Geological Disaster Early Warning Model Based on Big Data

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Abstract. As a country with high frequency of geological disasters, China still faces many problems in dealing with geological disasters and reducing economic losses. In recent years, with the deepening of the research on geological disaster early warning, as well as exchanges with various institutions and learning experience, we have made some achievements in how to carry out geological disaster early warning, which has become a major driving force for social development. Nowadays, people mostly deal with geological disasters with certain human intervention. This paper relies on the "big data analysis" and mathematical conventional statistical analysis in recent years, and carries out a series of experiments to establish the early warning model, and carry out corresponding analysis on the multiple attributes of the model, so as to explore the usability of the early warning model in the future geological disasters. In this paper, the corresponding exploration of geological disasters in recent years is carried out. Correlation analysis and statistical analysis are carried out in the aspects of year, disaster frequency, loss and early warning, and the prediction model is established. It is found that with the development of time, the occurrence times of geological disasters are uncertain, and people pay more attention to the early warning of geological disasters and face the loss caused by geological disasters It will decrease gradually.

Keywords: Big Data, Geological Hazards, Early Warning Model, Statistical Research

1. Introduction

With the improvement of our living standard and productivity, our life is also colorful. At the same time, the complexity of our activity space is also increasing rapidly, and the geological disaster events are gradually increasing. Every year, there are many accidents caused by geological disasters, and various injuries occur frequently, which not only bring pain and all kinds of harm to people's lives At the same time, it has brought great losses to the economy. Therefore, we should pay attention to the prevention and control of geological disasters, which can be said to have reached an urgent stage [1].

Geological disaster early warning is not a simple field, many aspects should be studied. For example, the timeliness and dynamics of early warning, and geological disasters also have many
attributes: category, intensity, time, etc., these attributes determine the quality of disaster warning. Therefore, people should not only observe the real-time data of geological disasters, but also compare and analyze the data of previous years, because this is also an important research direction. Only in this way can we achieve accurate and real-time early warning of geological disasters, which is a great leap for the prevention and control of geological disasters [2-3]. In today's world, big data is developing rapidly, and data-driven technology is precisely in this context, the rapid processing and analysis of a variety of massive data, constantly mining and obtaining the corresponding new knowledge, better service for user decision-making command. The technology has been used in many industries, and even widely used in many industries, such as financial industry, and even e-commerce and art industry. Therefore, this study applies it to geological disaster early warning to help establish a more perfect geological disaster monitoring and early warning system [4]. Fang Xiao Lei believes that China has a vast territory, complex and diverse geological structures, and a large number of potential geological hazards [5]. Indeed, the types of geological disasters in our country are very diverse, such as various forms of collapse, collapse, landslide, land subsidence, debris flow, ground fissures, etc., which have brought great losses to all aspects. For example, it has caused immeasurable damage to people's life, property and ecological environment [6]. As we all know, the junction of frequent crustal activities is more prone to geological disasters. Sichuan Province in China is an example. The Himalayan Mediterranean earthquake is a famous seismic belt. Sichuan Province is located on it. The frequent occurrence of geological disasters has caused serious damage to the local geological environment. Therefore, the traditional early warning of geological disasters is widely used in this province. However, Li Weiyao thinks that the accuracy of the traditional geological disaster early warning model is not high, and in view of this phenomenon, big data technology can be used to improve [7]. For example, our traditional geological disaster early warning technology and methods are relatively simple, basically using the methods and experience handed down by predecessors, such as patch, embedding nails and other methods. Although these methods can also provide effective or even reliable basis for the early warning of geological disasters, because they can not automatically alarm and other functions, their prevention and control effect is not very good [8].

