Title. Application of GIS based data driven evidential belief function model in groundwater potential mapping

Abstract

Groundwater is recognized as one of the most important and dependable sources of water supply in all climatic regions across the world. Contamination of groundwater has been a major concern of local, state, and federal agencies. Therefore, information of the occurrence and availability on groundwater is necessary for the management of groundwater resources as well as to supply sufficient water to growing population. Under this background, several researchers have attempted to analyze groundwater availability and predict future groundwater possibility using different data-driven and knowledge-driven techniques combined with remote sensing (RS) and geographical information system (GIS). A GIS can be used effectively to combine different hydrological themes objectively and analyze them systematically. This study was aimed to produce a groundwater potential map (GPM) of the Hongseong-gun region in South Korea, based on evidential belief function (EBF) model within GIS environment. There are three main steps involved in groundwater potential map: (1) data collection and construction of a spatial database, (2) assessment of the spring potential using the relationships between spring occurrence and spring-related factors, and (3) validation of the results. The locations of the springs were determined by using filed surveys and point data acquired from government organization. The detected 357 springs were divided into two datasets: a training data set for 250 springs (70%) and a validation data set for 107 springs (30%). The 11 spring-related factors were used to analyze groundwater potential, such as elevation, slope, curvature, distance to drainage, drainage density, topographic wetness index, stream power index, soil texture, lithology, and land cover. For spatial data modelling purposes all factors were transformed into raster maps with grid cell size 10×10 m. Based on the training data set and 11 spring-related factors, the relationships between spring occurrence and spring-related factors were analyzed using the EBF and then mapped. The produced map was classified based on natural break classification scheme into very low, low, moderate, high, and very high. The relative operating characteristics (ROC) analysis was used to determine the accuracy of GMP created in this study. ROC plot assessment results showed that the success rate and prediction rate were 0.837, 0.801, respectively. It can be seen that the EBF model produced in this study showed reasonably good accuracy in spatial predicting of groundwater potential. Although the diversification of water sources through the creation of dams and pumping stations have been discussed by decision makers, such strategies will never completely substitute springs as a primary source of potable water. For this reason, the results of groundwater spring map can be useful for planners and engineers to evaluate groundwater exploration development comprehensively and management water resource effectively. In the future, the prediction accuracy of the method could be increased by adding other thematic layers. In addition, the advantages and disadvantages of EBF model should be clarified though comparison with other models.

Key words: Groundwater, Geographical Information System, Groundwater Potential Map, Evidential belief function, Relative Operating Characteristics

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