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Geostatistical inversing of transient pumping tests using temporal moments of drawdown

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Pumping tests belong to the most common techniques of hydrogeological site assessment. While the steady-state drawdown is determined by the distribution of transmissivity, the transient behavior is also influenced by the storativity field. In geostatistical inversing, the spatial distributions of both transmissivity and storativity are inferred from the drawdown curves and prior information on the spatial correlation of the parameter fields. So far, however, transient data have hardly been analyzed by geostatistical inverse methods, because the computational effort is rather high. In the present study, we characterize the drawdown by its temporal moments. We derive moment-generating equations and corresponding equations to compute the sensitivity of the temporal moments of drawdown with respect to the distributions of transmissivity and storativity. We utilize these equations to infer the transmissivity and storativity fields from transient pumping tests using the quasi-linear geostatistical approach of inversing. Considering temporal moments drastically reduces the computational effort of the estimation procedure. In test cases we show that the first two temporal moments are sufficient to characterize the drawdown curves. We investigate how erroneous assumptions regarding the spatial variability of storativity affect the estimate of the transmissivity field, and we analyze the effect of truncating the measured drawdown curves.