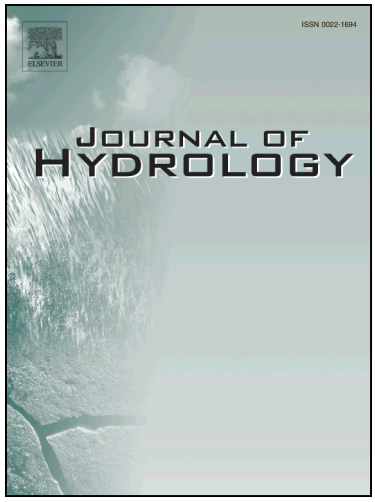

Research papers

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A Data Fusion-based Methodology for Optimal Redesign of Groundwater Monitoring Networks

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Abstract:

In this paper, a new data fusion-based methodology is presented for spatio-temporal (S-T) redesigning of Groundwater Level Monitoring Networks (GLMNs). The kriged maps of three different criteria (i.e. marginal entropy of water table levels, estimation error variances of mean values of water table levels, and estimation values of long-term changes in water level) are combined for determining monitoring sub-areas of high and low priorities in order to consider different spatial patterns for each sub-area. The best spatial sampling scheme is selected by applying a new method, in which a regular hexagonal gridding pattern and the Thiessen polygon approach are respectively utilized in sub-areas of high and low monitoring priorities. An Artificial Neural Network (ANN) and a S-T kriging models are used to simulate water level fluctuations. To improve the accuracy of the predictions, results of the ANN and S-T kriging models are combined using a data fusion technique. The concept of Value of Information (VOI) is utilized to determine two stations with maximum information values in both sub-areas with high and low monitoring priorities. The observed groundwater level data of these two stations are considered for the power of trend detection, estimating periodic fluctuations and mean values of the stationary components, which are used for determining non-uniform sampling frequencies for sub-areas. The proposed methodology is applied to the Dehgolan plain in northwestern Iran. The results show that a new sampling configuration with 35 and 7 monitoring stations and sampling intervals of 20 and 32 days, respectively in sub-areas with high and low monitoring priorities, leads to a more efficient monitoring network than the existing one containing 52 monitoring stations and monthly temporal sampling.