

QLARM Estimates of Losses after the April M7.8 Earthquake

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After large earthquakes worldwide, QLARM estimates the expected damage and the resulting numbers of fatalities and injured in minutes. These earthquake alerts are distributed without charge to any one who wants it. In case the estimated losses are significant, QLARM calls those who wish to be called in order to speed up the response.

For the M7.8 earthquake on 16 April 2016 in Ecuador the estimate within minutes was that several hundred fatalities were sustained. QLARM called the Swiss disaster response team within minutes of the earthquake. This estimate turned out to be correct.

The media report fatalities and injured according to some ones count in parts of the devastated area (Figures 1 and 2). This paints a misleading picture of the extent of the disaster. Even if media add that the death toll may rise, first responders and the public do not know to what size the disaster is expected to grow. This is a serious shortcoming in reporting because the extent of the disaster is already known approximately from QLARM and PAGER (USGS) real-time estimates.

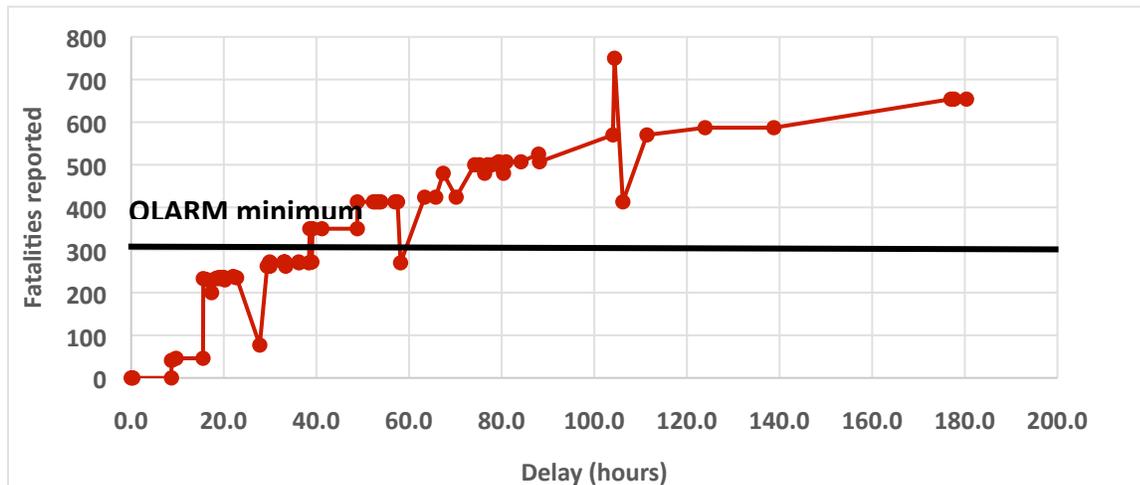


Figure 1: Fatalities reported by news media as a function of time after the earthquake of 16 April 2016 in Ecuador, compared to the real time estimate using QLARM after 23 minutes.

The fatality reports by the media remained below half of the ultimate number for two day, even though QLARM had already indicated the correct final outcome 23 minutes after the earthquake (Figure 1)

The number of injured reported by news media also lagged behind QLARM estimates for days (Figure 2). This especially important because the injured need help. With an order of magnitude fewer injured reported at first than the ultimate count, the help for people in need is inadequate.

