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Risk assessment of groundwater level variability using variable Kriging methods

Katerina Spanoudaki and Nikolaos A. Kampanis

Institute of Applied and Computational Mathematics, Foundation for Research and Technology-Hellas, Heraklion, Crete, Greece

Assessment of the water table level spatial variability in aquifers provides useful information regarding optimal groundwater management. This information becomes more important in basins where the water table level has fallen significantly. The spatial variability of the water table level in this work is estimated based on hydraulic head measured during the wet period of the hydrological year 2007-2008, in a sparsely monitored basin in Crete, Greece, which is of high socioeconomic and agricultural interest. Three Kriging-based methodologies are elaborated in Matlab environment to estimate the spatial variability of the water table level in the basin. The first methodology is based on the Ordinary Kriging approach, the second involves auxiliary information from a Digital Elevation Model in terms of Residual Kriging and the third methodology calculates the probability of the groundwater level to fall below a predefined minimum value that could cause significant problems in groundwater resources availability, by means of Indicator Kriging. The Box-Cox methodology is applied to normalize both the data and the residuals for improved prediction results. In addition, various classical variogram models are applied to determine the spatial dependence of the measurements. The Matérn model proves to be the optimal, which in combination with Kriging methodologies provides the most accurate cross validation estimations. Groundwater level and probability maps are constructed to examine the spatial variability of the groundwater level in the basin and the associated risk that certain locations exhibit regarding a predefined minimum value that has been set for the sustainability of the basin's groundwater resources.

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