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Hydraulic head estimation at unobserved locations: Approximating the distribution of the absolute error based on geologic interpretations

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Assessing the availability of groundwater reserves at a regional level, requires accurate and robust hydraulic head estimation at multiple locations of an aquifer. 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 spatial distribution of the hydraulic conductivity in the aquifer, and it is usually determined through trial-and-error, by solving the groundwater flow based on a properly selected set of alternative but physically plausible geologic structures. In this work, we use: 1) dimensional analysis, and b) a pulse-based stochastic model for simulation of synthetic aquifer structures, to calculate the distribution of the absolute error in hydraulic head estimation as a function of the standardized distance from the nearest measuring locations. The resulting distributions are proved to encompass all possible small-scale structural dependencies, exhibiting characteristics (bounds, multi-modal features etc.) that can be explained using simple geometric arguments. The obtained results are promising, pointing towards the direction of establishing design criteria based on large-scale geologic maps.