

**Key Points:**

- The interdisciplinary fields that comprise geohealth have a significant role in prediction, prevention, and recovery from disasters

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## The Role of GeoHealth in Science During Crisis

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**Abstract** The likelihood that crisis events will increase in number and severity is significant. Science has served, and will continue to serve, to address crisis events, whether natural or human attributed. Science during crisis has distinctive requirements. A call to action for science during crisis has been made, and described here are recommendations for response by scientists, including those in disciplines associated with GeoHealth.

Since 2014, the global community has experienced 1,639 disaster events, both man-made and natural, that collectively have caused more than 75,000 fatalities and US\$917 billion in damages and recovery costs (Swiss Re Institute). Weather and climate disasters, combined with natural hazards, for example, earthquakes, public health emergencies associated with disease outbreaks, and human error disasters like contaminant spills and industrial accidents, not only threaten human lives but also challenge relief efforts, ecosystem restoration, and community rebuilding. The interdisciplinary fields that comprise geohealth have a significant role in prediction, prevention, and recovery. Improving the application of science during crisis is the subject of a recent report of the American Academy of Arts and Sciences, *Science During Crisis: Best Practices, Research Needs, and Policy Priorities*. The report is highly relevant to the American Geophysical Union and its interdisciplinary GeoHealth Section.

Science—biological, physical, social, behavioral, cultural, engineering, and medical, interdisciplinary geohealth sciences—plays an important role in response and recovery. For example, physicians and geochemists collaborated in assessing short- and long-term health impacts of dust from the 11 September 2001 attacks on the World Trade Center. In 2010, scientists and engineers expert in oceanography, geology, engineering, physics, public health, and ecology worked together to contain the Deepwater Horizon oil spill and assess damage to the Gulf Coast. Immediately following the 2010 Haitian earthquake, the European Commission Joint Research Council employed satellite imagery to produce rapid damage assessment to inform the prioritization of emergency response. When Hurricane Sandy made U.S. landfall in 2012, scientists and engineers were summoned to evaluate structural damage, assess health and environmental risks, and assist in directing response and recovery efforts. During the emergency response to the 2013 Typhoon Haiyan in the Philippines, the UN Office for Coordination of Humanitarian Affairs coordinated crowd-sourced mapping with satellite and other data to develop emergency response maps. In each of these examples, science during crisis was essential for effective response.

Science during crisis has distinctive characteristics. Science in support of emergency management and disaster response must be rapid, decisive, and deliver results of necessity based on limited and uncertain information, with very little opportunity for replication. Success is measured by lives saved, injuries reduced, economic impacts minimized, and ecosystem and infrastructure services restored. Speed of recovery and development of mitigation tools for future disasters are also measures of value. Science during crisis requires heightened attention to address coupled human-natural systems and cascading consequences. It demands rapid establishment of interdisciplinary scientific teams; quick integration of local knowledge into scientific work; seamless integration of data sets across sectors to enable rapid analysis; compelling visualization of results; and concise communication to decision makers, disaster response specialists, and the public.

A rich literature and extensive practical experience in preparing for crises exist, but strategic deployment of scientific expertise and application of scientific information *during* crisis events must be improved and enhanced. Best practices for collection of relevant data, active collaboration with affected communities, coordination of scientists, engineers, crisis managers, and decision makers when disaster strikes, and guaranteeing collaboration throughout the crisis, response, and recovery are critical.

Selected recommendations of the Academy's report include the following:

1. expanding joint training of emergency response and scientific communities and ensuring scientists are included in emergency response exercises;
2. establishing central, curated clearinghouses for data and scientific information during crisis and making accessible those that currently exist;
3. identifying and/or updating baseline information in anticipation of future disasters and best methods to synthesize scientific findings and associated uncertainties; and
4. ensuring ethical, moral, and legal considerations in the crisis decision-making process.

Geohealth issues examined systematically could significantly improve delivery and application of science during crisis. Collection of baseline health data for disaster responders and scientists, and integration of the data into disaster preparedness protocols would be a major contribution. Development of a predictive capacity for environmental, health, social, and economic cascading consequences of disasters (by type and severity) and best methods for quickly synthesizing divergent scientific findings and associated uncertainty could comprise a major contribution of geohealth.

Policy reforms most certainly can advance delivery of science during crisis. The report recommends several reforms relevant to the United States: appointment of a chief science officer by state governments to facilitate and coordinate science during a crisis event and modification of the Federal Advisory Committee Act to allow teams of federal and nonfederal scientists to better collaborate and cooperate during a declared emergency.

The Academy report is a call to action for government agencies, academic institutions, professional organizations, and stakeholders who rely on and contribute to science during crisis. Future climate and weather disasters will only be more frequent, severe, costly, and deadly; the communities affected by these events will need the very best science—including geohealth sciences—to support first response and recovery.

### **Conflict of Interest**

The authors declare no conflicts of interest relevant to this study.

### **Reference**

Swiss Re Institute. (2014-2018). *Annual Sigma Reports*. Zurich, Switzerland: Swiss Re Institute.