PROBABILISTIC SPATIOTEMPORAL-MAGNITUDE SINKHOLE HAZARD MAP FOR EAST CENTRAL FLORIDA

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Abstract

As one of many forms of ground subsidence or collapse, sinkholes are the most common geohazard in karst landscapes. Karst sinkholes are developed due to dissolution of carbonate rocks by acidic groundwater and they are widely found throughout East Central Florida (ECF) due to its unique hydrogeological and climate conditions. Sinkholes can lead to financial and human losses, as well as causing severe damage to regional environment. Therefore, it is essential to develop an effective tool for understanding sinkholes and predicting potential sinkhole areas. Existing sinkhole hazard study is limited to the prediction of the future sinkhole spatial occurrence as known as susceptibility mapping, but it should take the temporal and magnitude components into account to assess accurately the sinkhole hazard. This study presents the development of a probabilistic spatiotemporal-magnitude sinkhole hazard model and a regional scale map for ECF using an artificial neural network (ANN) approach. A sinkhole inventory map was prepared using Subsidence Incident Reports of Florida Geological Survey with GIS. In the study area, a total of 747 sinkholes were identified, and 80% (598) of sinkhole locations were randomly selected for building a sinkhole hazard model, while the remaining 20% (149) were used for validating the model. Five contributing factors were used in the sinkhole hazard analysis, and they were divided into erosion-related and stability-related factors. The hydrogeological factors include hydraulic head difference, overburden thickness, surficial aquifer system thickness, intermediate aquifer system thickness, and proximity to karst features. Subsequently, a probabilistic spatiotemporal-magnitude sinkhole hazard map was created by implementing the ANN model. The model prediction accuracy was validated by computing the area under the receiver operating characteristic (ROC) curve, which is referred as AUC. The result showed that the ANN has good performance in the prediction of sinkholes in ECF.