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Assessing the Influence of Station Density on Geostatistical Prediction of Groundwater Levels in a Semi-arid Watershed of Karnataka

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Abstract : The effect of station density on the geostatistical prediction of groundwater levels is of critical importance to ensure accurate and reliable predictions. Monitoring station density directly impacts the accuracy and reliability of geostatistical predictions by influencing the model's ability to capture localized variations and small-scale features in groundwater levels. This is particularly crucial in regions with complex hydrogeological conditions and significant spatial heterogeneity. Insufficient station density can result in larger prediction uncertainties, as the model may struggle to adequately represent the spatial variability and correlation patterns of the data. On the other hand, an optimal distribution of monitoring stations enables effective coverage of the study area and captures the spatial variability of groundwater levels more comprehensively. In this study, we investigate the effect of station density on the predictive performance of groundwater levels using the geostatistical technique of Ordinary Kriging. The research utilizes groundwater level data collected from 121 observation wells within the semi-arid Berambadi watershed, gathered over a six-year period (2010-2015) from the Indian Institute of Science (IISc), Bengaluru. The dataset is partitioned into seven subsets representing varying sampling densities, ranging from 15% (12 wells) to 100% (121 wells) of the total well network. The results obtained from different monitoring networks are compared against the existing groundwater monitoring network established by the Central Ground Water Board (CGWB). The findings of this study demonstrate that higher station densities significantly enhance the accuracy of geostatistical predictions for groundwater levels. The increased number of monitoring stations enables improved interpolation accuracy and captures finer-scale variations in groundwater levels. These results shed light on the relationship between station density and the geostatistical prediction of groundwater levels, emphasizing the importance of appropriate station densities to ensure accurate and reliable predictions. The insights gained from this study have practical implications for designing and optimizing monitoring networks, facilitating effective groundwater level assessments, and enabling sustainable management of groundwater resources.

Keywords : station density, geostatistical prediction, groundwater levels, monitoring networks, interpolation accuracy, spatial variability
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