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Applying indicator-based geostatistical approaches to determine potential zones of groundwater recharge based on borehole data

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Evaluating a potential zone of groundwater recharge is considerably critical for planning a scheme of quality protection and quantity management of groundwater. This study determined potential zones of groundwater recharge using indicator kriging (IK) based on borehole data in the Pingtung Plain, southern Taiwan. Subsoil data were first classified into four categories - gravel (very high subsoil infiltration), coarse sand to medium sand (high subsoil infiltration), fine sand to very fine sand (low subsoil infiltration), and silt, mud, and clay (very low subsoil infiltration). IK was used to characterize the classifications of subsoil infiltration by selecting a maximum estimation probability. Then, very high and high soil permeability contents in unsaturated aquifers, which represent the capacity of unsaturated aquifer percolation, were estimated spatially and probabilistically using IK. Finally, combinations under different conditions of subsoil infiltration and unsaturated aquifer percolation were recommended to delineate potential zones of groundwater recharge. Owing to limited observed data, estimated probabilities of subsoil infiltration and unsaturated aquifer percolation obtained from IK can explore the uncertainty of estimated parameters. The analyzed results reveal that IK has good functionality for determining potential zones of groundwater recharge. The northeastern and southeastern regions are main groundwater recharge zones, approximately 19.6% of total area. Artificial ponds or wetlands can be established in the suggested zones to enhance groundwater recharge.
Keywords: Groundwater recharge; Indicator kriging; Subsoil infiltration; Soil percolation; Uncertainty; Probability