With the rapid development of modern science and technology, all aspects of the instrument manufacturing more sophisticated and advanced, a variety of high-quality, multi-functional instruments emerge in endlessly, the same is true of modern geological early-warning instruments. Compared with the old machines decades ago, all aspects have been greatly improved, with more powerful functions, higher accuracy, better timeliness, and modern geological disaster warning instruments All aspects of the function are constantly improving and improving [9-10]. Not only that, the integration of geological disaster early warning instruments into other fields plays a complementary role. For example, we often use multimedia sensing, satellite remote sensing and other technologies. Using these technologies, we can carry out image transmission in areas with serious geological disasters. We can also use various information platforms to establish corresponding early warning systems. We can comprehensively use modern technical means such as satellite space positioning and network, supplemented by big data, to carry out real-time monitoring and early warning of geological disasters, so as to make big data into a real-time monitoring and early warning system. The new development of the combination of big data technology and geological disaster monitoring and early warning has been reflected in the online geological disaster monitoring system of line combined structure [11-12].

2. Method

2.1. Big Data

Big data refers to the data collection that cannot be grasped, managed and processed by conventional software tools within a certain period of time. Big data technology refers to the ability to quickly obtain valuable information from various types of data. Big data technology is applicable to many fields. In fact, as long as we observe carefully in our life, you can find many shadows of big data
technology, such as large-scale parallel processing (MPP) database, data mining power grid, distributed file system, distributed database, cloud computing platform, Internet, and scalable storage system. Nowadays, big data has been integrated into all walks of life. The reasons are related to the following: first, its data volume is very large. Second, the data types it collects are very diverse. Third, it has high processing speed and high efficiency. Fourth, its value density is low. These basic characteristics lead to big data becoming the darling of the new era. In the aspect of disaster warning, it also plays a mainstay role. Generally speaking, a significant feature of big data is that its amount of data is large and complex, and it can no longer be collected and managed by human resources. Using a computer to carry out statistics, analysis, comparison, collation and a series of steps, we can find a certain rule from it, which is the meaning of big data.

2.2. Early Warning
In the past many natural geological disasters, we can find some common points: when the disaster is about to happen, people have very little response time, and their environment is also very bad, at this time, it is too late to dredge or warn. In some places, there are public broadcasting systems, which, to a certain extent, will play a certain role, but the scope of action is relatively narrow. Due to the limited range of broadcasting, and the weather will bring limitations to it. For example, in some bad weather conditions, broadcast signals will be seriously interfered, and signals can not be effectively guaranteed, so they can not play a corresponding role. Some places may develop rapidly, and some large electronic screens will be invested. It is not a good way to release useful early warning information in this way. First, when a disaster occurs, people are usually flustered and have no time and energy to read the discrimination information carefully. Moreover, this method is too expensive, so it is not recommended to use. Nowadays, it is more common for the local government to establish a big data monitoring platform to monitor and analyze the geological conditions in real time. In combination with the geological disaster data, it is necessary to conduct discriminant analysis and early warning. Generally, TV broadcast early warning, or sound alarm warning, etc. these means can reduce casualties and property losses to a certain extent.

2.3. Statistics
As an important branch of mathematics, the main goal of statistics is to observe, analyze and infer data by calculating probability combined with the principle of probability theory. It can effectively provide strong evidence for some of our major decisions or suggestions, so it is widely used at all levels. Whether it is physics, or humanities, or in business decision-making, government reference, or even people's reference, etc., it is inseparable from its shadow. Statistics can be subdivided into two aspects: when there is a set of data, describe the data mathematically. This usage is called descriptive statistics. Another method is to establish a mathematical model of data to explain the uncertainty and randomness of the data, so as to infer the steps and matrix in the research. This method is called inferential statistics. No matter which method is used, it has certain compatibility for disaster early warning. Statistical analysis of disaster data over the years, seeking its laws, and obtaining the results we need, is the role of statistics in disaster early warning.

2.4. Model Algorithm
From the point of view of statistics, the possibility of disaster occurrence is set as a (1). For the occurrence time t, a (T) is certain on the one hand, for example, the crustal activity is frequent in a certain period of time. In other ways, it is uncertain, such as the exact time of occurrence. If the definite relation is set as C (1), the law of periodic occurrence is p (T), and the random relation is expressed as C (T), then the mixed forecasting model can be expressed as follows:

\[ A(t) = B(1) + P(t) + C(t), \quad t = 1, 2, 3, 4, 5, \ldots \]  

(1)
3. Experiment
According to the previous paper, based on the above theoretical research results, combined with some significant characteristics of geological disasters, the following two models are tested.

