Research on the Earthquake Disaster Thematic Electric Map

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Abstract: This paper introduces the concept of the earthquake disaster, analyses the thematic mapping elements and expression methods on the thematic e-map of the earthquake disaster. While the paper makes the earthquake disaster e-map into four types map: Earthquake Disaster Distribution Map, Earthquake Disaster Process Map, Earthquake Disaster Economic Losses Map, and Earthquake Disaster Trend Map. And it promotes the mapping principles of the earthquake disaster and illustrates the designing methods of the earthquake disaster thematic e-map by some experiments.

Keywords: Earthquake Disaster, Thematic E-map, Visual Variable

1 Introduction

Recently, earthquakes have happened frequently such as the 5.12 Wenchuan earthquake, Yushu earthquake and etc. Facing to these disaster, we could see that these incidents happened suddenly, affected largely extend and at a high degree of concern. So that the mapping of the thematic e-map has to pay more attention, which brings forward high demands.

2 Conception of the Earthquake

Earthquake is the rapid breakdown of the Earth's interior longitudinal and shear waves generated by a complex interaction of movement, and within a certain range caused by the earthquake ground dynamic phenomenon. The center location of the earthquake is called earthquake source. Vertical projection point on the ground is called the epicenter. The depth of the earthquake is the distance between the earthquake source and the epicenter. According to the different focal depth, earthquake can be divided into shallow earthquake, the middle-distance earthquake and deep earthquake. Two rules of the scale of earthquake are earthquake magnitude and earthquake intensity. The number of the energy released in an earthquake affects the strength of the earthquake magnitude. The greater the energy released, the higher the earthquake magnitude. Earthquake intensity is the extent of the earthquake damaged. When earthquake happened, there has only one earthquake magnitude, but the earthquake intensity is different along with the location. Nearer the epicenter, the intensity is higher. In General, the grade includes 12 levels. Due to the occurrence cause the earthquake has been divided into tectonic earthquake, volcanic earthquakes, subsidence earthquakes, induced seismicity, and artificial earthquake.

Earthquake disasters are the disaster which is caused by the earthquake. The scope of the earthquake disaster refers to the magnitude size of the earthquake, epicenter distance, focal depth, earthquake type, geological conditions, seismic performance of buildings, population density, economic development, the degree of social civilization and etc. Earthquake disaster includes direct, secondary disasters and third disasters. Direct damage includes buildings damage, landslides, mudslides, ground fissures, subsidence, spilling and other surface damage and tsunami. Secondary disasters include fire, flood, gas, toxic gas leaks, bacteria, radiation diffusion, and plague and so on. Third disaster includes the command system failure, panic disorder and other people.

3 Analysis the Methods and the Cartography Elements of the Earthquake Disaster Thematic Map

3.1 Cartography elements analysis
By analyzing the concept of the earthquake, the cartography elements of the earthquake thematic electronic map can be got, as shown in table 1.

<table>
<thead>
<tr>
<th>Types</th>
<th>Contents</th>
<th>Elements Feature</th>
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<tbody>
<tr>
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<td>Earthquake Source, Epicenter</td>
<td>Quality</td>
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<tr>
<td>Earthquake Types</td>
<td>Tectonic Earthquake, Volcanic Earthquakes, Subsidence Earthquakes, Induced Seismicity, Artificial Earthquake</td>
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<td>Earthquake Levels</td>
<td>Earthquake Magnitude and Earthquake Intensity Area</td>
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<td>Size of the Earthquake Magnitude, Epicenter Distance, Focal Depth, Earthquake Intensity Area</td>
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</tr>
<tr>
<td>Earthquake Disaster Types</td>
<td>Direct Disasters, Secondary Disasters, Third Disasters</td>
<td>Quality</td>
</tr>
<tr>
<td>Earthquake Disaster Losses</td>
<td>Building Area, Number of Hurt and Death People, Economy Losses</td>
<td>Quantity</td>
</tr>
</tbody>
</table>

### 3.2 Cartography methods analysis

Cartography method and cartography purposes were inseparable, and therefore, according to the different uses the method used was also somewhat different. After analysis, the authors believed that the earthquake thematic e-map could be divided into four categories base on the demands of thematic e-maps [6], namely the earthquake disaster distribution map, earthquake process map, the earthquake disaster economic losses map, earthquake disaster trend map. The earthquake disaster distribution map, the earthquake disaster economic losses map and the development trend map were expressed in the small scale map; the process of earthquake disaster was expressed in the large scale map. Based on the characteristic of the e-map, these types could be integrated together. If the user chose the type which he wanted to see, the e-map would be shown. In terms of time, earthquake disaster trend map was forecast map, the others were the afterward maps.

