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Hydrology and Earth System Sciences Discussions

Interactive comment on "Analyzing the effects of geological and parameter uncertainty on prediction of groundwater head and travel time" *by* X. He et al.

Anonymous Referee #3

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The authors discussed the influence of hydraulic parameter and geological structure uncertainties on groundwater model predictions. Three scenarios based on a study area in Denmark are considered. In the first scenario, only geological structure uncertainty is considered; in the second scenario, the model is calibrated on the observations; in the third scenario, parameter uncertainty within the geological unit is added. They concluded that "the uncertainty on the conceptual geological model was as significant as the uncertainty related to the embedded hydraulic parameters". The topic is of interest and it is good to apply on real field data.

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MAIN COMMENTS

1. The authors stated that previous applications of MPS use 2D training images instead of 3D ones. However, there are some cases using 3D TIs. The current study is not the first to apply a full 3D TI. Here are two examples using 3D TI.

(1)Zhang, T., Pedersen, S. and McCormick, D. 2008. Patched path and recursive servo system in multiple-point geostatistical simulation. GEOSTATS.

(2)Honarkhah, M. and Caers, J. 2012. Direct Pattern-Based Simulation of Non-stationary Geostatistical Models. Math Geosci (2012) 44:651–672.

2. Multiple point geostatistics is used to simulate the geological structures in the study field. However, the training image shows no typical curvilinear features (e.g., Fig.2 and Fig.4). Two-point based variogram might be sufficient to characterize the geological structure in this case. For instance, sequential indicator simulation can be used to generate the geological unit distribution and the electrical resistivity data could be integrated to constrain the realizations. This would save the construction of a 3D TI.

3. The introduction to algorithm of multiple point geostatistical simulation (Section 3.1 Page 2796-2797) does not have to be so detailed.

4. Page 2804 Line 18. “The heavy red or red dots are found at places where boreholes are located, and it indicates that the hard data have been honored in all 100 simulations”. Please provide a map showing the location of the boreholes so that the readers can determine themselves whether the hard data are honored. Another question is how many hard data are used? Do they correspond with the observation shown in Table 1?

5. Section 5.2. First the authors said “Each model was calibrated by PEST,. . .”(Page 2804 Line 26-27), and then “the models were not calibrated and the same hydraulic parameters were specified” (Page 2805 Line 9-10). In fact, no calibration is involved in scenario 1 while the authors explained the model calibration in the section. The

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readers will be confused by this inconsistency.

6. Page 2805 Line 15-16. “while a maximum standard variation of nearly 3m is found on the northern part.” Why does the maximum standard variation appear on the northern part? Also please explain why the standard deviation along the river course increases in the 4th layer (same page Line 18).

7. Page 2805 Line 20, “accumulated standard deviation was withdrawn from ten cells.” What is the relationship between the “ten cells” and those shown in Figure 7 such as “Cell 2249” and “Cell 4283” etc?

8. Page 2806 Line 3-8. The distribution of groundwater travel time in the north-western part is “less skewed” while in the south-eastern part “more skewed”. What does this “skewed” mean here? Please interpret it not only in mathematics but in hydrogeology.

9. Page 2808. “the R values for the GeoParModel are at least for three of the points much higher” (Line 13-14) and “higher than the corresponding interval for GeoModel-II for three of the observation points.” (Line 19-20). What happened to the fourth well “Obs 57” and why?

OTHER COMMENTS

1. Page 2791 Line 23-26. The similarity between layers should be minimized rather than maximized by replicating a single TI. Is there anything I am missing?

2. Page 2796 Line 4-5. “These data were considered to be more accurate, and hence the standard deviation for the uncertainty was assumed 2m.” How the authors know these data were more accurate? Furthermore, they are more accurate than what? Basically we are talking about at least two things when we use “more”.

3. Page 2796 Line 12 “average discharge is 0.8 m3s-1 (69 265 m3d-1).” What is the relationship between the 0.8m3s-1 and 69265m3d-1? It is not correct if converted directly. Please clarify it.

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4. Page 2798 Line 25. “Brauchler et al.,2005; ” should be “Brauchler et al.,2007;”.

5. Page 2799 Line 27 “in a simplified matter” change to “in a simplified manner”.

6. Page 2802 Line 9-11. “while the river level was taken from the national digital elevation model with a resolution of 1.6m, and the river bottom elevation was assumed to be 1m below river level.” Does this mean that water in the river is 1m deep? Is it reasonable to assign a constant depth along the stream?

7. The following three reference items are not cited in the text and thus should be removed from the reference list.

(1)Boucher, A.: Considering complex training images with search tree partitioning, Comput. Geosci., 35, 1151–1158, 2009.

(2)Winter, C. L.: Stochastic hydrology: practical alternatives exist, Stoch. Env. Res. Risk A., 14, 271–273, 2004.

(3)Zhang, D.: Stochastic Methods for Flow in Porous Media: Coping with Uncertainties, Academic Press, San Diego, CA, 2001.

8. Page 2822 Figure 1. “The red line indicate place . . .” should be “The red line indicates place . . .”

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 2789, 2013.