China Wenchuan Earthquake Disaster (May 12.2008) and Its Loss Assessment

Peijun SHI
Disaster Assessment Group of the National Wenchuan Earthquake Expert Committee of China;
Academy of Disaster Reduction and Emergency Management, Ministry of Civil Affairs & Ministry of Education,
Beijing Normal University, China
August 29, 2008
Content

1 Background: Natural Disasters in China
2 Wenchuan Earthquake
3 Secondary Disasters Induced by Wenchuan Earthquake
4 Wenchuan Earthquake Emergency Response
5 Loss Assessment
6 Conclusions and Discussion
Flood in Yangtze River Basin of China in Summer & Autumn, 1998
Dust, 2005
Power—Communication

Freezing Rain & Snowstorm Disaster, Southern of China, 2008
Natural Disasters Occurred in China
Natural Disasters Occurred in China

**Earthquake (Ms ≥ 5.0, 1901–2008)**

Data Source: ADREM, BNU, China

Drawn by ADREM, BNU, China
Natural Disasters Occurred in China

<table>
<thead>
<tr>
<th>Year</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961</td>
<td>2</td>
</tr>
<tr>
<td>1962</td>
<td>3</td>
</tr>
<tr>
<td>1963</td>
<td>4</td>
</tr>
<tr>
<td>1964</td>
<td>5</td>
</tr>
<tr>
<td>1965</td>
<td>6</td>
</tr>
<tr>
<td>1966</td>
<td>7</td>
</tr>
<tr>
<td>1967</td>
<td>8</td>
</tr>
<tr>
<td>1968</td>
<td>9</td>
</tr>
<tr>
<td>1969</td>
<td>10</td>
</tr>
<tr>
<td>1970</td>
<td>11</td>
</tr>
<tr>
<td>1971</td>
<td>12</td>
</tr>
<tr>
<td>1972</td>
<td>13</td>
</tr>
<tr>
<td>1973</td>
<td>14</td>
</tr>
<tr>
<td>1974</td>
<td>15</td>
</tr>
<tr>
<td>1975</td>
<td>16</td>
</tr>
<tr>
<td>1976</td>
<td>17</td>
</tr>
<tr>
<td>1977</td>
<td>18</td>
</tr>
<tr>
<td>1978</td>
<td>19</td>
</tr>
<tr>
<td>1979</td>
<td>20</td>
</tr>
<tr>
<td>1980</td>
<td>21</td>
</tr>
<tr>
<td>1981</td>
<td>22</td>
</tr>
<tr>
<td>1982</td>
<td>23</td>
</tr>
<tr>
<td>1983</td>
<td>24</td>
</tr>
<tr>
<td>1984</td>
<td>25</td>
</tr>
<tr>
<td>1985</td>
<td>26</td>
</tr>
<tr>
<td>1986</td>
<td>27</td>
</tr>
<tr>
<td>1987</td>
<td>28</td>
</tr>
<tr>
<td>1988</td>
<td>29</td>
</tr>
<tr>
<td>1989</td>
<td>30</td>
</tr>
<tr>
<td>1990</td>
<td>31</td>
</tr>
<tr>
<td>1991</td>
<td>32</td>
</tr>
<tr>
<td>1992</td>
<td>33</td>
</tr>
<tr>
<td>1993</td>
<td>34</td>
</tr>
<tr>
<td>1994</td>
<td>35</td>
</tr>
<tr>
<td>1995</td>
<td>36</td>
</tr>
<tr>
<td>1996</td>
<td>37</td>
</tr>
<tr>
<td>1997</td>
<td>38</td>
</tr>
<tr>
<td>1998</td>
<td>39</td>
</tr>
<tr>
<td>1999</td>
<td>40</td>
</tr>
<tr>
<td>2000</td>
<td>41</td>
</tr>
<tr>
<td>2001</td>
<td>42</td>
</tr>
<tr>
<td>2002</td>
<td>43</td>
</tr>
<tr>
<td>2003</td>
<td>44</td>
</tr>
<tr>
<td>2004</td>
<td>45</td>
</tr>
<tr>
<td>2005</td>
<td>46</td>
</tr>
<tr>
<td>2006</td>
<td>47</td>
</tr>
</tbody>
</table>

Data Source: ADREM, BNU, China
Drawn by ADREM, BNU, China

Earthquake ($M_s \geq 6.0$, 1901–2008)
Natural Disasters Occurred in China

Frequency of Typhoon in the NorthWest Pacific Ocean (1949-2006)
2 Wenchuan Earthquake of China
Wenchuan Earthquake

• 14:28 pm on May 12 of 2008, a major earthquake measuring 8 Richter scale jolted Wenchuan County of Southwest China’s Sichuan province.

