Estimating earthquake losses rapidly to help the injured

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INTRODUCTION

It is important to estimate the extent of an earthquake disaster rapidly so that an adequate response can be mounted. Usually the harm done is minor in major earthquakes, so no international response is needed. This information is necessary because response teams do not have to fret whether or not to gear up for helping. In case of a disaster, it may not be required to know the exact number of fatalities and injured, just the order of magnitude. If that number is reliable, an appropriate international response can be mounted. The parameters of an earthquake disaster calculated, and the tools available for estimating them are briefly summarized.

TOOLS TO CALCULATE EARTHQUAKE LOSSES

QLARM is the only computer tool in Europe that estimates fatalities and injured within less than an hour for major earthquakes worldwide. It distributes its manual estimates within 29 minutes of earthquakes by email (Wyss, 2014). The original estimate of fatalities for the M8 Wenchuan, China, earthquake of 2008 was 55,000 ± 30,000 (Figure 1 left) while the official Chinese government reports remained below 5,000 for days. PAGER is the tool used by the US Geological Survey (USGS) team to estimate earthquake losses. It delivers automated loss estimates within 25 minutes (median) and may deliver manual estimates later (http://earthquake.usgs.gov/earthquakes/pager/). Both of these tools require data sets of world building stock (e.g. Jaiswal et al., 2008) and world population data (e.g. Trendafiloski et al., 2011).

THE SEQUENCE OF INFORMATION FLOW IN EARTHQUAKE DISASTERS

The earthquake parameters (location, magnitude, depth) are issued automatically by the GeoforshungsZentrum (GFZ) within 8 minutes and later updated manually. The USGS delivers the same parameters within 18 minutes, manually. Loss estimates are based on these inputs and sometimes on the data supplied by the European Mediterranean Earthquake Center and the Tsunami Warning Center. After a few days, the final number of fatalities can be estimated by extrapolating from past developments of earthquake fatality counts, using an empirical formula (Li et al., 2011). Due to the delay of a few days, this estimate is not useful for immediately saving lives, but it gives an idea of what effort will be required to deal with the disaster in the longer run.

The role of the news media in reporting the extent of earthquake disasters is not favorable. The typical reporting by mass media is as follows. Within hours, television stations report 2 fatalities, within a day this grows to 20, and later to 200, when in fact there are tens of thousands dead and a multiple of that are injured. These typical reporting sequences (Figure 1) do not take into account that within less than an hour two quite accurate theoretical estimates of the extent of the disaster exist, and that within a few days the Chinese team (Li et al., 2011) could extrapolate to the approximate final fatality count, as detailed above.

In the example in the heart of Europe at the occasion of a small, therefore more tractable earthquake (L'Aquila, Italy, M6.5, 2009), news reports took about 24 hours to work their way up to an estimate of about half the final number of fatalities (Figure 1), when the QLARM alert had estimated within 23 minutes a death toll of 275, which turned out to be 309 in the end.

The reason for the initial gross underestimate of the fatalities by the media is that reports reaching the world come from the periphery of the devastated area, where only minor losses are sustained. From the epicentral area, no information flows for days. During the 12 years of reporting, the QLARM team witnessed one especially dramatic negative impact of reporting by mass media: QLARM sent out an

alert that about 1,000 fatalities were expected after an earthquake during the night in a North African country. Based on this report, the Swiss Agency for Development and Collaboration offered help within one hour and was turned down by officials in the country affected because BBC had reported only 2 fatalities. The QLARM expert was reprimanded for issuing an exaggerated estimate. Twenty hours later, too late to be effective, the shaken country asked for help because they began to realize that a disaster had taken place. The death toll was 600 in the end and the injured numbered a multiple of this. The news media will continue to play their obstructing role in rescuing injured people below their collapsed homes, unless they learn about the advanced methods in estimating the extent of worldwide earthquake disasters within minutes to days, as reviewed here briefly.

CONCLUSIONS

Methods to estimate losses due to earthquakes worldwide have advanced to be correct within a factor of two of the ultimate count. News media however report the extent of earthquake disasters in less detail than is estimated by agencies with a 10 year track record.

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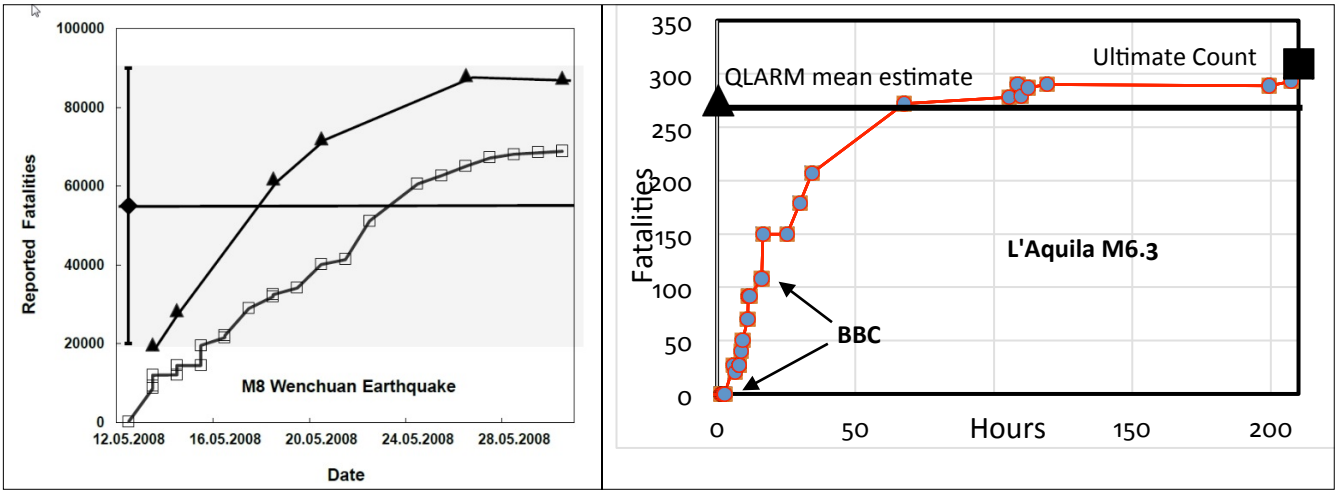

Figure 1. Comparison of news reports of fatalities after disastrous earthquakes as a function of time with the initial theoretical estimate by QLARM. Whereas the public believed gross underestimates by news media for days, the theoretical calculations by QLARM (diamond at left and triangle at right) were already right on target 100 minutes and 23 minutes, respectively, after the disasters had struck. The uncertainties in both cases (vertical error bars) are large because in real-time several parameters are not known reliably.

KEYWORDS

earthquake, loss estimates in real time

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