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Comment on "Sensitivity Analysis and Determination of Streambed Leakance and Aquifer Hydraulic Properties" by Xunhong Chen and Xi Chen, Journal of Hydrology, 2003, v.284, 270-284

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Comment on "Sensitivity analysis and determination of streambed leakance and aquifer hydraulic properties" by Xunhong Chen and Xi Chen, Journal of Hydrology, 2003, v. 284, 270-284.

Recently, studies of the Platte River watershed have gained significant attention from federal and Nebraska, USA, state agencies due to the importance of groundwater/surface-water interactions under drought conditions. Using archive data from a 1983 pumping test, Chen and Chen (2003) interpret the hydraulic properties of the alluvium and a streambed of the Platte River near Kearney, Nebraska, and compare their data with results of other studies performed over the past several years. Three important inconsistencies of this article will be highlighted here: (1) misuse of the analytical model of Hunt (1999), (2) departure of their results from previously published data, and (3) unsatisfactory explanation of these anomalous results.

1. ***Application of the Hunt (1999) analytical model.*** Although Chen and Chen (2003) list some of the assumptions inherent in Hunt's model, they do not explicitly state that this model is valid only for a well near a single straight stream. Nevertheless, the authors apply this model to the case of a pumping well located on an elongated island between two parallel stream channels located at distances of 69 m and 201 m from the pumping well. Considering the applied pumping rate of 8,300 m^3/day, neither of these channels can be neglected in the analysis. Therefore, the results of the "north-channel" analysis in Table 5 for one channel only are not convincing.

The authors also applied an analytical two-channel model to the field data, which appears to be an extension of Hunt's original model. Yet they do not provide the mathematical framework that is needed to understand this extension. The reader is left with the impression that the authors simply combined two single-channel solutions using the superposition principle, which is invalid in this case.

Comparing the results from the application of the single- and two-channel model, the authors claim that the results differ only slightly. However, a closer examination reveals that the presented leakance values from the two interpretation methods are inconsistent. Indeed, the single-channel model yielded a leakance value that is about twice as large as the value obtained with the two-channel model to compensate for the absence of another source of surface water. The authors disregard this important fact in their discussion. Therefore, all principal results of the article summarized in Table 5 are questionable.

The authors ignore, or are apparently unaware of, the recent studies by Christensen (2000), Nyholm et al. (2002), Kollet et al. (2002), and Kollet and Zlotnik (2003), which extensively discussed the issues of parameter sensitivity and uncertainty and the impact of simplifying assumptions on the parameter identification process. For example, Kollet and Zlotnik (2003) showed that aquifer heterogeneity and deviations of the model from real conditions (such as stream geometry among other factors) can be leading factors in large variances in K_r. The authors also are apparently not aware of the model of stream-aquifer interactions by Butler et al. (2001), which explicitly honors the finite stream width and appears to be more adequately representing some of the features of the stream-aquifer system under investigation (large width of the channel(s) and their proximity to the pumping well at the test site).

2. *Departure of results from previously presented field studies*. Chen and Chen (2003) compare their results obtained from the application of invalid models with hydraulic property values obtained from other previously published analyses of aquifer tests in the Platte River valley. While Chen and Chen (2003) obtained values for the e.g., horizontal hydraulic conductivity, K_r, ranging from about 202 to 328 m/day, these previous studies arrived at K_r values ranging from 38 m/day to 227 m/day with typical values on the order of $K_r \approx 100$ m/d as published by Chen and Ayers (1998), Chen (1998), Ayers et al. (1998), McGuire and Kilpatrick (1998), and Chen et al. (2003) (see Table 4 in the article). Thus, without any clarifying discussion, the authors ignore even

their own previously obtained results. Note that K_r is considered the parameter of least uncertainty obtained via pumping test data analysis (see literature review in Moench, 1997). Significant heterogeneity of the large-scale aquifer tests under these spatially similar fluvial conditions of the Platte River developed during the Pleistocene is not expected, contrary to the authors' results. Most likely the "anomalous" results presented by Chen and Chen (2003) can be explained by the use of the invalid models.

3. Unsatisfactory explanation of anomalous results by sediment compaction.

Instead of investigating possible causes of the large data discrepancies with previous investigations and regional data on K_r, *the* authors casually claim on p. 281: "We believe that compaction of the alluvial materials..." is responsible for this inconsistency. This unusual explanation defies established knowledge of the formation of the hydraulic conductivity in alluvial sediments (e.g., Bridge, 2003). It is well known that the hydraulic conductivity of unconsolidated sediments (and sand-and-gravel aquifers in particular) is dominated by the grain size distribution and sorting (e.g., Domenico and Schwartz, 1990), and the deposition and overburden conditions are relatively uniform at all sites that the authors cited by the authors.

Summary

Using archive field data of a pumping test near Kearney, Nebraska, Chen and Chen (2003) carried out a study that mimics the methodology of Hunt et al. (2001), Christensen (2000), Nyholm et al., (2002), and Kollet and Zlotnik (2003). Inaccuracies in their approximations and mathematical procedures seem to have led to numerous errors in their results. This article either invalidates results of previous studies in the Platte River valley, including their own, or is flawed. This is unfortunate considering the importance of such data for ongoing large-scale projects in the Platte River valley, Nebraska.

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