

The earthquake loss estimating tool QLARM: Applications in real-time and for predictions

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QLARM is a loss-estimating tool being constructed jointly by WAPMERR and the Swiss Seismological Service. This computer program and its standard world dataset will be available for use by any professional. Its purpose is to calculate mean damage to the built environment and human losses in case of earthquakes anywhere in the world. The world data sets we are currently updating include: Population, building stock, attenuation of seismic waves, local soil conditions, critical facilities, and regional earthquake source properties.

The population is given by number of inhabitants down to the smallest settlements available for each country. QLARM is thus able to rank settlements according to the severity of losses, which is useful for rescue teams in earthquake disasters.

The building stock is distributed in vulnerability classes of the EMS-98 scale. This distribution is a function of the region and of the settlement size. The information on building quality comes from the World Housing Encyclopedia, from the literature, satellite images, ground surveys, and expert opinion.

Attenuation functions are taken from the literature and by calibration. Although it is clear that regional differences exist, they are not well quantified. In some areas we may need to modify the attenuation relationship such that intensities observed in past earthquakes are matched.

Soil properties are defined in varying detail for important cities worldwide in the literature. We derive amplification factors (for intensity or acceleration) as well as we can from published data on soil properties, microzonation maps, geological maps, and topography.

The most probable depth for shallow earthquakes is a parameter we are mapping by region because the need for this parameter arises in real-time loss estimates. We calculate losses for large earthquakes worldwide within less than an hour of their occurrence when there is only a teleseismic estimate of the depth available, with its large error. This poses a problem because losses depend crucially on the hypocentral depth.

An example of a loss estimate in real time is the Sichuan earthquake of the 12 May 2008. At first the magnitude was given as M7.5. Based on this, we distributed an email 28 minutes after the quake, giving 3,000 +/-1,000 as the

most probable number of fatalities. As soon as information reached us that the magnitude may be M7.9, we revised our estimate to 40,000 to 100,000 fatalities (50 minutes after the event). Our alerts by email are distributed to anyone who requests them. Figure 1A shows the map of mean damage to settlements that we placed on our website for public viewing 52 minutes after the Sichuan earthquake (www.wapmerr.org).

Predictions of several earthquakes of class M8+ are currently in effect worldwide based on the MSc algorithm (Kossobokov, personal communication). We calculated losses that are expected to result in two of these cases, if the respective predictions should come true. The damage state resulting from a possible future large earthquake in central Chile is shown in Figure 1B. We expect that a major earthquake disaster is likely to occur in central Chile in the future with more than 1,000 fatalities.

To have some confidence in these results, we calibrated QLARM by verifying that the selected attenuation function and the building stock properties yield the intensities and human losses observed in past earthquakes in the region in question. Calibrating QLARM for different parts of the globe is an important ongoing activity. The parameters we consider modifying regionally include vulnerability curves, attenuation functions, distribution of buildings into classes, and the casualty matrix on which the number of fatalities and injured is derived for a given damage state.

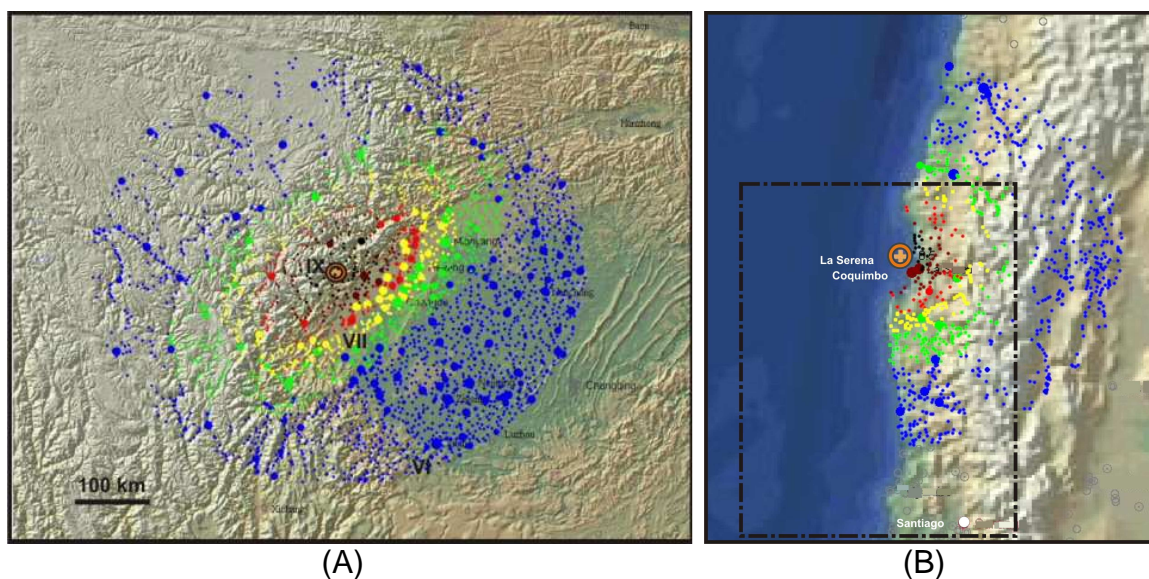


Figure 1. Maps of mean damage state of buildings in settlements, (A) in the case of the Sichuan earthquake M7.9, May 12 2008, and (B) in a hypothetical scenario that may result in the future from a likely M8.5 earthquake off the coast of central Chile near a location for which a prediction is in effect. The colour of the dots corresponds to the mean damage in settlements from black (major destruction) to blue (minor damage). The size of the dots is proportional to the population, the epicenter is marked by a ring and roman numerals indicate intensities.