and we have to do a better job," Calais said. "We have got to use this event to raise awareness not only in Haiti, but at a much broader scale, and better connect the scientific community—researchers like me—with decision makers, with politicians, and with people who know how to handle natural hazards from a practical point of view."

Brian Tucker, president of GeoHazards International, Palo Alto, Calif., said he hopes a portion of the funds being raised to help Haiti are set aside to help prevent similar disasters in the future, perhaps affecting other communities along the same fault.

Tucker said a key role for scientists is to move people away from fatalism and to educate them that something can be done to protect vulnerable communities from earthquake tragedies. "Scientists know where earthquakes are going to occur; they know approximately the capacity of faults. We have got to get away from this fatalistic mentality that we can't do anything about it," Tucker said.

He added that it was unfortunate that buildings occupied by agencies and organizations such as the United Nations also collapsed during the earthquake. "Had they built their buildings to be earthquake-resistant, they would have stood amidst all the rubble as a symbol that we are capable of withstanding this earthquake shaking, and that it is not God's will that everyone die. That it is not an act of God, but that it is an act of man to build these things poorly."

Tucker noted that there have been some isolated improvements in earthquake hazard preparedness in California and elsewhere around the world. But he questioned whether these improvements are keeping pace with problems caused by rapid urbanization in developing countries. "The story is getting boring," he said, referring to repeated earthquake tragedies. "It's always the same thing: that people are not prepared and they spend 10 times as much money responding to and repairing the event than would be necessary if we prepared for it rather than waiting until it occurred."

The earthquake in Haiti, Mann told *Eos*, provides the science community with an important "learning moment." Scientists and science funders in developed countries "need to become more proactive and systematic about focusing research efforts on faults capable of *M* 6–8 quakes, especially in densely populated areas with poor construction practices." He said funding also should be targeted for earthquake engineering and for earthquake education and outreach.

Mann, too, expressed concern about the potential for seismic events in other locations, including possibly along other segments of the same fault zone and along the parallel Septentrional fault zone (which, he indicated, is "exactly the same type of 'time bomb' plate boundary strike-slip fault as the EPGFZ 'time bomb' was to Port-au-Prince and its environs").

Noting that the Haiti earthquake released about the same amount of energy (32 megatons) as the largest thermonuclear bomb ever tested and has affected millions of people, Mann added, "Countries with faults threatening dense populations need to approach earthquake 'defense' with the same energy, consistency, and level of scientific spending as devoted to their military defense."

For more information, visit http://earthquake.usgs.gov/earthquakes/eqinthenews/2010/us2010rja6/, http://web.ics.purdue.edu/~ecalais/haiti/, and http://www.jsg.utexas.edu/news/rels/011310.html.

—Randy Showstack, Staff Writer

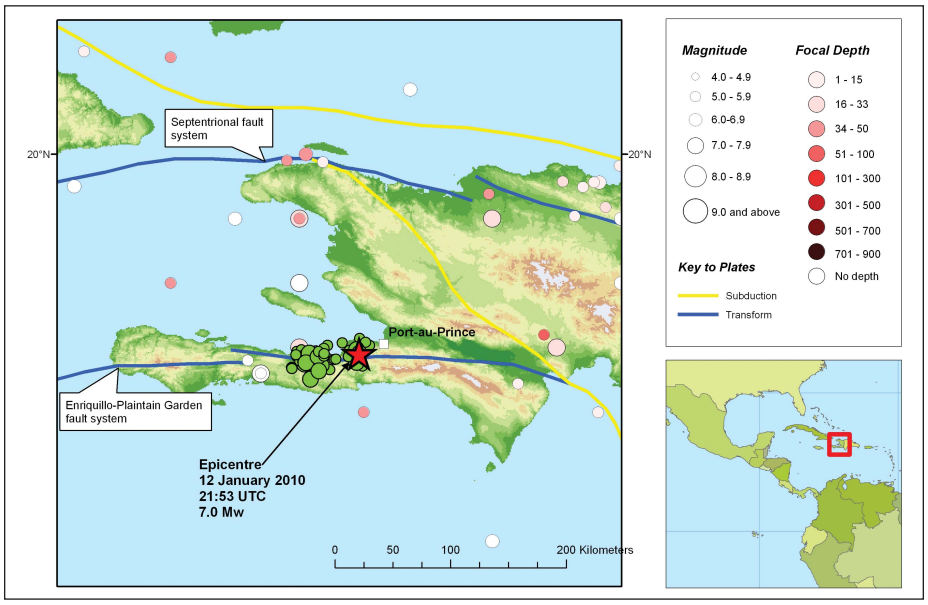

Fig. 1. Red star indicates the epicenter of the magnitude 7.0 earthquake on 12 January. Green circles indicate some of the aftershocks. Historic earthquakes are in red and pink; focal depths are in kilometers. Topography and epicenter information courtesy of U.S. Geological Survey. The figure is reproduced and modified with permission from the British Geological Survey © Natural Environment Research Council.