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Assessment of ground subsidence hazard near an abandoned underground coal mine using GIS

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This study shows the construction of a hazard map for presumptive ground subsidence around abandoned underground coalmines (AUCMs) at Samcheok City in Korea using a probability (frequency ratio) model and a statistical (logistic regression) model, with a Geographic Information System (GIS). To evaluate the factors related to ground subsidence, an image database was constructed from a topographical map, geological map, mining tunnel map, Global Positioning System (GPS) data, land use map, lineaments, digital elevation model (DEM) data, and borehole data. An attribute database was also constructed from field investigations and reinforcement working reports for the existing ground subsidence areas at the study site. Nine major factors causing ground subsidence were extracted from the probability analysis of the existing ground subsidence area: 1) depth of drift, from the mining tunnel map; 2) DEM and slope gradient, calculated from the topographical map; 3) groundwater level, permeability, and rock mass rating (RMR), from borehole data; 4) lineaments and geology from the geological map; and 5) land use from the land use map. The frequency ratio and logistic regression models were applied to determine each factor's rating, and the ratings were overlaid for ground subsidence hazard mapping. The ground subsidence hazard map was then verified and compared with existing subsidence areas. The verification results showed that the logistic regression model (accuracy of 95.01%) is better in prediction than the frequency ratio model (accuracy of 93.29%). The verification results showed sufficient agreement between the presumptive hazard map and the existing data on ground subsidence area. Analysis of ground subsidence with the frequency ratio and logistic regression models suggests that quantitative analysis of ground subsidence near AUCMs is possible.