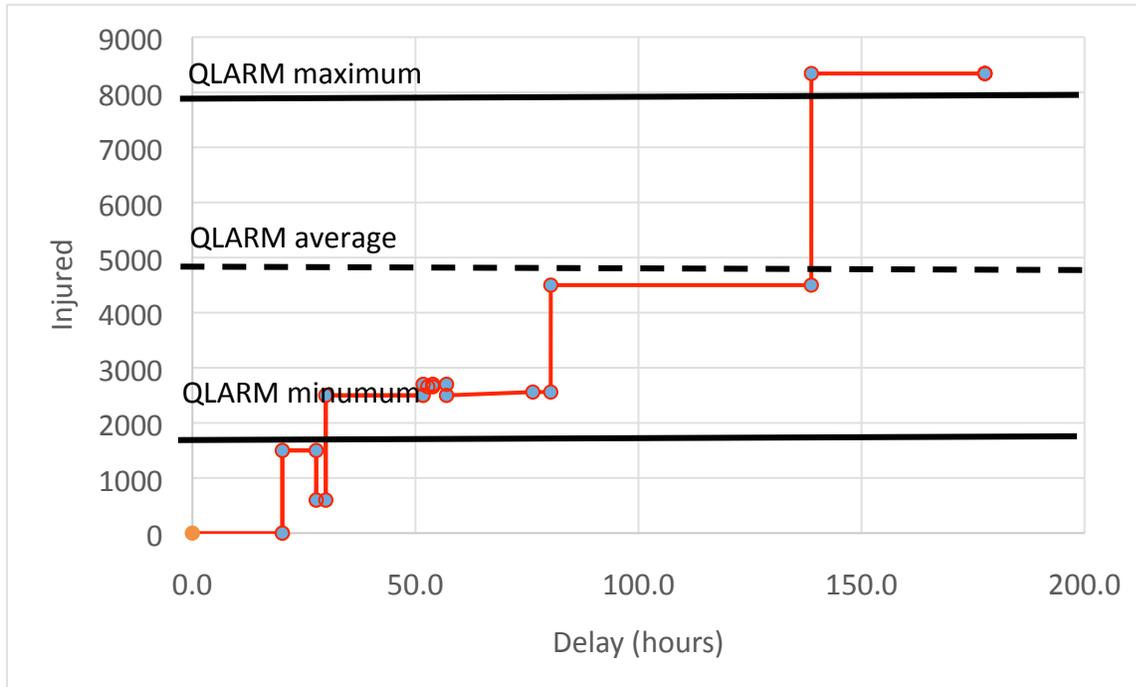
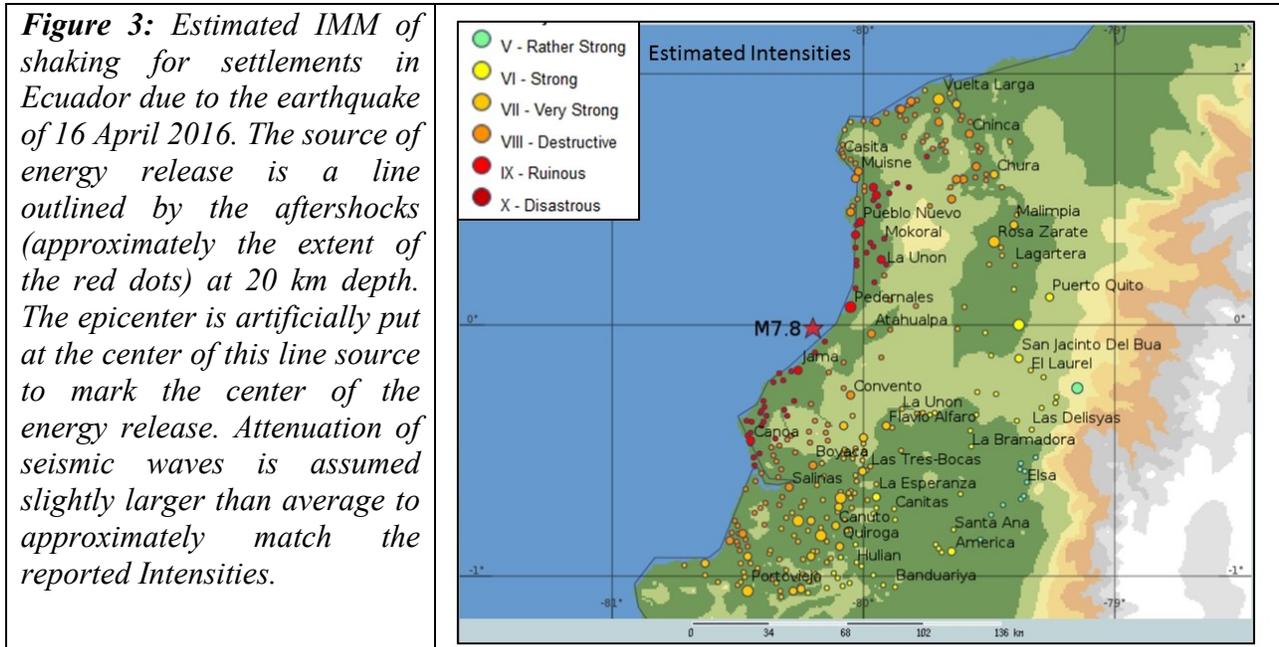


