## General concern about our use of uncorrelated conductivity fields:

Since both referees commented on this, we are responding to them together.

The reviewers correctly point out that hydraulic conductivity is a random field; furthermore, it is correlated at some scales. Indeed, the effect of small-scale correlations on regional velocities and mass transport is completely understood at least through second-order (Gelhar and Axness, 1983; Winter et al., 1984; Neuman and Orr, 1992), and there is no doubt that scaled up regional velocities can be affected by the degree of correlation between conductivities at small scales, even when the conductivity field is heterogeneous at local and regional scales (Winter and Tartakovsky, 2002). But the degree of correlation, and hence its effect on regional velocities and quantities like stream-aquifer exchanges that are influenced by them, depends on the meaning of "small". The small scale of our study is set by the 1 km x 1 km size of our grid cells. Many alluvial systems have correlation lengths that are much smaller than that, e.g., Rehfeldt et al. (1992) and Riva et al. (2006), so at the "small" scale of our study, which is typical of simulations used to support regional watershed management, conductivities are effectively uncorrelated in some real settings. Hence, it is informative, and in some cases realistic, to investigate the effect that a field of independent, identically distributed conductivities has on the state variables of regional models. Our experiments show that stream-aquifer exchanges estimated by a typical regional simulation (one that ignores local heterogeneity) can be biased even when local conductivities are uncorrelated. We agree with the reviewers that more remains to be done with regard to the study of locally correlated fields, and we (and we hope others) are at work on such studies. But the work must start somewhere, and it seems sensible to start with the maximum entropy model: one like ours that makes the fewest assumptions about the structure of conductivity, yet is relevant to watershed management. We hope the reviewers and editor will agree that such a model provides a baseline for additional studies and is useful in its own right. If the reviewers and editor believe it will help, we will be glad to put a discussion to this effect in our paper.

## Responses to Referee #1:

Thank you very much for your comments. We paid careful attention to your concerns and respond to each of them as follows.

**(1) Main concern: Justify the assumption of uncorrelated conductivity fields.**

- This is clearly a critical issue.  Please see above.

**(2) Line 26 on Page 5: Does “second” follow “First” in Line 18 of Page 5?**

- Yes, “second” in Line 26 of Page 5 follow “First” in Line 18 of Page 5. We put them into the same paragraph in the reversed manuscript.

**(3) Line 14 on Page 12: Is this conclusion based on Figure 2c?**

- This conclusion is based on Fig. 2a and 2b, so we added reference here in the revised version.

**(4) It is better to add a dashed zero-line on Figure 2c so that the differences of groundwater table below (or above) 0 can be explicitly shown.**

- There are two vertical axes in Fig. 2c, and their scales are different. The groundwater table changes are much larger than river stage changes, so it may not be necessary to add a dashed zero-line. We will follow the advice of the editor and reviewer regarding modifying this figure, but we have left it the same for now

**(5) Figure 3b is a little hard to read. It is suggested to use gray color for water table depth and improve the contrast with monthly leakage data.**

- Using gray color for water table depth is better to improve the contrast with monthly leakage data, but it is not so easy to see the distinct groundwater table changes. As we tried to demonstrate that the groundwater table distribution affects the groundwater flow rate distribution and stream-aquifer exchanges in the later text, it seems better to highlight the colorful water table depth.  We will follow the editor's and reviewer's further advice on this point.

**(6) Line 1 on page 15: Is this confidence interval computed based on 10 realizations generated using equation (1) and (2)? Is the realization number sufficient to make a reasonable statistics?**

- Yes, this confidence interval, computed based on 10 realizations, is generated using equations (1) and (2). We have compared the different realization results, and found they are almost the same with more realizations. So 10 realizations seem sufficient to make a reasonable statistics. We have added a statement to this effect in our paper.

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