• The most serious earthquake of China since 1949:
  – high intensity
  – large disaster affected area
  – serious frequent aftershocks and secondary disasters
  – the most difficulty of disaster relief
  – the most severe damage and loss
5•12 Wenchuan Earthquake, 2008
Cities close to the epicenter are flattened; whole mountains collapsed.
Millions of people lost their beloved ones, their homes, their belongings. Yet there is no looting, no complaints, just people helping each other (CNN)
2.1 Earthquake tectonic background

- **China**: locates in two large seismic belts (Circum-Pacific Seismic Belt and Eurasia Seismic Belt)
- **The North-South Seismic Belt (NSSB) of China**: since the 20th Century, 29 earthquakes ($M \geq 7$), including 4 earthquakes ($M \geq 8$)
- **The 2008 Wenchuan earthquake**: occurred in the NSSB, exactly at the Longmenshan Fault Zone, in the joint of Qinghai-Tibetan Plateau and Sichuan Basin.
Distribution map of seismic structures and aftershocks in the Longmenshan fault zone

the epicenter-Ying Xiu town of Wenchuan earthquake
Wenchuan Earthquake Zone Seismic Tectonic Map
Wenchuan Earthquake Earth-surface Rupture Map
2.2 Analysis of aftershock sequence

- The Wenchuan earthquake: a main shock-after shock type
  - The main shock: an intraplate thrust earthquake,
  - The aftershocks: distributed along a narrow and long region with a length of about 300km and a width of over 40km.
  - 22982 recorded aftershocks after the Wenchuan M=8 main shock, including 251 M>=4 aftershocks, 38 M>=5 and 5 M>=6 aftershocks (up to Aug. 9 of 2008)
  - the largest M=6.4 aftershock occurred on May 25 in Qingchuan county, Sichuan province.
  - the aftershock frequency is clearly reducing gradually after the main shock, but the magnitude of the aftershocks is going up in opposite.
  - a magnitude-7 aftershock may still occur at the north part of the Longmenshan fault zone in the late 3 months.
The $M \geq 3$ aftershock sequence (up to August 9 of 2008)

The $M \geq 3$ aftershock frequency (up to August 9 of 2008)
The $M \geq 4$ aftershock distribution map (up to August 9 of 2008)
2.3 The characteristics of earthquake dynamics and kinematics

- As the general north drive of the Indian plate, the eastern edge of the Qinghai-Tibetan Plateau along the Longmenshan structural zone east crushed under the Sichuan Basin, and the accumulation of energy suddenly released in the zone of Yingxiu-Beichuan area.
- The main tectonic fault zone, associated with the other three co-seismic fault zones, caused the Wenchuan earthquake disaster.
- The focal depth is about 15km, and the epicenter is latitude 31° N and longitude 103.4° E.
- The cross section of the formed Yingxiu-Beichuan fault zone inclines steeply (70°-80°) to the northwest, and surface rupture exceeds 200km, with an average vertical and horizontal slip amount of 1-2m.
- The Wenchuan earthquake affected area is about 500,000 km² totally, and the epicentral intensity is grade 8 (XI).
The destructive zone of the earthquake fault through the old city of Beichuan County
Map of Seismic Intensity Zoning

The most inner intensity is: IX(9), X(10) grade and its above

Inner material by the State Seismological Bureau of China
3 Secondary Disasters Induced by Wenchuan Earthquake

- The induced geological disasters: induced by the earthquake and rainstorms, reaches 9556, including 5117 landslides, 3575 rock falls, 358 debris flows and 34 barrier lakes, resulted in a direct economic loss of 43.8012 billion RMB.

