Public Release of Estimated Impact-based Earthquake Alerts
by the U.S. Geological Survey

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The U.S. Geological Survey (USGS) has begun publicly releasing earthquake alerts for significant earthquakes around the globe based on estimates of potential casualties and economic losses. These estimates should significantly enhance the utility of the USGS Prompt Assessment of Global Earthquakes for Response (PAGER) system that has been providing estimated ShakeMaps and computing population exposures to specific shaking intensities since 2007. Quantifying earthquake impacts and communicating loss estimates (and their uncertainties) to the public has been the culmination of several important new and evolving components of the system.

First, the operational PAGER system now relies on empirically based loss models that account for estimated shaking hazard, population exposure, and employ country-specific fatality and economic loss functions derived using analyses of losses due to recent and past earthquakes. Second, human and economic loss information is now portrayed as a supplement to existing intensity/exposure content on both PAGER summary alert (available via cell phone/email) messages and web pages. Loss calculations also include estimates of the economic impact with respect to the country’s gross domestic product. Third, in order to facilitate rapid and appropriate earthquake responses based on our probable loss estimates we implemented a four-level Earthquake Impact Scale (EIS). Instead of simply issuing median estimates for losses—which can be easily misunderstood and misused—this scale provides ranges of losses from which potential responders can gauge expected overall impact from strong shaking. EIS is based on two complementary criteria: the estimated cost of damage, which is most suitable for U.S. domestic events; and estimated ranges of fatalities, which are generally more appropriate for global events, particularly in earthquake-vulnerable countries. Alert levels are characterized by alerts of green (little or no impact), yellow (regional impact and response), orange (national-scale impact and response), and red (international response). Corresponding fatality thresholds for yellow, orange, and red alert levels are 1, 100, and 1000, respectively. For damage impact, yellow, orange, and red thresholds are triggered when estimated US dollar losses reach 1 million, 100 million, and 1 billion+ levels, respectively.

Finally, alerting protocols have been improved to explicitly support EIS-based alerts. Critical users can receive PAGER alerts i) based on the EIS-based alert level, in addition to or as an alternative to magnitude and population/intensity exposure-based alerts, and ii) optionally, based on user-selected regions of the world.
Example red alert PAGER summary figure showing population density and contoured intensity level (lower left), total population exposed per color-coded intensity level (middle), selected cities with population and intensity level (lower right), vulnerable structures and relevant historical earthquakes (middle right) and the color-coded impact scale indicated the alert level (top). The alert level is based on the median loss estimates; the uncertainty in the alert level can be gauged by the histogram.