#### 3.2.1 Earthquake disaster distribution map

In these maps, the key point was the location of the epicenter and the area of the disaster, types of the disaster, level of the disaster and influence sphere. The types of the disaster were the quality feature; the levels of the disaster were the quantity feature. The methods used position point method and area method together. The position point was at the location of the epicenter, and colors were the types of the disaster, scales represented the levels of the earthquake, the range of color or direction lines represented the area affected.

#### 3.2.2 Earthquake disaster process map

The key of such maps was the earthquake source, epicenter, types of the earthquake, and scopes of the earthquake. Among these contents earthquake source, epicenter, types of the earthquake were the quality feature, and levels of earthquake and intensity were the quantity feature. Due to the direction character of the disaster diffusion, the method was moving line method.

#### 3.2.3 Earthquake disaster economic losses map

This type maps showed the loss situation every district. So the important point was the loss situation about building loss, personnel loss, and economy loss. The types of the damaged building, money, personnel belonged to the quality feature, and the area of the damaged building, extent of the damage, the number of the hurt and death people, the sum of the money belonged to quantity feature. The method was zone statistics chart method.

#### 3.2.4 Earthquake disaster trend map
This type maps included the range of possible future expansion, the situation of the possible secondary disasters and third disasters, the likely extent of the damage prediction. Possible secondary disasters and third disasters belonged to the quality feature; the extent of damage was the quantity feature. The method was the area method.

In summary, the methods and the visual variables were summarized as shown in table 2.

<table>
<thead>
<tr>
<th>Map Purposes</th>
<th>Expression Methods</th>
<th>Visual Variables</th>
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<tr>
<td>Earthquake Disaster Distribution Map</td>
<td>Point Value Method And Area Method</td>
<td>Shape, Scale, Color, Aspect</td>
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</table>

4 The Mapping Principle of the Earthquake Disaster Thematic Electric Map

A. Science features. The symbols should distinguish the feature between the quality and quantity, and should be remembered and recognized easily. The graphic shape is logical. The topic should stand out.

B. Multimedia features. This map should exert the multimedia features of the e-map sufficiently, use animation, sound, video and other means of supporting display to reflect the theme information.

C. Aesthetics features. Interface and symbol colors should be consistent. The symbols assemble in reason. And the graphic expression accord with the people’s feeling and cognize.

5 Mapping Methods of the Earthquake Disaster Thematic Electric Map

5.1 Base-map design

Given the characteristics of the electronic map, the base-map of the earthquake thematic e-maps used two-dimensional map to combine with three-dimensional shadow map, image map or aerial map. The reason was that location, traffic, residential area, water system, annotate and etc. in two-dimensional map made users find what they have wanted to get, at the same time the others map could reflect the real world, which made the users realize the reason and the process of the earthquake.

5.2 Symbol design

In aspect of the design of the symbol, the authors followed the design principles of map symbols, selected the similar shapes and pictures to be the unit of the map symbols, which referred the paper—General Development of electronic map symbol library. For example, in the earthquake disaster economic loss map, legend with people, buildings simple similar shape or different colors represented the economy loss types; in the earthquake disaster process map, legend with similar photos represented earthquake types.

5.3 Expression methods

Due to the feature of the e-map, the expression method was delicate. The method could be extended and assisted at some special effects except that above table methods. For example, in the earthquake disaster process map, let the arrows flow in some time interval to enhance to reflect the fact. And the direction of the arrows was the direction of the earthquake extend, while sound and video showed the real process of the earthquake. In the distribution map of the earthquake, the earthquake source symbol shined at the center location of the earthquake source which was encircled by several concentric rings. The larger the
concentric ring, the smaller earthquake affected areas and the lighter the color. Additionally, theme skin, idiographic numbers and digital tables were helpful for the map aesthetics, intuitive performance, which illustrated the loss situation in the earthquake loss map and showed the disaster trend in the earthquake trend map.

5.4 Samples

![Figure 1 The Earthquake Disaster Process Map](image1)

![Figure 2 Earthquake Disaster Loss Map](image2)
6 Conclusion

The earthquake disaster thematic electric maps have become the regard map in recent years. This paper discusses this thematic map and makes primary experiments about the earthquake disaster thematic electric maps. However, there are still new demands and change in actual application, such as the symbol library, thematic map quick making and etc, so that methods have to been changed and researched.

References