

Article

The universal risk model and application in Mainland China

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Natural disaster risk refers to the possibility and intensity of natural disasters, it is a comprehensive result interacted by the danger of hazard and the vulnerability of hazard-affected area. By comparatively analyzing previous studies, we can find out the general disaster risk model is mainly developed from one or two dimensions, disasters itself and hazard-affected bodies, then select some specific variables to represent these two dimensions, and finally use multiplication or division method to make these variables together to get a disaster risk model. Among these risk models, for the model that using one dimension to represent risk, it is measured by intensity and possibility of disasters, which just only considering the nature of the hazard itself; for the model using two dimension to represent risk, it is measured by intensity of hazard itself and vulnerability of hazard-affected bodies, while it does not take the relationship between these two dimensions into account, that is to say, it ignores the distance between disasters and its affected area. The concept of distance is actually a kind of relationship between hazard and hazard-affected bodies. As we know, when the distance between disaster and its affected area is far, the damage and losses of the affected area could be greatly reduced. Therefore, we add the third dimension in risk model. Finally, we design the universal risk model by referring form of the universal gravitation model; the universal risk model can be represented as follows:

$$R = k \frac{H \cdot V}{r^2}$$

R is the natural disaster risk; H is the danger of natural disasters; V is the vulnerability of affected areas; r is the relationship between hazards and its affected bodies, which refers to the relationship between the danger of natural disasters and the vulnerability of hazard-affected bodies. It is important to note that the relationship r can be physical or geographical distance, which can also be a degree of their correlation. The stronger the relationship, the smaller the distance between them, and the greater damage will be caused to the affected areas by disasters; and vice versa, the weaker the relationship, the farther the distance, and the less damage disasters can cause to the hazard-affected body. Here k can be interpreted as a constant, which will vary among different types of disasters; for example, k_1 refers to coefficient of earthquake disasters, and k_2 refers to coefficient of fire disasters, and we can find k_1 is much larger than k_2 , because the influences brought by earthquake are much greater than fire.

The above universal risk mode is a nonlinear disaster evaluation model which is similar with universal gravity model in physics. It can be applied in both natural disaster and social incident such as epidemic situation or accident.

Risk evaluation index system in accordance with Chinese reality could be constructed, which contains some second-class indicators and more third-class indicators; moreover, the universal risk evaluation model was designed combined with nonlinear damage evaluation method; then, the disaster risk of Mainland China's 31 provinces was evaluated, as well as the urban risk ranking and risk map of 31 provinces were presented. The evaluation results can make us see the urban risk situation clearly and intuitively, which helps the related department to clearly focus on their work, as well as provides theoretical guidance for the national and local disaster prevention and mitigation planning.