Teleseismic Loss Estimates in Near-Real-Time After the M8 Wenchuan Earthquake of May 12, 2008

Max Wyss, Philippe Rosset, and Goran Trendafiloski

8/26/2009 Beijing
What is WAPMERR?

A non-profit agency with the aim to assist developing nations with reducing earthquake risk and with recovery after earthquake disasters.

Located in Geneva, Switzerland, with employees in USA, Georgia, Russia

Collaborating with investigators in Japan, Germany, USA, Peru, Portugal, India, Iran, Turkey, Greece, Algeria, United Kingdom, Italy, Spain (CHINA?)

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LOSSES

1) fatalities
2) injured
3) damage

as a function of settlement and district for large cities

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Earthquake

Damage to buildings

Building fragility data base

Population data base

Earth transmission properties: ground motion

Accurate parameters: X, Y, Z, M

Estimates:
- Building conditions
- Number of fatalities
- Number of injured

Rescue Agency:
- mobilizing (yes/no)
- offer of help (yes/no)

Disaster Manager:
- accept help (yes/no)

Help injured

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Epicenters of earthquake for which loss reports have been issued 2004 to 2007
Near-real-time example: Wenchuan, M7.9, Depth 15 km, Attenuation low, 100 minutes after the event

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Preferred loss estimate for Wenchuan in near-real time
Wenchuan earthquake 12 May 2008: Estimates of number of fatalities in near-real time

Fatalities (red) and the sum of fatalities plus missing (squares) as a function of time, compared to WAPMERR’s estimate after 100 minutes (blue).
Reported fatalities due to the L’Aquila earthquake of 6 April 2009 (triangles) as a function of time after the earthquake, compared to the quantitative estimate by WAPMERR, based on M6.3, 22 minutes after the occurrence time (diamond with error bars).
## Wenchuan earthquake: Information About Parameters With Time

<table>
<thead>
<tr>
<th>Hour (GMT)</th>
<th>Min</th>
<th>Agency</th>
<th>Lat (deg)</th>
<th>Lon (deg)</th>
<th>Dep. (km)</th>
<th>M</th>
<th>Action</th>
<th>Loss Estimate</th>
<th>Delay (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>06</td>
<td>28</td>
<td>Origin Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>06</td>
<td>35</td>
<td>GFZ</td>
<td>31.08</td>
<td>103.15</td>
<td>43</td>
<td>7.7</td>
<td>automatic</td>
<td></td>
<td>7</td>
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<tr>
<td>06</td>
<td>43</td>
<td>JRC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>automatic</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>06</td>
<td>49</td>
<td>WAPMERR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>preliminary warning by phone to SDC, based on automatic solution</td>
<td>major disaster</td>
<td>21</td>
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<tr>
<td>06</td>
<td>55</td>
<td>USGS</td>
<td>31.08</td>
<td>103.27</td>
<td>10</td>
<td>7.5</td>
<td>reviewed parameters</td>
<td>fatalities 1,000 to 4,000</td>
<td>27</td>
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<tr>
<td>06</td>
<td>57</td>
<td>WAPMERR</td>
<td>31.08</td>
<td>103.27</td>
<td>10</td>
<td>7.5</td>
<td>email, first quantitative loss estimate based on M7.5, reviewed</td>
<td>fatalities 3,000 to 9,000</td>
<td>29</td>
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<tr>
<td>07</td>
<td>03</td>
<td>EMSC</td>
<td>31.12</td>
<td>103.25</td>
<td>10</td>
<td>7.5</td>
<td>reviewed parameters</td>
<td></td>
<td>35</td>
</tr>
<tr>
<td>08</td>
<td>07</td>
<td>USGS</td>
<td>31.08</td>
<td>103.27</td>
<td>10</td>
<td>7.8</td>
<td>reviewed magnitude</td>
<td></td>
<td>99</td>
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<tr>
<td>08</td>
<td>08</td>
<td>WAPMERR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>revised loss estimate, based on M7.8, phone call</td>
<td>fatalities 20,000 to 90,000</td>
<td>100</td>
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<tr>
<td>08</td>
<td>17</td>
<td>GSR</td>
<td>31.1</td>
<td>103.4</td>
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<td>08</td>
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<td>31.12</td>
<td>103.24</td>
<td>10</td>
<td>7.8</td>
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<tr>
<td>17</td>
<td>03</td>
<td>WAPMERR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>final, revised loss estimate based on M7.9, low attenuation</td>
<td>fatalities 40,000 to 100,000</td>
<td>635</td>
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</tbody>
</table>

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QLARM – a new tool for estimation of losses due to earthquakes worldwide
Loss Estimates by Email

If you want to be put on the alert list,
Simply let me know.
### Expected Deaths due to Hypothetical Earthquakes in the Himalaya (Wyss, March, 2005)

<table>
<thead>
<tr>
<th>Location</th>
<th>Lat. (deg.)</th>
<th>Lon. (deg.)</th>
<th>Depth (km)</th>
<th>M</th>
<th>Expected Deaths (thousand)</th>
<th>Number Injured (thousand)</th>
<th>No Settle I = 7</th>
<th>No Settle I = 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Assam</td>
<td>27.8</td>
<td>92.3</td>
<td>25</td>
<td>8.1</td>
<td>24 - 49</td>
<td>52 - 99</td>
<td>160</td>
<td>1900</td>
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<tr>
<td>2 Bhutan</td>
<td>27.3</td>
<td>89.5</td>
<td>25</td>
<td>8.1</td>
<td>76 - 151</td>
<td>163 - 274</td>
<td>270</td>
<td>2500</td>
</tr>
<tr>
<td>3 Katmandu</td>
<td>28.1</td>
<td>84.2</td>
<td>25</td>
<td>8.1</td>
<td>21 - 42</td>
<td>45 - 86</td>
<td>330</td>
<td>2600</td>
</tr>
<tr>
<td>4 W. Nepal</td>
<td>28.7</td>
<td>81.8</td>
<td>25</td>
<td>8.1</td>
<td>11 - 22</td>
<td>24 - 53</td>
<td>370</td>
<td>2800</td>
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<tr>
<td>5 Garhwal</td>
<td>29.7</td>
<td>79.6</td>
<td>25</td>
<td>8.1</td>
<td>58 - 115</td>
<td>125 - 230</td>
<td>380</td>
<td>3000</td>
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<tr>
<td>6 Dehra Dun</td>
<td>30.7</td>
<td>77.7</td>
<td>25</td>
<td>8.1</td>
<td>96 - 199</td>
<td>210 - 433</td>
<td>450</td>
<td>3300</td>
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<tr>
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<td>33.0</td>
<td>75.0</td>
<td>25</td>
<td>8.1</td>
<td>67 - 137</td>
<td>146 - 293</td>
<td>550</td>
<td>4000</td>
</tr>
</tbody>
</table>

**Reported Death due to M7.6 Kashmir Earthquake of October 2005: 85,000**
Maximum number of fatalities in scenario earthquakes in the Himalaya (published in March 2005 in Natural Hazards)
CONCLUSIONS

- Major earthquake disasters can be discriminated from minor ones in real time (on average within 30 minutes).

- Scenario loss estimates can give order of magnitude estimates of losses in future earthquake disasters.

- Many improvements to the data sets and computer codes to estimate earthquake losses are possible and necessary.

more at www.wapmerr.org
Fields of Collaboration

- Population number by settlements
- Regional building stock
- City models
- Regional casualty matrices
- Scenario loss calculations

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