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A comparison of deterministic and stochastic approaches for regional scale inverse modelling. Application to the Mar del Plata aquifer.

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Inversion of the spatial variability of transmissivity (T) in groundwater models can be handled using either stochastic or deterministic (i.e. geology-based zonation) approaches. While stochastic methods predominate in scientific literature, they have never been formally compared to deterministic approaches, preferred by practitioners, for large aquifer models. We use both approaches to model groundwater flow and solute transport in the Mar del Plata aquifer, where seawater intrusion is a major threat to freshwater resources. The relative performance of the two approaches is evaluated in terms of model fits to head and concentration data (available for nearly a century), plausibility of the estimated T fields and their ability to predict transport. We also address the impact of using T data from large scale (i.e. pumping test) and small scale (i.e. specific capacity) on the calibration of this regional coastal aquifer. We find that stochastic models, based upon conditional estimation and simulation techniques, identify some of the geological features (river deposit channels) and yield better fits to calibration data than the much simpler geology-based deterministic model. However, the latter demonstrates much greater robustness for predicting sea water intrusion and for incorporating concentrations as calibration data. We conclude that qualitative geological information is extremely rich in identifying variability patterns and should be explicitly included in the calibration of stochastic models.