- The secondary disasters such as barrier lakes, damaged reservoirs and damaged dams:
  - 34 barrier lakes with different levels of danger, and the Tangjiashan Barrier Lake near the county seat of Beichuan County was of extremely severe danger;
  - Over 1800 damaged reservoirs in Sichuan province;
  - Dams in Sichuan, Chongqing, Shaanxi, Gansu and Yunnan with a length of 1054km were damaged
Landslide and rockfall
山体崩塌
Mountain Collapse

从山顶至山谷 200—300米
唐家山堰塞湖坝顶一角
次生灾害对可耕地的破坏
Damaged farmland and orchids

2008-05-01
before earthquake

2008-05-15
after earthquake
Monitoring of Barrier lakes and landslides

Ping wu, May 15

Landslides
Barrier lakes
Monitoring of Barrier lakes and landslides

Ping wu, May 18
4 Wenchuan Earthquake Emergency Response of China
抗震救灾舆论进程

Internet Consensus Statistics

据北京师范大学承担的“综合灾害风险防范关键技术与示范研究”搜索引擎搜索结果，5月31日

<table>
<thead>
<tr>
<th>Keywords</th>
<th>Records</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sichuan Earthquake</td>
<td>19031</td>
</tr>
<tr>
<td>Quake searching &amp; rescuing</td>
<td>1347</td>
</tr>
<tr>
<td>Emergent transfer</td>
<td>346</td>
</tr>
<tr>
<td>Resettlement</td>
<td>100</td>
</tr>
<tr>
<td>Production restoration</td>
<td>570</td>
</tr>
<tr>
<td>After-quake reconstruction</td>
<td>1833</td>
</tr>
<tr>
<td>Government response</td>
<td>94</td>
</tr>
</tbody>
</table>
Response of Central Government/State Council and The army

5.12: 部署军队应急机制
5.13: 中央军委紧急会议决定成立全军抗震救灾工作组
5.14: 政治局常委会进一步部署抗震救灾
5.15: 总指挥部会议决定增派工作组负责水库、饮水问题
5.16: 胡锦涛总书记飞赴什邡指导抗震救灾
5.19: 总指挥部会议要求做好人员搜救、防疫和善后工作
5.21: 国家发展改革委研究抗震救灾和经济发展工作
5.22: 政治局常委会研究部署继续全力抗震救灾
5.23: 总指挥部会议专题研究堰塞湖问题
5.26: 政治局常委研究部署继续抗震救灾和灾后重建
5.30: 总指挥部会议研究捐赠物和救灾物资管理

第一阶段 5.12-5.19
第二阶段 5.19-5.26
第三阶段 5.26-日期

“5.12汶川地震”中央政府和军队应急响应
## Response of Governmental Sectors & Local Governments (1)

**中央部委：**

5.12a. 启动国家Ⅰ级应急响应
5.12b. 国家地震灾害紧急救援队奔赴灾区
5.12c. 住建部启动应急预案

**地震局：**

5.14a. 召开第三次全国地震预报专家会议
5.14b. 15支省级地震灾害紧急救援队驰援灾区

5.12. 15时46分宏达国家应急响应二级响应，23:00分等级提升为一级响应，成立省政府抗震救灾指挥部
5.12. 国家减灾委办公室紧急向国家相关机构提供灾区灾情图解

**民政部：**

5.15. 记者召开全国社会福利部门报告会，自然灾害救助工作
5.15. 2.5快速，要求各地对国际援助进行紧急响应，采取措施配合国际社会，解决灾区群众的基本生活，确保灾区恢复重建、经济发展的需要

5.21. 民政部、公安部、卫生部联合下发《关于“5.12”地震受困人员转移接收的方案》
5.21. 民政部、公安部、卫生部联合制定《关于“5.12”地震多处人员转移接收的方案》

