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Development of novel geostatistical tools in space-time modelling of aquifer level

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Space-Time Residual-Kriging (STRK) is a reliable method for spatiotemporal interpolation. In this work STRK is applied to combine the estimated trend and interpolated residuals for the final prediction of the groundwater level in an unconfined aquifer. However, the proposed methodology examines apart from the lag distance, the hydraulic gradient for the calculation of the experimental space-time variogram. Spatiotemporal trend is approximated using a combined component based on a physical law that governs groundwater flow in an aquifer under pumping conditions. A Bayesian approach based on the bootstrap idea is employed to determine the uncertainty of the spatiotemporal model parameters (trend and covariance) and estimations. The interdependence of the spatiotemporal residuals is modeled using a new space-time variogram based on the product-sum approach that involves the hydraulic conductivity anisotropic ratio within the exponential function and the Spartan covariance family. The proposed methodology is applied to predict spatiotemporal groundwater level fluctuations and to investigate the uncertainty of estimations at a sparsely gauged basin on the island of Crete, Greece.