Comparative Study of Flash Flood Risk Assessment Models Across Different Spatial Scales: Postprint

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Abstract

This study investigates three common models for flash flood disaster risk assessment: the multi-criteria decision model, the maximum entropy model, and the information content model. The Hexi Corridor and Zhangye City are selected as study areas at geographical region (large/medium) and municipal (small) spatial scales, respectively. A flash flood disaster risk assessment indicator system is constructed, and risk assessment mapping based on the three models is completed for both spatial scales. Using data from the Gansu Province Geological Disaster Survey and Zoning Report, the applicability of the three models at different spatial scales is comparatively analyzed from the perspectives of model validation, spatial autocorrelation, accuracy comparison, and scale effects, and an optimal model is recommended. The results demonstrate that: the maximum entropy model is the optimal model for flash flood disaster risk assessment at the geographical region scale in the Hexi Corridor; the multi-criteria decision model is not applicable to evaluation at the Zhangye City (municipal) spatial scale, and the performance of all three models is inferior to that at the Hexi Corridor (geographical region) spatial scale; the three models exhibit significant scale effects, performing relatively well at the geographical region spatial scale, with simulation errors increasing when scaled down to the municipal spatial scale; across different spatial scales, the maximum entropy model consistently outperforms the multi-criteria decision model and the information content model, and is suitable for flash flood disaster risk assessment at both geographical region (large/medium) and municipal (small) spatial scales.

Full Text

Preamble

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Abstract

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This study selected the Hexi Corridor and Zhangye District in Gansu Province, China as study zones representing different spatial scales of geography division (large and medium scale, e.g., Hexi Corridor) and region (small scale, e.g., Zhangye District). Three popular models for assessing mountain torrent disasters—including the multi-criterion model, MaxEnt model, and information model—were selected as study objects. Based on an established risk assessment index system for mountain torrent disasters, risk assessment maps for mountain torrent disasters in the Hexi Corridor and Zhangye District were generated using the three models respectively. Model suitability was analyzed from the perspectives of model validation, spatial autocorrelation, precision comparison, and scale effect, based on statistical data from geological disaster investigation and divisional reports in Gansu Province, and the preferred model was identified. The results showed that the MaxEnt model was the optimal model for risk assessment of mountain torrent disasters at the spatial scale of geography division. The multi-criterion model was not suitable at the spatial scale of region, and the results from the three models for Zhangye District were not as good as those for the Hexi Corridor. The scale effect of the three models was extremely obvious, and the application effect at the spatial scale of Hexi Corridor was better than that at the spatial scale of Zhangye District. The MaxEnt model was superior to the multi-criterion decision model and the information model regardless of spatial scale, and can be used to support monitoring, pre-warning, and protection engineering projects for mountain torrent disasters in the Hexi Corridor.

Keywords: mountain torrent disaster; risk assessment; spatial scale; model adaptation; model comparison

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Note: Figure translations are in progress. See original paper for figures.