Compilation of Disaster Risk Atlas and its Application in Integrated Disaster Risk Governance
—Taking Compilation of China Natural Disaster (System) Atlas and Wenchuan Earthquake Disaster Atlas as Examples

SHI Peijun¹,²,³  WANG Jingai²,⁴  LIU Lianyou²,³
ZHANG Weixing¹,⁵  CHEN Wenfang¹  LV Lily¹

¹.State Key Laboratory of Earth Surface Processes and Resource Ecology, Beijing Normal University;
². Key Laboratory of Environmental Change and Natural Disaster, Ministry of Education of China, Beijing Normal University;
³. Academy of Disaster Reduction and Emergency Management, Ministry of Civil Affairs & Ministry of Education;
⁴. School of Geography and Remote Sensing Science, Beijing Normal University;
⁵. National Disaster Reduction Center, Ministry of Civil Affairs; the People’s Republic of China, Beijing 100875, China
Contents

1. Content and Technical System of Compiling Disaster Risk Maps (Atlases)
2. Compilation of China Natural Disaster (System) Atlas and Wenchuan Earthquake Disaster Atlas
3. Application of Disaster Risk Maps (Atlases) in Integrated Disaster Risk Governance
4. Conclusion and Discussion
1 Content and Technical System of Compiling Disaster Risk Maps (Atlases)
Disaster risk maps (atlases) should show the variation law of regional disaster system in temporal and spatial aspects.

Disaster risk maps (atlases) should show the occurring and developing law and temporal-spatial pattern of such disaster chain in view of the association between hazard and disaster.
Content System of Compiling Disaster Risk Maps/Atlases

Framework of content system for compiling disaster risk maps/atlases
Disaster risk maps can be divided into three kinds: paper, digital and multi-media maps.

Digital maps (atlases), in addition to all the technical contents of paper maps (atlases), also need support of database technical system, geographic information system, drawing software system, computer standard and performance system.

Multi-media maps (atlases), in addition to all the technical contents of paper and digital maps (atlases), also need support of the multi-media software system, visual technical system, computer audio/video system, etc.
2 Compilation of China Natural Disaster (System) Atlas and Wenchuan Earthquake Disaster Atlas
Compilation of Atlas of Natural Disasters in China

The Atlas of Natural Disasters in China (in Chinese and English versions)  
(ZHANG Lansheng, et al, 1992)
The Atlas of China Natural Disaster
(in Chinese and English versions)
目录

中国行政区划 ............................................................................................................ 1

孕灾环境与承灾体

中国主要地震带分布 ......................................................................................... 4
中国地震带分布 ......................................................................................... 6
中国滑坡自然灾害 .................................................................................... 7
中国地震 ....................................................................................................... 8
中国气候分布 .............................................................................................. 10
中国降水分布 .............................................................................................. 10
中国冰川分布 .............................................................................................. 10
中国冻土分布 .............................................................................................. 10
中国主要气候灾害 .................................................................................... 12
中国灾害平均年频率及年际变化 ................................................................ 14
中国农业灾害风险和灾害类型分布 ................................................................ 14
中国主要农作物病虫害面积和灾害损失 ................................................................ 14
中国主要灾害面积和灾害损失 ................................................................ 14
中国森林分布 .............................................................................................. 16
中国主要林区分布 .................................................................................... 18
中国主要城市人口分布 ............................................................................ 19
中国主要城市人口分布 ............................................................................ 19
中国主要城市工业及农业商品基地 ................................................................ 22

致灾因子

气象·水文灾害

干旱 ............................................................................................................. 34
台风 ............................................................................................................. 36
暴雨 ............................................................................................................. 38
洪涝 ............................................................................................................. 40
冰雹 ............................................................................................................. 42
暴雪 ............................................................................................................. 44

CONTENTS

Administrative Division of the People's Republic of China .............................................. 1