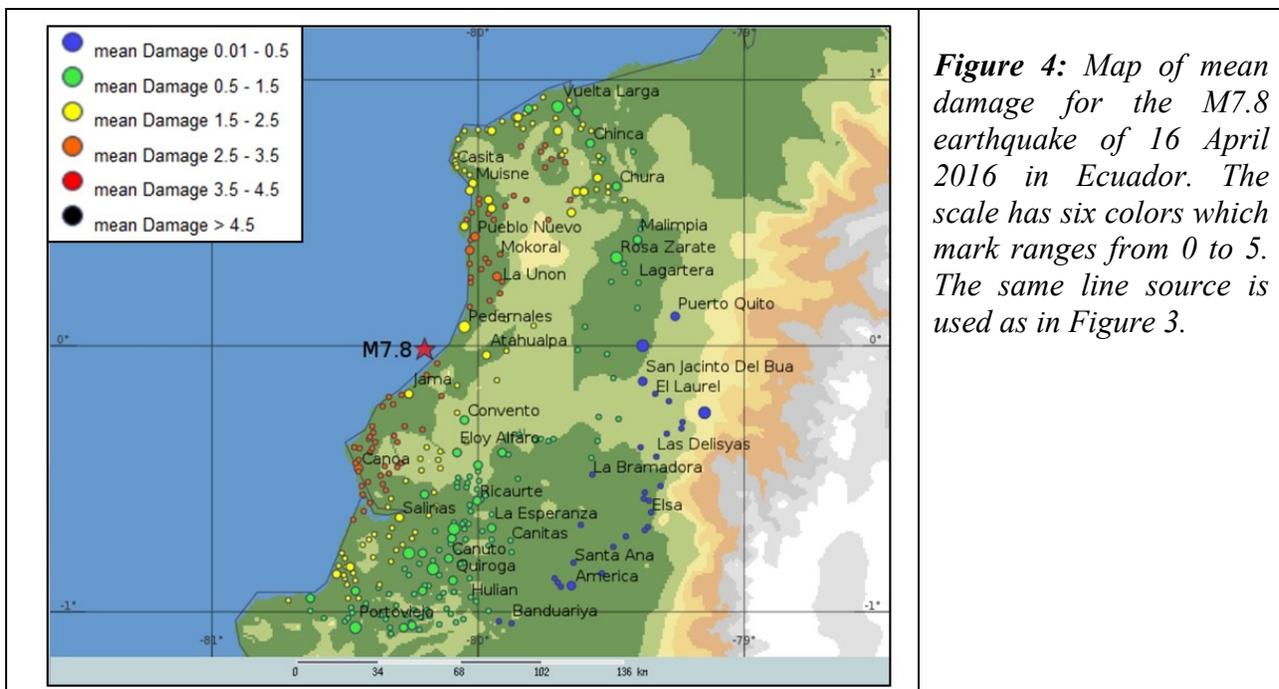
Figure 1: Injured reported by news media as a function of time after the earthquake of 16 April 2016 in Ecuador, compared to the real time estimate using QLARM after 23 minutes.

First loss estimates are based on **point earthquake sources** because only the epicenter, the depth and the magnitude are known. The aftershocks that follow and are located by the US Geological Survey and the GeoForschungsZentrum (GFZ) give clues to the direction and the extent of the rupture. Days after the earthquake, the Intensity (IMM) of shaking at some locations are reported to the US Geological Survey and give clues as to the extent of the rupture and the local transmission properties of seismic waves.

With the aforementioned additional pieces of information, QLARM can calculate a loss model based on a line source. This means that a line of energy release with the direction and length of the aftershocks is assumed. Furthermore, the reported Intensities of shaking allow an adjustment of the transmission of seismic waves for the model calculation. This gives a far more realistic picture of the loss pattern because earthquakes in the range of $7 < M < 8$ have rupture length of about 100 km to 200 km. In the case of the M7.8 Ecuadorian earthquake settlements more than 100 km south of the epicenter were in immediate vicinity of the rupture and thus severely affected (Figures 3 and 4).



A pattern of mean damage (Figure 4) is derived from the IMM calculated and the model for the building stock in the various settlements. Weak buildings may collapse, strong buildings may retain minor damage. Figure 4 shows the mean damage calculated for each settlement.



From the damage expected, the numbers of fatalities and injured are calculated for each settlement. The sum of the fatalities (Figure 1) and injuries (Figure 2) are the main basis of the QLARM estimate of the extent of the disaster.