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Interactive comment on "Sequential hydraulic tests for transient and highly permeable unconfined aquifer systems – model development and field-scale implementation" *by* C.-F. Ni et al.

Anonymous Referee #1

Received and published: 28 January 2016

General evaluation:

This paper is of potential interest to HESS. However, the amount of new information is limited. I understand that the joint estimation of T and S fields with inverse modelling and on the basis of hydraulic tomography has already been published in a number of studies. New is the extension for unconfined flow. Given this specific extension, it could have been tested what is the specific role of this extension. How would results have been if the inversion would not take into account non-linearity due to unconfined flow? It does not become clear what the additional value is of the specific extension.

Although I see a contribution of the paper, also because both a synthetic study and

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real-world case were analyzed (but no sound verification of the results of the synthetic study was possible), the paper should be strengthened by focusing on the new part, which is the unconfined flow, and what was the contribution of the specific extension made in this paper.

Some additional points have to be handled. The conclusions section is not well written and should be better structured. The literature review in the introduction should be extended. It would be good if the sensitivity of the results towards the prior geostatistical model would be explored.

I recommend therefore major revision.

Other main points:

Introduction. Important references are missing. Hendricks Franssen and Gomez-Hernandez (1999) already estimated spatially distributed T and S fields and with less stringent assumptions than in this approach. They assimilated information from a large number of pumping tests. The same authors published a paper in 2002 in SERRA for 3D characterization of K in a fractured aquifer (and constant S), assimilating information from six interference tests. Also other authors jointly conditioned T and S fields. These papers should be included in the introduction.

P12572, L12. I think $h(x)$ should be $b(x)$ here. Or did you define $h=0$ at the aquifer bottom?

L12588, L17-L19. This seems to be a bug in the model. I understand that this artificial point had some influence, which was not desirable. Why did you not remove this bug from the code?

P12589. How did you obtain a reliable prior geostatistical model for lnK and lnS and how sensitive are results with respect to this prior model?

L12590, L8-L10. Suddenly introduced. Would it not be better to elaborate on this in the methods section instead of introducing it here?

L1250, L24-L25. Unclear. Left lower corner does not seem to be the same for all models.

L12591, L29. Given the limited CPU-time in terms of minutes for the smaller domain, I wonder why the spatial discretization was not at higher resolution. In addition, more experiments could have been carried out, or more repetitions of the same experiment to get more sound conclusions that are less affected by a specific set-up.

Conclusions. Rewrite in better English, better structured and with some quantitative information on the summary of the results.

Editorial:

P12569, L10: Change to: "number of measurements"

L12579, L23: Skip "However"

L12580, L22-L24: Rephrase. In general, from section 5.1.2 the text is not so well written and I suggest reformulating those text parts.

L12581, L6: "is flexible" instead of "are flexible".

L12581, L8-L9: Unclear.

L12581, from L19: past and present tense are mixed. Choose one.

L12582, L19-L21: Skip, repetition.

L12582, L21-L23. Sentence unclear.

L12583, L24: Change to: "random selection" (..) "is summarized (..)".

L12584, L1-L4: Reformulate.

L12584, L25: "slight" instead of "slightly".

L12589, L17: Change to: "geostatistical".

L12590, before 6.4: Improve reformulation.

L12591, L2: "show" instead of "showed".

L12591, L5: skip "the determinations".

L12591, L18: skip "normal".

L12592, L26-L27: Vague sentence, skip.

L12593. Change to: "The comparison (. . .)". In general, you use too often plural.

Figure 9. Where are the numbers below the well?

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 12567, 2015.