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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Sensitivity of Hydrologic and Geologic Parameters on Recharge Processes in a Highly-Heterogeneous, Semi-Confined Aquifer System" *by* Stephen R. Maples et al.

Anonymous Referee #1

Received and published: 23 September 2019

This manuscript presents an assessment study of the hydrologic and geologic impact on managed aquifer recharge processes. At 100 randomly sampled sites across the model domain the correlation between 17 hydro(geo)logical site characteristics/parameters and simulated recharge "benefits" is evaluated. Overall, upscaled vertical K multiplied with "Water Table Depth" (WTD) produce a good correlation with recharge rates. This proxy parameter (GPP – Kgeom * WTD) are most correlated with recharge rates, validated by local and global sensitivity analysis. Moreover, the analyses also indicate that permeability and unsaturated zone pore volume (porosity used as an indicator for Sy) were relatively more important than other hydraulic parameters.

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Discussion paper

The study presented is comprehensive, thorough, well-organized, and clear. The conclusions are informative and I do not see any over-statement in the conclusions drawn. I thus think the manuscript should be considered for publication in HESS, although I would suggest that a minor revision is needed to clarify some parts of the manuscript.

Maybe the most critical point I see is how to transfer the obtain important information for MAR (interconnected coarse-texture facies paired with water table depth information are crucial for finding suitable recharge sites) to any other field where this information is difficult to acquire. I see your point that GIS-derived indices of recharge suitability rely solely on soil and surface geology to determine geologic suitability for recharge (e.g. Line 354) and the integrated values (up-scaled K + WTD) are more useful. But the question is how we could get the required information without knowing the subsurface in every detail in the whole model domain/study area. Certainly, in your (semi-)synthetic approach we know the parameterization (by the way it is just one field/realization and there remain uncertainties about the distribution, however, for this study and target it is ok I believe but should be note more clearly in the discussion) but how could we use your guidelines where it is not known. I suggest discussing that more to strengthen the manuscript and impact of this interesting study. Comprehensive field tests could be probably the best to better understand the problems in general. However, they are time-consuming and only a limited number of sites are available to accommodate the tests. The numerical analysis, on the other hand, allows us to explore and assess multiple sites relatively easily, yet the validity needs to be carefully checked. So, how can your useful guideline to be considered by practitioners?

Another point is related to the WTD. Correct me if I am wrong but my impression based on your manuscript (for instance Fig. 8) is that Kgem * WTD is very useful where the WTD is deep (so large unsaturated zone and thus more storage). Can you split your analysis/results further to see if the depth to the water table matters or not?

Further minor comments: Line 94: What kind of geological analysis?

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Section 2.3.3 Model Spin up and Calibration: All sentence related to boundary conditions should be moved to section 2.3.2 Boundary conditions. (line 134-141)

Table 2: Are these parameters the calibrated values?

Section 2.4.1 Why do you select the sites randomly? I would assume that MAR will be pretty much every time in more coarse sediments. I think, a useful comparison would be to choose the sites based on the surface information (as you mentioned as the "classical" GIS-approach) and compare the results with results from some randomly chosen sites. You might find additional arguments to criticize the "classical" workflow. I think that would be "just" another post-processing step and no demanding model runs are required.

Line 201: for all 100 sites

Line 230: 6 hydraulic properties and not 8!

Line 258: Where are the four representative sites! You could add these sites to figure 3a.

Line 286: yes, they are important, but it is not demonstrated here. The results section just comes a few pages later. Please reformulate.

Line 3357: Yes, but again how to get this information for a larger study site.

Figure 7: Change the 95% confidence lines to dashed lines or change the figure caption.

Figure 10: Why is the gravel n so important for V_fines?

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