5.26. 民政部、公安部、卫生部联合下发《5.12》
5.26. 民政部、公安部、卫生部联合制定《5.12》

5.26. 建立地级以上、五类重灾地区临时接收点
5.26. 建立地级以上、五类重灾地区临时接收点

5.28. 建立地级以上、五类重灾地区临时接收点
5.28. 建立地级以上、五类重灾地区临时接收点

5.28. 建立地级以上、五类重灾地区临时接收点
5.28. 建立地级以上、五类重灾地区临时接收点

5.30. 建立地级以上、五类重灾地区临时接收点
5.30. 建立地级以上、五类重灾地区临时接收点

**教育部：**

5.16. 研究部署灾后学生心理援助工作
5.16. 研究部署灾后学生心理援助工作

5.16. 召开灾区教育部门会议，进一步做好教育系统地震灾区教育工作
5.16. 召开灾区教育部门会议，进一步做好教育系统地震灾区教育工作

**公安部：**

5.19. 澄清全国公安机关迅速开展抗震救灾工作
5.19. 澄清全国公安机关迅速开展抗震救灾工作

5.19. 联合部际联席会议开展灾区社会维稳工作
5.19. 联合部际联席会议开展灾区社会维稳工作

5.19. 联合部际联席会议开展灾区社会维稳工作
5.19. 联合部际联席会议开展灾区社会维稳工作

5.19. 联合部际联席会议开展灾区社会维稳工作
5.19. 联合部际联席会议开展灾区社会维稳工作

**铁道部：**

5.19. 启动应急响应机制，铁路部门启动应急预案
5.19. 启动应急响应机制，铁路部门启动应急预案

5.19. 启动应急响应机制，铁路部门启动应急预案
5.19. 启动应急响应机制，铁路部门启动应急预案

5.19. 启动应急响应机制，铁路部门启动应急预案
5.19. 启动应急响应机制，铁路部门启动应急预案

5.20. 启动应急响应机制，铁路部门启动应急预案
5.20. 启动应急响应机制，铁路部门启动应急预案

5.20. 启动应急响应机制，铁路部门启动应急预案
5.20. 启动应急响应机制，铁路部门启动应急预案

5.20. 启动应急响应机制，铁路部门启动应急预案
5.20. 启动应急响应机制，铁路部门启动应急预案

**地震局**

5.19. 住建部启动应急预案
5.19. 住建部启动应急预案

5.19. 住建部启动应急预案
5.19. 住建部启动应急预案

5.19. 住建部启动应急预案
5.19. 住建部启动应急预案

5.19. 住建部启动应急预案
5.19. 住建部启动应急预案

5.19. 住建部启动应急预案
5.19. 住建部启动应急预案

5.19. 住建部启动应急预案
5.19. 住建部启动应急预案

5.19. 住建部启动应急预案
5.19. 住建部启动应急预案

**日期**

5.12 5.19 5.26
### Response of Governmental Sectors & Local Governments (2)

#### 中央部委:
- 5.12：召开视频会议，研究部署卫生系统疫情防控工作
- 5.14：成立卫生应急指挥部，探索城市群，全力应急支援工作
- 5.15：制定《公共卫生突发事件预防控制应急预案》
- 5.16：召开全国疫情防控工作会议，研究部署下一步工作
- 5.18：接受和反馈，落实和执行政策和措施，确保疫情得到有效控制

#### 科技部
- 5.13：发布关于印发《防控应急物资生产技术及产品》的通知
- 5.14：发布关于印发《农村地区疫情防控技术与产品》的通知
- 5.16：发布关于印发《乡镇卫生院疫情防控技术与产品》的通知
- 5.18：发布关于印发《农村地区疫情防控技术与产品的通知》

#### 水利部
- 5.13：召开中央紧急会议，研究部署下一步疫情防控工作措施
- 5.15：成立卫生应急指挥部等领导小组，全力以赴防控重点区域
- 5.16：发布关于印发《防控应急物资生产技术及产品》的通知
- 5.17：发布关于印发《乡镇卫生院疫情防控技术与产品》的通知