Hazard-formative Environments and
Hazard-affected Bodies

Land Use Map of China .................................................................................. 1
Major Factors of China ................................................................................... 7
Comprehensive Physiogeographical Regionalization of China .................................. 7
Topography of China ....................................................................................... 7
Temperate of China .......................................................................................... 7
Proliferation of China ....................................................................................... 19
Population Density of China ............................................................................. 11
Average Net Inverse of Forests and Its Change in China ......................................... 14
Tara, Output Value of Annual Humidity in China .................................................. 14
Production of Major Grain Crops Per Mu and Per Capita of China ............................. 15
Seeded Area and Production of Cotton, Oil Crops and Sugar Crops in China .......... 13
Distribution of Forests in China ......................................................................... 16
Comprehensive Agricultural Regionalization of China ......................................... 14
Population of Minor Cities and Towns of China ................................................... 19
Major Roads in China ...................................................................................... 23
Major Urban Industrial and Agricultural Contingency Basis of China ..................... 22

Hazard-formative Factors

Meteorological and Hydrological Hazards

Drought ......................................................................................................... 29
Typhoon ....................................................................................................... 29
Rainstorm ..................................................................................................... 35
Flood and Waterlogging ................................................................................ 31
Hail ............................................................................................................... 38
Cold and Freezing Injury ............................................................................... 48

Contents of Atlas of Natural Disaster in China
(in Chinese and English versions)
Flood and Waterlogging in English Version
Compilation of Atlas of Natural Disaster System of China

The Atlas of Natural Disaster System of China (in Chinese, English and CD versions)
(SHI Peijun, 2003)
The Contents of the “Atlas of Natural Disaster System of China” in Chinese and English
The Contents Framework of the “Atlas of Natural Disaster System of China”
Typhoon Risk of Shenzhen Urban Districts
The compilation departments of the Atlas

- The Expert Group of Earthquake Resistance and Disaster Relief under National Commission for Disaster Reduction
- Ministry of Civil Affairs National Disaster Reduction Center
- Chengdu Map Press
- Institute of Geographical Sciences & Natural Resources research, Chinese Academy of Sciences
- Academy of Disaster Reduction & Emergency Management
- National Fundamental Geographic Information Center
- China 21st Century Agenda Management Center
- State Key Laboratory of Earth Surface Processes and Resource Ecology, Beijing Normal University

Functions of the departments

- The Expert Group of Earthquake Resistance & Disaster Relief and the National Commission for Disaster Reduction organized the relevant institutions of the atlas compilation
- National Geomatics Center led the overall programming compilation of the Atlas, and collected data
- Chengdu Map Press published the Atlas

Wenchuan Earthquake Disaster Atlas

SHI Peijun as its chief editor (technical) and CHEN Jun as the chief editor (mapping) 8K size
## Wenchuan Earthquake Disaster Atlas

(Wenchuan Earthquake Disaster Atlas (8 parts, 44 themes))

<table>
<thead>
<tr>
<th>Introductory Maps</th>
<th>Disaster incubating environment</th>
<th>Exposure</th>
<th>Hazard</th>
<th>Disaster evaluation</th>
<th>Disaster response</th>
<th>Recovery and reconstruction</th>
<th>Addendum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topography of China; Map of China; Affected area and disaster degree.</td>
<td>Geological structure; Geological topography; Climate; Hydrology; Soil; Biomass.</td>
<td>Population; Cities &amp; towns; Transportation &amp; Communication; Water Power; Resource; Economy.</td>
<td>Earthquake; Geological disasters, flood &amp; water logging; Landslide; Collapse; Debris flow; Barrier lakes.</td>
<td>The integrated disaster evaluation, Casualties, Housing damage; Agricultural losses; Industrial losses; Service industry; Infrastructure losses, Social losses; Residential property losses; Land and resource losses; Natural ecological losses; Relic losses, etc; The integrated disaster assessment of the 10 severe disaster counties/districts; The integrated disaster assessment of 41 major disaster counties/districts.</td>
<td>Emergency rescue; Emergency relief; National mourning day; Emergency transfer &amp; relocation; Scientific &amp; technical support; Disaster monitoring; International rescue.</td>
<td>Reconstruction planning; Pairing-assistance.</td>
<td>The planning rule of resuming &amp; reconstruction after disaster; Explanation of Atlas compilation.</td>
</tr>
</tbody>
</table>

### The Framework of the “Wenchuan Earthquake Disaster Atlas”
Atlas has emphatically represented the spatial distribution law of the disaster system caused by a seismic catastrophe (Richter 8.0) in China, especially the formation of hazards and disaster and the spatial pattern of catastrophe condition.
Demonstrating methods

