

Interactive comment on “Analyses of uncertainties and scaling of groundwater level fluctuations” by X. Liang and Y.-K. Zhang

Anonymous Referee #2

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Comments on HESS Paper “Analyses of uncertainties and scaling of groundwater level fluctuations “ X. Y. Liang and Y.-K. Zhang

General Comments

Liang and Zhang present an extension of previous work on the impact of temporal variations in hydrological processes on the uncertainty in groundwater level fluctuations. The authors derived analytical solutions for variance, covariance and spectrum of groundwater levels under random boundary conditions and a random source/sink, which is something new and interesting to the hydrological community.

The current work strongly relies on previous work of the same authors in that field, it can be interpreted as extension taking into account random boundary conditions and

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a random source/sink for a bounded groundwater flow model. Therefore, a technical note instead of a full research article appears to me the more appropriate form for publication.

In this line, the section on *Results and Discussion*, especially section 3.1 could be shorted (specific comments later). Most of the publication is well-written, parts (in particular section 2 and 3.1) need to be improved in language, ideally by a native speaker.

Figures and tables are in a good shape. However, the number of figures can be reduced by combining Figures 1+2 and Figures 3+4. I highly recommend to prepare an additional figure illustrating the one-dimensional groundwater flow model, including the nomenclature of the relevant processes (time-dependent source/sink, initial conditions, boundary conditions,...) for improving readability.

Specific Comments

Introduction p.3 l.1: What do you mean with "inherently erroneous"? The sentence could be misinterpreted.

p.3 l.6-7: Please specify the sentence "The uncertainties in model parameters were investigated." (e.g. Which parameters? How?).

p.3 l.11: Specify "Little attention" (Who?).

Formulation and solutions

p.5 l.6-7: Please elaborate more on the simplification of setting $H_0(x)$ to the steady-state solution to the one-dimensional transient groundwater flow equation. Why is that an appropriate assumption?

p.5 l.11-12: please explain this step on more detail.

p.6 l.11-12: Give a justification for the assumption of uncorrelated functions. How realistic is that assumption?

Results and Discussion

There are remarkable differences in the style and language of sections 3.1. and 3.2. To me, section 3.1 is much too circumstantial, where section 3.2 is more compact and to the point of interest. Therefore, section 3.1 should be shortened and adapted in style to that of section 3.2. Steps for improving the readability might be:

- reducing doubling of explanations (e.g. p.9 l. 14/15) for all cases discussed
- not announcing the content of figures (e.g. p.9 l. 17 – p.14 l. 2) for all cases discussed. You may announce the visualization of results in Figure 1 at the beginning of the section and then directly refer to the Figure of interest, without repeating "The dimensionless standard deviation ... was presented in Figure 1...".
- Shortening aspects which can obviously be seen in the figure (e.g. p. 12. l. 3-6) "Similar to ...".
- Use a more compact description of the results (e.g. entire page 10).

Conclusions

p.17 l.10: What is a "typical aquifer studied"? Please formulate in a more generally way. If it is referred to the previous discussed example, please specify. (In general the conclusions drawn should be understandable without knowing details from the previous sections)

p.17 l.15: In both brackets it is stated "low frequencies".

Figures and Tables

Figure 1: The Figure is in general well constructed to show the different impacts of the processes. The readability of the figure and caption text could be improved by:

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- specifying the difference in the rows before ":(a) and (b)..." (e.g. by stating in the caption "for different combinations of ... (four rows) ")
- write the specific case to the figures (e.g. $\sigma_W^2 \neq 0$ to Fig. 1c, etc.)
- The range of time values in Fig. 1b and 1d is different to those t values in Fig. 1f and 1h., where only the second range (those of 1f and 1h.) is state in the caption.

Figure 2: There is the same problem with values of t in Figure 2b and the caption. Figure 2 should be combined with Figure 1, being sub-figures 1i and 1j.

Figure 4: Analogously to Figure 2, this Figure should be combined with Figure 3.

Technical Corrections

The text needs language improvements, ideally by a native speaker, in particular section 2 and 3.1.

p.3 l.21: typo: "temporospatial"

p.9 l. 13: new paragraph starting.

p.9 l.17: typo in σ'_h

p.11 l. 6-8: Please rephrase. The sentence ("Unlike ...") is hardly understandable.

p.12 l.16: typo "setting σ "

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