#### 其余部委
- 5.13：发布关于印发《防控应急物资生产技术及产品》的通知
- 5.14：发布关于印发《防控应急物资生产技术及产品》的通知
- 5.16：发布关于印发《防控应急物资生产技术及产品》的通知

#### 当地政府:
- 5.12：四川省启动了第一级响应预案，派出紧急医疗队，要求“省部全力支持，市州全力支援”
- 5.13：四川省启动了第一级响应预案，要求“省部全力支持，市州全力支援”

#### 四川省
- 5.12：四川省启动了第一级响应预案，要求“省部全力支持，市州全力支援”
- 5.13：四川省启动了第一级响应预案，要求“省部全力支持，市州全力支援”

#### 甘肃省
- 5.12：甘肃省启动了第一级响应预案，要求“省部全力支持，市州全力支援”
- 5.13：甘肃省启动了第一级响应预案，要求“省部全力支持，市州全力支援”

#### 陕西省
- 5.12：陕西省启动了第一级响应预案，要求“省部全力支持，市州全力支援”
- 5.13：陕西省启动了第一级响应预案，要求“省部全力支持，市州全力支援”

#### 其他省市
- 5.12：各省市启动了第一级响应预案，要求“省部全力支持，市州全力支援”
- 5.13：各省市启动了第一级响应预案，要求“省部全力支持，市州全力支援”

### 中央及地方政府对“5.12汶川地震”的响应

- 5.12：召开紧急会议，研究部署卫生系统疫情防控工作
- 5.14：成立卫生应急指挥部，探索城市群，全力应急支援工作
- 5.15：制定《公共卫生突发事件预防控制应急预案》
- 5.17：发布关于印发《乡镇卫生院疫情防控技术与产品》的通知
- 5.18：发布关于印发《农村地区疫情防控技术与产品的通知》
- 5.20：发布关于印发《防控应急物资生产技术及产品》的通知
- 5.21：发布关于印发《防控应急物资生产技术及产品》的通知
- 5.22：发布关于印发《防控应急物资生产技术及产品》的通知
- 5.23：发布关于印发《防控应急物资生产技术及产品》的通知
- 5.24：发布关于印发《防控应急物资生产技术及产品》的通知
- 5.25：发布关于印发《防控应急物资生产技术及产品》的通知
- 5.26：发布关于印发《防控应急物资生产技术及产品》的通知

### 第一阶段

- 5.12

### 第二阶段

- 5.19

### 第三阶段

- 5.26
Wen Jiabao, 66, Chinese Prime Minister, boarded on a plane 30 minutes after the earthquake, and arrived in disaster area in 2 hours. He has been the chief of the rescue operation since then, working almost around clock at the frontline with rescue workers.
1,1000 paratroopers started boarding airplanes 2 hours after earthquake. Despite heavy rain, high wind and thick cloud, they jumped from over 20,000 foot high to remote mountain areas where they did not even know if there would be a place for them to land. The first jumped off plane was Senior Colonel Li Zhenbo (李振波), 51.
Soldiers and rescue workers working around clock to rescue people still buried. Unable to transport heavy machineries to the remote areas since roads are buried by landslides, they often have to use hands to move tons of concrete.
Within hours, people rushed to rescue. Blood donation lines run for 100 yards, and people waited hours to donate blood; within 24 hours, all major blood banks ran out storage space. The highway to the earthquake struck city Dujiangyan (20 mile from Chengdu) was almost jammed one hour after the earthquake, not by people fleeing the aftershocks, but by volunteers, led by over 1,000 taxi drivers, came from Chengdu to rescue.

Chen Guangbiao(陈光标), owner of a big construction company 1,500 miles from the disaster area, just 2 hour 30 minutes after the earthquake, started transporting 60 construction machineries and led 120 volunteers to rescue. They arrived at the disaster area 24 hours later, almost the same time as Army Engineering Corp.
Zhang Jiwang(张吉万), 11, carrying his sister Zhang Han(张韩), 3, walked 12 hours straight to flee the disaster center.
Medical workers provided care under extreme conditions; they even delivered many new born babies on the parking lot.
People are rushing to donate money. Many rich people donated in millions, but no one can match Xu Chao (徐超), 60, on the right. He is a homeless in Nanjing, 1000 miles from the disaster area. He saw the news and went to donate 5 Yuan in the morning. He said people in the disaster area were worse off than him because their lives were threatened. He came back in the afternoon, donated another 100 Yuan ($14). He explained that all he had were pennies and dimes, and he didn't want to waste volunteer workers' time to count them, so he went to the bank to change everything he had into one big bill. This is from a man who doesn't have money to buy food for himself.
A 5 year old boy was rescued after being buried under rubbles for 24 hours. His left hand was broken, but he smiled and saluted to his rescuers. His smile made everybody cry.
Yuan Wentin (袁文婷), 26, first grade teacher. When the earthquake struck, she rushed to carry her stunned students from classroom on the 3rd floor to the ground. She managed to pull out most of her students, but the building collapsed when she was trying to pull out the last few. At the last moment of her life, she was trying to use her body to shield the students from falling concrete.