- One is based on the characteristics of natural disaster phenomena
- Second is based on the basic unit of natural disaster database
- The third is to integrate two or more methods while considering both the natural disaster phenomena and the basic database units
- In addition, the hill shading is widely used as an aid.
Demonstrating methods2

- The isopleth method is used to show the hazard-formative environments.
- The symbolic method to demonstrate the epicenter and magnitude of earthquake, and the area method to indicate the distribution of hazards such as flood dust storm and hail.
- The grade ratio method to reflect the vulnerability level of hazard-affected bodies and the degree of disaster effects, etc.
Demonstrating methods

As the plan focused on a large number of statistical charts, so we try to use various forms to express, so that each piece of thematic maps have their own characteristics, while maintaining the overall style of uniform Atlas
Tint design(1)

There are two main bases for tint design:

1) The color is approximate to the landscape color of disaster phenomena for the purpose of mental connection.

2) The color red is a metaphor for the magma activity to result in earthquake disasters.
We use **eight colors** for the word bar decoration on the top margins to express:

* precedent chart
* hazard-formative environments
* hazard-affected bodies
* disaster condition assessment
* emergency response
* recovery
* Reconstruction
* addendum
The thematic maps which express the quantitative difference of disaster systems by layer tinting usually introduce the transition of 2-3 color spectrums according to the number of quantity scales.

The more serious the disaster effects or the bigger the amount, the purer color is used for emphasizing the illustrating degree of disasters in the maps.
Wenchuan Earthquake Disaster Atlas
Wenchuan Earthquake Disaster Atlas
3 Application of Disaster Risk Maps (Atlases) in Integrated Disaster Risk Governance
Disaster risk maps (atlases) are the scientific basis for integrated disaster reduction planning

Since the disaster risk maps are the main scientific basis for formulating the division of disasters and disaster risk:

Based on the compilation of Atlas of Natural Disasters in China (in Chinese and English version), we have completed "China Natural Disaster Regionalization", "China Agricultural Natural Disaster Regionalization" and "China Urban Regionalization"

Based on these items of regionalization, "China Integrated Disaster Reduction Planning" has been formulated.

Based on this, China Basic Planning for Disaster Relief Goods Reserve has been formulated.
Regionalization of Natural Disaster in China
Comprehensive Regionalization of Agriculture Natural Disaster in China
The Regionalization of Natural Disaster in Urban Areas

3 first zone; 15 second zone: Highlight the combination of the similarity types of disasters;
22 third zone: highlighted the urban agglomeration and the composite index of high-value area
The Regionalization of Disaster Relief in China

15个区域

注：图中带下划线的储备基地为已有国家储备基地
Disaster risk maps (atlases) are the technical support in determining the premium rate of disaster insurance

The regional variation law shown in the disaster system plays a major role of technical support in rationally determining the premium rate for disaster insurance:

In 2007, the Chinese Government started to implement the measures of agricultural disaster insurance with the financial support. In formulating the premium rates for disaster insurance of such crops as paddy rice, maze, wheat and cotton, Atlas of Natural Disasters in China (in Chinese and English versions) and Atlas of Natural Disaster system of China (in Chinese and English) compiled by us have played an important role.

The publication of Wenchuan Earthquake Disaster Atlas had provided a technical support for the area to undertake the disaster reduction by means of insurance against seismic disasters, as well as a certain technical support especially for PICC to speed up with the catastrophe insurance.
Disaster Risk Reduction Strategy of China

China’s natural disaster insurance
Disaster risk maps (atlases) are the main basis of management science for compilation of emergency plans.

The series of maps for disaster chain risks have become the important scientific basis for the risk management:

Regarding the disaster chain triggered by catastrophe, the emergency processing procedures and necessary institutional assurance for disaster chain resistance should be made clear in both spatial and temporal aspects when preparing emergency plans for the catastrophe, so that a series of work for multi-departmental cooperation and integrated optimization at central and local can be implemented, while safety construction can be further promoted.
play an important role in earthquake relief

become an important tool for the leading decision-making, expert studies and the rescue forces
Organization system: “One Office and Four Committees”

Disaster Risk Reduction Strategy of China--
The Integrated Disaster Management System of China
### Natural Disaster Management System of China

