Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2020-572-RC1, 2021

Hydrology and Earth System Sciences
Discussions
Open Access
EGU

Interactive comment on "Technical note: Discharge response of a confined aquifer with variable thickness to temporal nonstationary random recharge processes" *by* Ching-Min Chang et al.

Anonymous Referee #1

Received and published: 20 February 2021

Review of DISCHARGE RESPONSE OF A CONFINED AQUIFER WITH VARIABLE THICKNESS TO TEMPORAL NONSTATIONARY RANDOM RECHARGE PROCESSES

This paper provides an analysis, through a lumped model, of confined aquifer discharge to random recharge. It also accounts for variable thickness of the confined system. The authors propose a closed-form expression for the transfer function which will be employed in the linear lumped confined aquifer model.

Printer-friendly version

Discussion paper

Although interesting solutions are developed from this study (therefore there is a technical merit to this work), I have concerns regarding the following points:

1. Justification for the model adopted. It neglect heterogeneity and the 1D approximation is not well justified for this reviewer given the knowledge of the works done in the past. The model presented by the authors does not account for heterogeneity and is a 1D system. It also averages out variability along x3.

2. The authors neglect a large body of literature that worked on this topic of aquifer recharge and flow (and even transport where these effects are more pronounced). There are a series of works published where authors looked at aquifer recharge (stochastic and deterministic) in the presence of heterogeneity in 2d and 3d flows. Furthermore, there is also a body of recent literature looking at the uncertainty related to climate projection on aquifer flow and transport. Please see my detailed comments below.

3. The applicability of this model. How does this model improve our fundamental knowledge with respect to the previously published works that tackled more complex flow conditions? This needs to be addressed.

Therefore, I believe this technical note needs to be revised prior to its exposure. Below I provide more details on my comments that range from minor to major.

- Please revise equation notations. For example, in eqn 10, the square brackets are small and do not match the size of the fraction (i.e. partial h partial x).

- Line 129: I do not agree with the authors when they write “small fluctuations in the x1 and x2 directions” led a 1D flow. Many authors in the stochastic hydrogeological community have shown that variability in x1 and x2 can impact meandering of the streamlines – even for log-conductivity variances smaller than one.

- In fact, the work under revision neglects a few contributions on the presence of aquifer recharge in heterogeneous aquifers. For example, see works by:

Printer-friendly version

Discussion paper

o Rubin, Y., & Bellin, A. (1994). The effects of recharge on flow nonuniformity and macrodispersion. Water resources research, 30(4), 939-948. o Li, L., & Graham, W. D. (1998). Stochastic analysis of solute transport in heterogeneous aquifers subject to spatially random recharge. Journal of hydrology, 206(1-2), 16-38. o Ciriello, V., & de Barros, F. P. J. (2020). Characterizing the Influence of Multiple Uncertainties on Predictions of Contaminant Discharge in Groundwater Within a Lagrangian Stochastic Formulation. Water Resources Research, 56(10), e2020WR027867. o Destouni, G., Simic, E., & Graham, W. (2001). On the applicability of analytical methods for estimating solute travel time statistics in nonuniform groundwater flow. Water Resources Research, 37(9), 2303-2308. - Later the authors talk about the lack of studies looking at climate change and its impact in the subsurface environment. See for example the work of Libera et al (2019) where it was shown how changes in recharge impact flow rates and consequentially transport and aquifer remediation strategies. o Libera, A. et al. (2019). Climate change impact on residual contaminants under sustainable remediation. Journal of Contaminant Hydrology, 226, 103518.

- What is the justification for expression 18? Why an exponentially variable thickness? Is this used for a mathematical convenience? Please justify.

- Applicability of this model: Are there any data to compare the results of this model to? This might be out of the scope of this work but it would be nice to see additional discussion related to the applicability of this model and its range of validity.

- Please highlight the key novelties of this work with respect to the previously published literature on recharge and aquifers.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2020-572, 2020.