Many teachers did the same thing. They are 谭千秋、张米亚、苟晓超、吴忠洪、杜正香......
5 Loss Assessment

• 5.1 Casualties
• 5.2 Disaster impact area assessment
• 5.3 Integrated Assessment of Seismic Disaster Loss
5.1 Casualties

until 12:00 of July 11, 2008, the Wenchuan Earthquake in Sichuan province had caused:

- 69197 death toll
- 18341 people missing
- 374176 injured
- 15.106 billion transferred and relocated
- 96445 hospitalized injured people, of which 88391 people have left hospital already, and 5405 people remain in hospital
- 3334 people who had been transferred to other provinces from Sichuan province
- Treatments of the sick and wounded summed up to 2827552 person-times
5.2 Disaster impact area assessment

(1) Assessment Principles

- To fit the reconstruction demands
- To face disaster issues and earthquake and hazards magnitude
- To utilize multi-data source
- To focus on serious area affected by the earthquake and other hazards
(2) Criterion of earthquake impact area assessment and disaster index

- Based on *Notice of General Office of the State Council about Wenchuan Earthquake rebuild plan*, i.e., making clear criterions to separate severe impact area and other general areas, and define planning areas.

- Disaster Index (DI), is created to define the impact areas, calculated by the five indicators of the conditions of deaths, missing people, relocated people, earthquake magnitude and geological disaster risk.
Five specific group of assessment indicators

• ① Average magnitude of earthquake: considering that there may be several earthquake magnitude zones in one county, we use the proportion of the area of one specific magnitude in a specific county as the weight to calculate the average magnitude of earthquake (I).

• ② Number of deaths and missing people, percentage of deaths and missing people: both are based on county (city or district).

• ③ Number of collapsed houses per 10,000 persons: use the collapsed house number to divide the household population in the impact county (city or district) for calculation.

• ④ Risk of geological disaster: impact residents, roads, rivers, bridges, reservoirs and lands by landslide are given equal weight to calculate the risk.

• ⑤ Percentage of people relocated: based on the statistics of every county (city or district).
**Disaster Index (DI)**

\[
DI = \sum (fk \times DIk)
\]

DIk is the normalized indicator value: 
\[DIk = \frac{DIk - \text{min}(DIk)}{\text{max}(DIk) - \text{min}(DIk)}\]

fk is the weight for each indicator.

- **The weight for each indicators:**
  - Average magnitude of earthquake (0.3);
  - Number of deaths and missing people, percentage of deaths and missing people (0.3, 0.15 for each);
  - Number of collapsed houses per 10,000 persons (0.2, 0.1 for each);
  - Risk of geological disaster: impact residents (0.1); Percentage of people relocated (0.1).
(3) Define the disaster impact areas

- Classified into severe impact areas and other areas:
  - County (city or district) (DI higher than 0.4) is classified into highly severe impact area (H).
  - County (city or district) (DI less than 0.4 and higher than 0.15) is classified into severe impact area (S).
  - County (city or district) (DI less than 0.15 and higher than 0.01) is classified into general impact area (G).
  - County (city or district) (DI less than 0.15 and higher than 0.01) is classified into impact area (I).
(4) Assessment Results

- Severe impact area includes 10 highly severe impact counties (city or district) and 36 severe impact counties (city or district).
- The general impact area includes 191 counties (city or district).
- The impact area includes 180 counties (city or district).

