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Saving lives by estimating the extent of earthquake disasters for first responder in minutes

An earthquake occurs anywhere in the world: Do capable countries need to mobilize rescue teams? Injured trapped below rubble can be saved alive within 3 days only, in general. Therefore, every minute counts in estimating whether or not international help is needed. QLARM (Quake Loss Assessment for Response and Mitigation) and PAGER (Prompt Assessment of Global Earthquakes for Response) estimate the likely ranges of fatalities within 25 minutes median.

The basis of rapid estimates of fatality numbers are the probable magnitude (M), the coordinates of the epicenter (x,y) (all distributed internationally within 6 to 30 minutes) and the regional properties of seismic wave transmission, the population present as well as the quality of construction of the local built environment (stored in QLARM and updated at present for Europe).

Fatality estimates by QLARM are distributed free of charge to interested parties for earthquakes with M ≥ 6 worldwide and M ≥ 5 in Europe and Asia. The good news is that QLARM has issued red alerts in all of the 4 recent earthquake disasters with more than 1000 reported fatalities (Myanmar M7.3, 28 March 2025: 7830†; Afghanistan M6.2, 8 September 2023: 2100†; Morocco M6.8, 8 September 2023: 2946†; Turkey M7.8, 6 February 2023: 53537†). However, the number of fatalities were underestimated by factors of 1, 4, 3, 10, respectively. The bad news is that the M of great earthquakes of approximately M ≥ 8 are always severely underestimated at first, leading to an initial underestimate of fatalities by an order of magnitude, as was the case for the earthquake in Turkey mentioned above. Also, the length and direction of the rupture are not known for days.

In addition to these real-time loss estimates, scenarios of unavoidable future earthquakes have been published for a number of earthquake prone countries. The match between the number of fatalities in historic earthquakes with those estimated by after the fact scenarios, is used for calibration of loss estimates. The extents of active faults are used to estimate the expected location and lengths of likely future ruptures, based on which the likely range of future numbers of fatalities is estimated. The purpose of scenarios is to allow local authorities and individuals to prepare on the basis of quantitative estimates of unavoidable future earthquake disasters.

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