

## Learning from the Disasters in Japan and New Zealand

*These earthquakes are among the most significant and relevant events for the earthquake community in the last several decades.<sup>1</sup>*

The New Zealand earthquakes of September 4, 2010, and February 22, 2011, and the Tohoku Japan earthquake and tsunami of March 11, 2011, presented rare learning opportunities that are highly relevant, not only to the affected countries, but also to the United States. On February 9 and 10, 2012, the Earthquake Engineering Research Institute (EERI) convened a workshop to review what was already being learned from these tragic events and to consider what and how further lessons could be drawn from them.

The National Science Foundation (NSF), one of the four NEHRP agencies, supported the workshop and EERI's subsequent report about the meeting.<sup>2</sup> Attendees included more than 100 researchers and representatives from universities, research organizations, and government agencies in the United States, Japan, and New Zealand. The NSF Director, the Japanese and New Zealand Ambassadors to the United States, and the Executive Director of the Japan Science and Technology Agency opened the workshop and expressed their strong support for the international collaborative effort to learn from these great disasters. Most researchers had been engaged in studies related to the Japan or New Zealand earthquakes under projects supported by NSF's Rapid Response Research (RAPID) grant program.

### Offering Lessons for Many

The settings of the New Zealand and Japan disasters—modern, developed, urbanized regions with social and built environments comparable to those in the United States—make their lessons applicable far beyond the areas impacted. In the case of the Tohoku Japan earthquake and tsunami, even the geologic setting (an off-shore subduction zone) has counterparts elsewhere, including in the U.S. Pacific Northwest.



*Devastation in Japan's Miyagi Prefecture following the 2011 Tohoku earthquake and tsunami. Credit: NOAA/NGDC, Shunichi Koshimura.*

The complexity and longitudinal aspects of these events also add to their educational potential. The New Zealand earthquakes illustrated the challenges that can be thrust upon a single urban area by a series of earthquakes. The March 2011 Japan earthquake triggered a series of events that affected a wide area and illustrated the cascading failures that can accompany large earthquakes, with wide-ranging and long-lasting consequences.

It is not only the kinds of data that are potentially available, but also the accessibility of these data, that made the Japan and New Zealand earthquakes such promising learning opportunities. Both countries have well-developed seismic monitoring systems and earthquake research communities that documented the disasters in unprecedented detail and are willing and able to collaborate with U.S. researchers.

### What Is Being Learned?

The workshop began with a review of 51 research projects initiated through the RAPID program in the wake of the earthquakes in New Zealand or Japan. Posters<sup>3</sup> and presentation slides<sup>4</sup> were used to summarize the objectives of these projects and the findings

<sup>1</sup> EERI, "The 2010 Canterbury and 2011 Christchurch New Zealand Earthquakes and the 2011 Tohoku Japan Earthquake: Emerging Research Needs and Opportunities," May 2012, [www.eeri.org/wp-content/uploads/JAPAN\\_NZ\\_RAPID\\_Workshop\\_Final.pdf](http://www.eeri.org/wp-content/uploads/JAPAN_NZ_RAPID_Workshop_Final.pdf), p. 5.

<sup>2</sup> NSF supported the workshop and preparation of the report cited above under grant CMMI-1154279.

<sup>3</sup> Posters are available at <http://nees.org/education/partners/rapid-2012>.

<sup>4</sup> Presentation slides are available at [www.eeri.org/japan-new-zealand-nsf-rapid-workshop/](http://www.eeri.org/japan-new-zealand-nsf-rapid-workshop/).

and opportunities for future research that they had discovered to date. The box below, which lists some of the topics studied in these projects, conveys the range of knowledge that is being advanced through research focused on the New Zealand and Japan disasters.

#### Selected RAPID Research Topics

##### Pursued Following the New Zealand and Japan Quakes

#### Geotechnical Engineering and Earth Sciences

- Ground motions and their effects on ground failure
- Effects of liquefaction on the built environment
- Quake impacts on subsurface rock structures
- Potential for large aftershocks near source of Japan quake
- Quake sequences and short-term predictability

#### Information Technology (IT)

- Damage to IT infrastructure: mitigation and recovery
- Damage assessment via guided remote data collection
- Use of ground-based, underwater, and aerial robots to gather data on impacts
- Telecommunications disruptions: impacts and solutions
- Automation of sensor-data collection and dissemination

#### Oceanography

- Characteristics of tsunami damage and flood zones
- Tsunami wave generation and propagation and resulting coastal inundation
- Topographic impacts of large-scale tsunami waves
- Tsunami impacts on seafloor deformation and erosion
- Spread of radionuclides from power plant into ocean

#### Social Sciences

- How fires ignited and spread after the Japan quake
- Residents' behavior during and after the quakes
- Relief operations in an environment of cascading disasters and a persistent (nuclear) threat
- Policy implications of the post-quake impact and use of advanced information and communication technologies
- Role of urban configurations in affecting community resilience in tsunamis

#### Structural Engineering

- Causes of structural damage to engineered buildings
- Effects of tsunami wave forces and debris impacts
- Effectiveness of post-1990 bridge design practices
- Performance of original and retrofitted floor and roof diaphragms in unreinforced masonry buildings
- Effects of repeated quakes on electricity infrastructure

#### Learning More from These Disasters

To help ensure that society takes full advantage of the learning opportunities afforded by the New Zealand and Japan events, workshop attendees synthesized what had been learned to date and distilled the most important directions for further research. Their findings were generated via three sets of small-group discussions organized by discipline, event, and cross-cutting themes (preparedness and mitigation, response and short-term recovery, long-term recovery).

The workshop steering committee consolidated these findings into key research themes (the central investigative threads around which future projects should be oriented) and into recommendations about how research focused on these themes can be facilitated:

#### *Themes for further research—*

- Understanding key components of resiliency
- Understanding the established and emerging role of information technology in mitigation and response
- Understanding the many-dimensional implications of the radiological disaster
- Understanding the socioeconomic consequences of such catastrophic events

#### *Recommendations for facilitating research—*

- Support for perishable data collection
- Establishment of an interdisciplinary digital data center
- Advancement of modeling, computational, and analytical capabilities
- Support for a holistic research program on vulnerability and resilience that integrates many disciplines and researchers, across the three countries

These workshop outcomes are informing future research directions related to the New Zealand and Japan earthquakes and the plans of U.S. researchers and their international collaborators. More information about the themes and recommendations, and the findings on which they are based, is available in the EERI workshop report cited above.

For more information, visit [www.nehrp.gov](http://www.nehrp.gov) or send an email to [info@nehrp.gov](mailto:info@nehrp.gov).


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