#### National Commission for Disaster Reduction

- **General Office**: 办公室
- **Board of Experts**: 专家委员会
- **NDRCC**: 国家减灾中心

<table>
<thead>
<tr>
<th>Ministry</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>科技部</td>
<td>Ministry of Science and Technology</td>
</tr>
<tr>
<td>公安部</td>
<td>Ministry of Public Security</td>
</tr>
<tr>
<td>铁道部</td>
<td>Ministry of Railways</td>
</tr>
<tr>
<td>农业部</td>
<td>Ministry of Agriculture</td>
</tr>
<tr>
<td>安全监管总局</td>
<td>Administration of Work Safety</td>
</tr>
<tr>
<td>中国地震局</td>
<td>China Seismological Bureau</td>
</tr>
<tr>
<td>国家海洋局</td>
<td>State Bureau of Oceanic Administration</td>
</tr>
<tr>
<td>民政部</td>
<td>Ministry of Civil Affairs</td>
</tr>
<tr>
<td>商务部</td>
<td>Ministry of Commerce</td>
</tr>
<tr>
<td>交通部</td>
<td>Ministry of Communications</td>
</tr>
<tr>
<td>卫生部</td>
<td>Ministry of Public Health</td>
</tr>
<tr>
<td>国家统计局</td>
<td>State Statistics Bureau</td>
</tr>
<tr>
<td>国家林业局</td>
<td>State Forestry Bureau</td>
</tr>
<tr>
<td>中国气象局</td>
<td>China Meteorological Bureau</td>
</tr>
<tr>
<td>国家测绘局</td>
<td>State Bureau of Surveying and Mapping</td>
</tr>
<tr>
<td>教育部</td>
<td>Ministry of Education</td>
</tr>
<tr>
<td>国土资源部</td>
<td>Ministry of Land and Resources</td>
</tr>
<tr>
<td>信息产业部</td>
<td>Ministry of Information Industry</td>
</tr>
<tr>
<td>国家环保总局</td>
<td>State Environmental Protection Administration</td>
</tr>
<tr>
<td>国家林业局</td>
<td>State Forestry Bureau</td>
</tr>
<tr>
<td>国家发改委</td>
<td>State Development and Reform Commission</td>
</tr>
<tr>
<td>国防科工委</td>
<td>Commission of Science, Technology and Industry for National Defence</td>
</tr>
<tr>
<td>建设部</td>
<td>Ministry of Construction</td>
</tr>
<tr>
<td>水利部</td>
<td>Ministry of Water Resources</td>
</tr>
<tr>
<td>国家广电总局</td>
<td>State Administration of Radio, Film and Television</td>
</tr>
<tr>
<td>中国科学院</td>
<td>China Academy of Science</td>
</tr>
<tr>
<td>自然科学基金会</td>
<td>The National Natural Science Foundation</td>
</tr>
<tr>
<td>武装警察部队</td>
<td>Chinese People’s Armed Police Force</td>
</tr>
</tbody>
</table>

#### Chinese Societies

- **China Society and Technology Association**: 中国科学技术协会
- **Red Cross Society of China**: 中国红十字会
The State Emergency Response Planning for Natural Disasters
4 Conclusions and Discussions
Conclusions

- Disaster risk maps (atlases) are **the scientific summary** of the temporal-spatial variation, formation mechanism and development process of the regional disaster system as well as **the long-term task** for construction of disaster risk science and its disciplines.

- The content system of disaster risk maps (atlases) focus on **temporal-spatial variation law** for hazards, disaster (conditions) and disaster risk.

The technical system for compilation of disaster risk maps (atlases) covers the **integration of three mapping techniques**: paper, electronic and multimedia.

- Disaster risk maps (atlases) are **the scientific basis** for compiling the integrated disaster reduction planning, **technical support** for determining the premium rate for disaster insurance and **basis of management science** for compiling disaster emergency plans.
Discussion

The challenges for compiling disaster risk maps (atlases) are the inadequacy of standardized data and online use (online service of huge data, etc), untimely updating of information and other problems.

Compilation of disaster risk maps (atlases) with high temporal-spatial resolution is a urgency for the integrated disaster risk governance, and a prior scientific and technological task for the world to cope with catastrophes currently.
Thank you!