<table>
<thead>
<tr>
<th>Type</th>
<th>Province</th>
<th>Area</th>
<th>Subtotal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe impact area</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highly severe impact</td>
<td>Sichuan</td>
<td>26410</td>
<td>26410</td>
<td>26410</td>
</tr>
<tr>
<td></td>
<td>Sichuan</td>
<td>61473</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gansu</td>
<td>20293</td>
<td></td>
<td>90246</td>
<td>116656</td>
</tr>
<tr>
<td>Shaanxi</td>
<td>8480</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe impact</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General impact area</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>383615</td>
<td></td>
<td>500271</td>
</tr>
</tbody>
</table>

Disaster impact areas of the earthquake (km²)
<table>
<thead>
<tr>
<th>Type</th>
<th>Percentage in deaths and missing people (%)</th>
<th>Percentage in collapsed houses (%)</th>
<th>Percentage in direct economic loss (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe impact area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highly severe impact</td>
<td>97.2</td>
<td>42.9</td>
<td>39.5</td>
</tr>
<tr>
<td>Severe impact</td>
<td>2.0</td>
<td>44.7</td>
<td>44.7</td>
</tr>
<tr>
<td>General impact area</td>
<td>0.8</td>
<td>12.1</td>
<td>15.2</td>
</tr>
</tbody>
</table>

**Statistical data different types of impact areas**
5.3 Integrated Assessment of Seismic Disaster Loss

(1) Integrated assessment content

- Including many aspects:
  - damaged degree and amount of town and countryside,
  - casualty,
  - housing,
  - infrastructure,
  - public service facilities,
  - industry and agriculture production facilities,
  - business circulate facility,
  - farmland,
  - the situation of environmental pollution,
  - ecological damage,
  - natural and historical cultural heritage,
  - resources environment bearing capacity,
  - geological disasters,
  - secondary disasters of earthquake and potential danger, etc.
(2) Support Materials for Assessment

- Earthquake intensity
- Collapse, Slides and debris flow, Barrier Lake induced by the earthquake
- Disaster Loss data provided by Civil Affairs at County Level
- Remote Sensing Data
- Field Investigation Data
Wenchuan Earthquake Intensity Maps
(China Seismological Bureau, CSB)
Wenchuan Earthquake Intensity Maps
(China Seismological Bureau, CSB)
Collapse, Landslides, Debris Flow and Barrier Lakes
Distribution of Geological Hazards
Field Investigation
Field Investigation Points
Seminar and Check
(3) Integrated assessment method

- ① Comprehensive proofreading of the statistical datasheet: including using the sum-up method and checkout by using other sources of relevant data for verification;
- ② According to the existing standards and relevant statistical data, the housing loss of various types in the disaster areas is accounted based on the origin estimation indicators of damaged housing loss form the civil affairs departments, and the proportion of different housing structure in different areas issued by the statistical departments;
- ③ Probability statistical analysis method: use the correlation analysis and the comparison analysis of the cumulative curve to check the serial changes of the selected samples relatively, and use the probability statistical analysis to realize the cross-check the statistical report and model data;
- ④ Integrated assessment by using disaster loss assessment models.
(4) The checkout and verification result of integrated loss

- The direct economic disaster loss: up to 845.136 billion RMB.
- The loss of Sichuan, Gansu, Shaan’xi province and the other regions (provinces, autonomous regions and Municipality) of China is 845.136 billion RMB with the perception of 92.07%, 5.19%, 2.52% and 0.21% of the total loss.
(4) Assessment Results
Integrated disaster assessment map of Wenchuan Earthquake
6 Conclusions and Discussion

• The 2008 Wenchuan earthquake is a main shock-after shock type and shallow-focus earthquake, with high magnitude and caused a great damage.
• It is the most serious earthquake of China since the foundation of the people’s republic of China in 1949.
• The Wenchuan earthquake affected area is about 500,000 km² totally, and the epicentral intensity is grade 8 (XI).
• The disaster area of the Highly Severe Impact Counties (city or district) sums 26,000 km², the Severe Impact Counties (city or district) 90,000 km², and the General Impact Counties (city or district) 384,000 km².
• Until July 11 of 2008, the disaster-affected death toll was up to 69197, the missing 18341, the injured 374176, and the transferred and relocated 151,060,000.
• The direct economic disaster loss of Wenchuan earthquake is up to 850.0-900.0(845.136) billion RMB
Discussion

• The deep analysis of Wenchuan earthquake forming reason need to be researched by detail observation and monitoring;
• The deduction of strong aftershock occurrence should be deeply studied and analyzed;
• The disaster loss should be further statistically validated and comprehensive assessed.
Thank you!