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Improvement for the vulnerability indices of groundwater contamination using an optimized back propagation artificial neural network model in Miryang City, South Korea

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The recent advance of computational and interpretational algorithms is useful for developing an accurate prediction of the spatial distribution of groundwater-contamination vulnerability. Classical DRASTIC model of Aller et al. (1987) has been the most widely used for aquifer vulnerability mapping with seven hydrogeological parameters. Despite of its popularity, this technique disregards the effect of regional characteristics and the objective selection of the model parameters. It doesn't have a specific calibration function to secure its accuracy. The main goal of this research is to implement a calibration technique using optimization artificial neural network algorithm to obtain the more reliable and accurate assessment. The nonlinear optimization problem was solved by using Levenberg-Marquardt method to reduce the error between the vulnerability index and actual NO_3-N concentration, and to maximize the correlation between them. The method was instigated to ANN model for an accurate prediction of the spatial distribution of groundwater-contamination vulnerability in the Miryang City, South Korea. This result showed that hydraulic conductivity, impact of vadose zone and land use are the most important predictors affecting the distribution of NO_3-N concentration in the study area. The calibration model showed the better performance result (r=0.64) in compare with an un-calibrating modified DARSTIC model (r=0.28) The calibrated vulnerability map showed the high vulnerability near the Nakdong river including the extensive agricultural activity. We concluded that ANN model attained the better performance and reliability in assessing the groundwater-contamination vulnerability using the nonlinear function to reduce the linearity of the modified DARSTIC model in the study area.