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The application of the pilot points in groundwater numerical inversion model

Bin Hu, Yanguo Teng, and Lirong Cheng
Beijing Normal University, China (pasoul@163.com)

Numerical inversion simulation of groundwater has been widely applied in groundwater. Compared to traditional forward modeling, inversion model has more space to study.

Zones and inversing modeling cell by cell are conventional methods. Pilot points is a method between them. The traditional inverse modeling method often uses software dividing the model into several zones with a few parameters needed to be inversed. However, distribution is usually too simple for modeler and result of simulation deviation. Inverse cell by cell will get the most actual parameter distribution in theory, but it need computational complexity greatly and quantity of survey data for geological statistical simulation areas.

Compared to those methods, pilot points distribute a set of points throughout the different model domains for parameter estimation. Property values are assigned to model cells by Kriging to ensure geological units within the parameters of heterogeneity. It will reduce requirements of simulation area geological statistics and offset the gap between above methods. Pilot points can not only save calculation time, increase fitting degree, but also reduce instability of numerical model caused by numbers of parameters and other advantages.

In this paper, we use pilot point in a field which structure formation heterogeneity and hydraulics parameter was unknown. We compare inversion modeling results of zones and pilot point methods. With the method of comparative analysis, we explore the characteristic of pilot point in groundwater inversion model.

First, modeler generates an initial spatially correlated field given a geostatistical model by the description of the case site with the software named Groundwater Vistas 6. Defining Kriging to obtain the value of the field functions over the model domain on the basis of their values at measurement and pilot point locations (hydraulic conductivity), then we assign pilot points to the interpolated field which have been divided into 4 zones. And add range of disturbance values to inversion targets to calculate the value of hydraulic conductivity. Third, after inversion calculation (PEST), the interpolated field will minimize an objective function measuring the misfit between calculated and measured data. It's an optimization problem to find the optimum value of parameters.

After the inversion modeling, the following major conclusion can be found out:

(1) In a field structure formation is heterogeneity, the results of pilot point method is more real: better fitting result of parameters, more stable calculation of numerical simulation (stable residual distribution). Compared to zones, it is better of reflecting the heterogeneity of study field.

(2) Pilot point method ensures that each parameter is sensitive and not entirely dependent on other parameters. Thus it guarantees the relative independence and authenticity of parameters evaluation results. However, it costs more time to calculate than zones.

Key words: groundwater; pilot point; inverse model; heterogeneity; hydraulic conductivity