



# (1) WAPMERR

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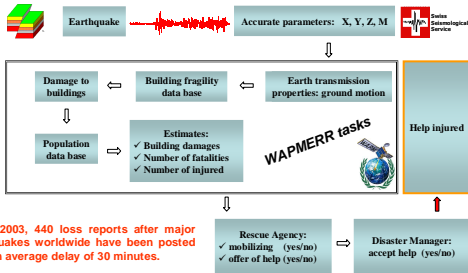
# Application of the loss estimation tool QLARM in Algeria

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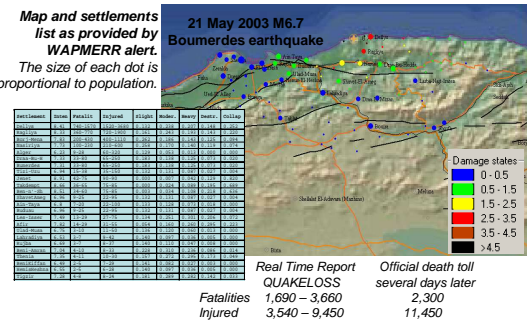


## 1- The concept of QLARM



Since 2003, 440 loss reports after major earthquakes worldwide have been posted with an average delay of 30 minutes.

Loss estimates we compute contain a map showing the average degree of damage in settlements near the epicenter, the total number of fatalities, the total number of injured, and a detailed list of the casualties and damage rates in these settlements.



..... provide developing countries and international relief organizations with fast information for disaster mitigation .....

## 2- Input data in QLARM

- The input parameters for this study include:
(1) Intensity related attenuation relations
(2) Soil amplification derived from average Vs30 values
(3) Distribution of building stock and population into vulnerability classes of the EMS-98 Scale as given in the PAGER database (for 3 city sizes)
(4) Population for 1540 settlements (census data for 1998 and 2008)

..... provide human losses estimates for future likely earthquake in zones at risk .....

## 3- Earthquake risk in Algeria

Since the 1980 El Asnam earthquake, seismic events in Algeria have killed about 6,000 people, injured more than 20,000 and left more than 300,000 homeless. On average, one earthquake with the potential to kill people (M>5.4) happens every three years in Algeria.

We propose to calibrate our new loss estimation tool QLARM (qlarm.ethz.ch) and estimate human losses for future likely earthquakes in Algeria.

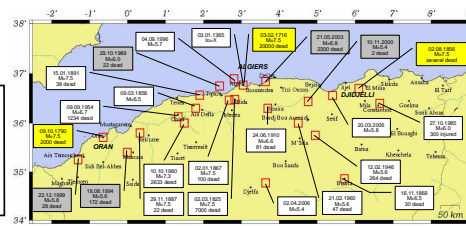
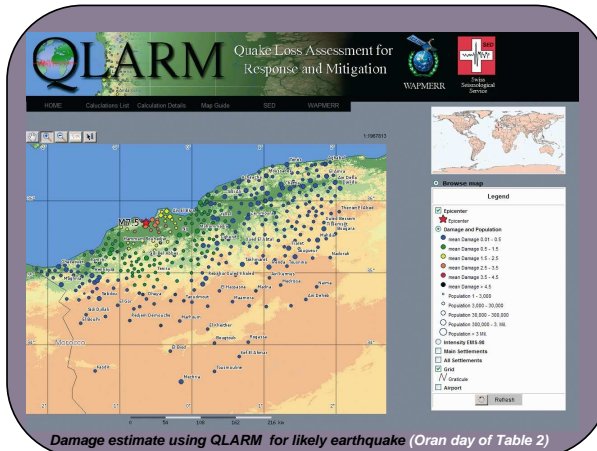


Figure 1. Largest and deadly earthquakes (1365-2006)

## 4- Calibration of QLARM

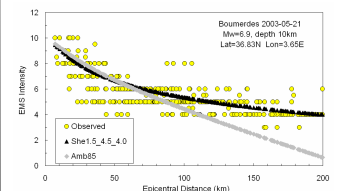
We perform an overall tool calibration by simulating past deadly events in Algeria for the period 1990-2003 (grey boxes of Figure 1).

Table 1. Source parameters of the events selected for calibration and observed and calculated casualties.



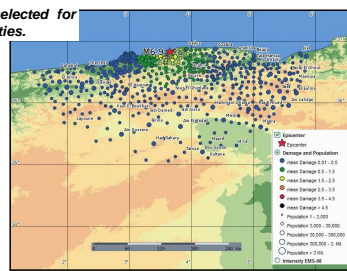
Damage estimate using QLARM for likely earthquake (Oran day of Table 2)

Table 1. Source parameters of the events selected for calibration and observed and calculated casualties.

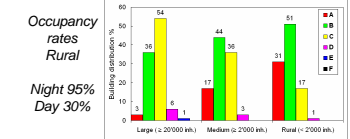
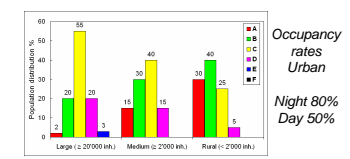


Calibration of seismic attenuation relations. Observed intensities are compared with calculated ones using Shebalin (1985) and Ambraseys (1985) laws.

References: Shebalin (1985) Regularity in Natural Disaster. Znanie [1 = 1.5^M - B\*log(sqrt((r^2+h^2)) + C] Ambraseys (1985) Intensity attenuation and magnitude intensity relationships for western European earthquakes.



Simulation of Boumerdes, 2003 event using QLARM. The dots correspond to each settlement of the database. Population is proportional to their sizes. Colors indicate the mean building damage degree.



Distribution of building and population using 3 sizes of cities. Residential buildings are divided into 5 classes of vulnerability (EMS-98 classification).

## 5- Scenarios

Calculated loss scenarios repeat the earthquakes of Algiers in 1716, Oran in 1790 and Djidjelli in 1856 (yellow boxes of Figure 1).

Table 2. Selected earthquake source parameters for the different scenarios and calculated casualties.

Table 2. Selected earthquake source parameters for the different scenarios and calculated casualties.

If we include site amplification at each settlement based on average Vs30 derived from topographic slope, the increase of casualties for Algiers, Oran and Djidjelli scenarios respectively is: - for fatalities, 40, 10 and 20% - for injuries, 40, 15 and 20%

## 6- Outlook

We calculate scenarios for likely earthquakes in Algeria after calibration of QLARM with observations from past earthquakes.

Results consider updated and detailed population data from census, 3 sizes of cities and the related building distribution following the five EMS-98 classes. Population is distributed in the 5 building classes and the occupancy rates are related to night&day and city size.

The different scenarios indicate that Oran, Algiers or Constantine region could expect thousands of killed people and 5 times more of injured in the case of the repetition of 1790, 1716 and 1856 earthquakes, respectively.

We propose to improve our city models and go further with our estimates by considering a range of new source parameters.