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Towards Determining the Optimal Density of Groundwater Observation Networks under Uncertainty

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Time series of groundwater level constitute one of the main sources of information when studying the availability of ground water reserves, at a regional level, under changing climatic conditions. To that extent, one needs groundwater observation networks that can provide sufficient information to estimate the hydraulic head at unobserved locations. The density of such networks is largely influenced by the structure of the aquifer, and in particular by the spatial distribution of hydraulic conductivity (i.e. layering), dependencies in the transition rates between different geologic formations, juxtapositional tendencies, etc. In this work, we: 1) use the concept of transition probabilities embedded in a Markov chain setting to conditionally simulate synthetic aquifer structures representative of geologic formations commonly found in the literature (see e.g. Hoeksema and Kitanidis, 1985), and 2) study how the density of observation wells affects the estimation accuracy of hydraulic heads at unobserved locations. The obtained results are promising, pointing towards the direction of establishing design criteria based on the statistical structure of the aquifer, such as the level of dependence in the transition rates of observed lithologies.

Reference:
Hoeksema, R.J. and P.K. Kitanidis (1985) Analysis of spatial structure of properties of selected aquifers, Water Resources Research, 21(4), 563-572.

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