

## Responding to Global Earthquake Hazards

# PAGER—Rapid Assessment and Notification of an Earthquake's Impact

**PAGER (Prompt Assessment of Global Earthquakes for Response) is an automated alarm system being developed to rapidly and accurately assess the severity of damage caused by an earthquake and to provide emergency relief organizations, government agencies, and the media with an estimate of the societal impact from the potential catastrophe.**

The U.S. Geological Survey's National Earthquake Information Center (NEIC), located in Golden, Colorado, reports over 30,000 earthquakes a year. Tragically, on average, 25 of these cause significant damage, injuries, or fatalities. The U.S. Geological Survey (USGS) often detects these damaging quakes well before eyewitness reports are available and must decide rapidly whether Federal and international agencies should be alerted to a potentially damaging event. Currently, the USGS relies primarily on the experience and intuition of the on-duty seismologists to estimate the impact of an event. To improve the accuracy of this assessment and the content of the USGS earthquake alerts, the USGS is developing an automated system to immediately estimate an earthquake's impact on humans for events anywhere worldwide; this system will provide important information to help emergency relief organizations, government agencies, and the media plan their response to earthquake disasters.

PAGER will distribute alarms via pager, mobile phone, and e-mail that will include a concise estimate of the earthquake's impact. The alarms will also report the earthquake location, magnitude, and depth, an estimate of the number of people exposed to varying levels of shaking, a description of the region's vulnerability, and a measure of confidence in the system's impact assessment. Associated maps of shaking level, population density, and susceptibility to landslides will be posted on the Internet. This information will be available within minutes of the determination of the earthquake's location and magnitude.

At the heart of PAGER are the timely and accurate earthquake location and magnitude determinations that the USGS has been producing for decades. PAGER uses these earthquake parameters to calculate estimates of ground shaking by using the methodology and software developed for ShakeMap (<http://earthquake.usgs.gov/shakemap/>). The number of people exposed to various levels of shaking is then calculated by combining the maps of predicted ground shaking with Oak Ridge National Laboratory's Landscan2003 population database. Finally, PAGER generates an impact statement by considering the vulnerability of the exposed population and infrastructure, potential for earthquake-induced landslides, and, if available, damage reports from previous nearby historic earthquakes for comparison purposes and damage projection.

Although the basic concept of PAGER is straightforward, the implementation will require significant system development, communication, and collaboration. The modular design of PAGER will allow the incorporation of more detailed datasets, new algorithms, and interactive tools, thereby improving the system's ability to rapidly assess an earthquake's impact.

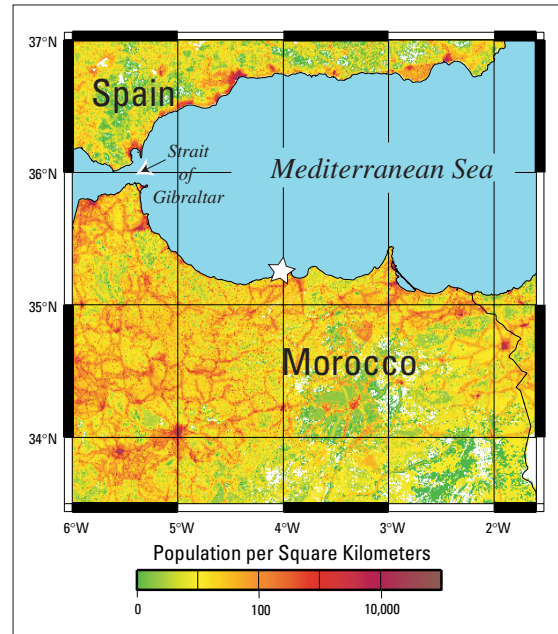
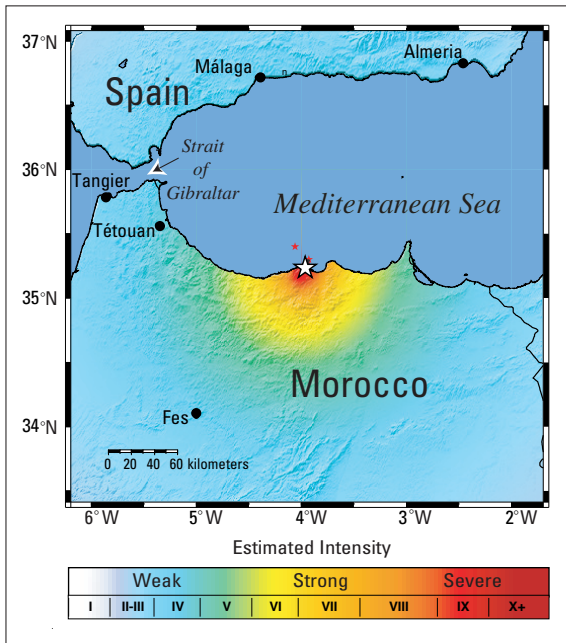
PAGER is still in development but is progressing toward a fast, accurate system that international and domestic users can rely on. The PAGER team is continuously seeking collaboration with other agencies, both domestic and worldwide, to create a system that will benefit the populations of earthquake-stricken areas.



Photograph showing destruction caused by the 1999 Izmit, Turkey, earthquake. For events such as this, PAGER will provide emergency relief organizations with a rapid assessment of an earthquake's impact that will allow them to determine which areas require the most attention.

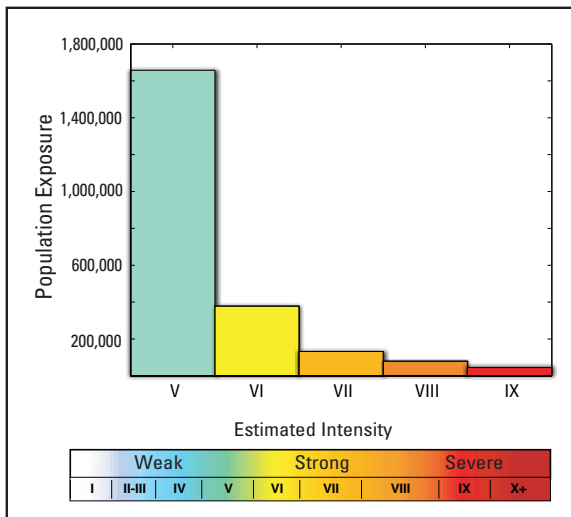
# The PAGER Process

The following steps are involved in estimating an earthquake's impact:



**1** After the magnitude and hypocenter of an earthquake are determined, an estimate of the resulting ground shaking is obtained by using ShakeMap methodology. This color-coded example is from the February 2004, magnitude 6.4, Al Hoceima, Morocco, earthquake.

**2** The population of the affected region is obtained from the Landsat2003 global population database developed at Oak Ridge National Laboratory.



**3** By combining the map of predicted shaking with the population, PAGER obtains an estimate of the number of people exposed to different levels of shaking.



Rescue Operation

**4** By using the population exposure and the vulnerability of the local infrastructure, PAGER will determine the potential scope of the catastrophe and issue alarms to emergency relief organizations, government agencies, and the media. PAGER is an interactive system. As subsequent information becomes available, more accurate maps of ground shaking are produced, and updated alarms are issued, if necessary.

## For More Information:

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