3.1. Dimensions of the Model
The impact of geological disasters is huge. This paper analyzes the time link, occurrence times, casualties, economic losses, number of early-warning projects, early-warning investment and so on, and constructs a model to understand the correlation of these multiple attributes.

3.2. Dimensions of the Model
In the whole model, we use linear nonlinear regression to fuse some trend items. In order to facilitate the algorithm on the mathematical level, we transform the nonlinear model \( x(T) = f(T, a, b) \) into a linear form. The converted general formula is:

\[
X(t) = A + BT
\]

The trend fitting model was established by the above formula.

3.3. Statistical Formula
Because geological disasters have certain certainty at all levels, we use Bayesian formula in statistics to explore. The advantage of this formula is that when facing some attributes supporting the occurrence of events, the more attributes it shows, the greater the probability of occurrence of this event. The formula is as follows:

\[
P(A|B) = \frac{P(B|A_i)P(A_i)}{\sum_i P(B|A_i)P(A_i)}
\]

4. Result

4.1. Results of Disaster Loss Model
In order to meet the sustainable development advocated by the state, the prediction and prevention of disasters is an indispensable part of human activities, and geological disasters in some areas of China are still relatively serious. Here we establish a prediction model. Since big data is just emerging in modern times, according to the geological disaster records of previous years, the disaster records of recent years after the 20th century are selected to increase the accuracy of experimental data. The above formula is used as the prediction formula, and the dynamic comparison analysis is used to draw Table 1 and figure 1.

| Particular year | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|-----------------|------|------|------|------|------|------|------|
| Number of geological disasters | 13652 | 17548 | 10632 | 25631 | 25968 | 10265 | 30869 |
| Casualties / person | 712 | 569 | 636 | 596 | .658 | 365 | 2278 |
| Economic loss / 10 million | 400 | 357 | 431 | 247 | 320 | 190 | 640 |
Figure 1. Results of disaster loss model

It can be seen from the above chart that, with the passage of time, the number of geological disasters has a certain linear relationship with time, showing an upward trend, while in terms of casualties and economic losses, 2008 is a node, showing an umbrella shaped discount, and generally showing a downward trend.

4.2. Results of Disaster Warning Model

In fact, most of the geological disasters happen suddenly, which is often unexpected. Nevertheless, it has its own rules. It has the following attributes: on the type level, it can be divided into earthquake, flood, debris flow and so on. In terms of intensity, we set a series to facilitate the study, while on the spatial level, it is more likely to occur in the places where the crustal activities are frequent. But under the certain intervention of our human beings, it can play a positive role in reducing the damage. People gradually understand the characteristics of geological disasters, and gradually start to prevent them, so as not to be at a loss when facing geological disasters.

Table 2. Results of disaster warning model

| Particular year                  | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---------------------------------|------|------|------|------|------|------|------|
| Economic loss / 10 million      | 400  | 357  | 431  | 247  | 320  | 190  | 640  |
| Number of preventive items     | 1800 | 2245 | 2280 | 3250 | 4200 | 5500 | 5436 |
| Preventive investment / 10 million | 150  | 157  | 196  | 225  | 545  | 542  | 546  |
According to the data in Table 2 and Figure 2, with the development of the times, with the time line, for the early warning, the large-span changes in 2008 have been reduced with the development of the early warning level. It shows that in the background of big data, human beings have the ability to give early warning and face natural disasters.

5. Conclusion
In a word, geological disaster is a kind of natural disaster that can have a very serious impact on economic construction, social development and people's life and property safety. Therefore, it is of great significance for the whole country and society to establish a model and early warning and prediction system of geological hazards, which can protect people's life and property safety to a certain extent, and also play a very important role in the security and stability of the whole society. The national geological disaster information management system established according to the research and development characteristics of big data breaks the barriers between the data from various information channels, makes the multi-source and massive data effectively integrated, and makes it possible to query and transfer relevant data quickly and conveniently. The application of big data technology in geological disaster early warning research is of great significance for scientific deployment of geological disaster prevention and control work and further improvement of geological disaster prevention and management efficiency, which is also of great significance to the economic construction and development of the whole society, and has played a huge role in promoting.

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