

Interactive comment on “Analyzing streamflow changes: irrigation-enhanced interaction between aquifer and streamflow in the Republican River Basin” by R. Zeng and X. Cai

Anonymous Referee #2

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Review of Hess-2013-235

This paper uses a modeling technique to analyze the relationship between pumping and streamflow over a half-century period for a portion of an aquifer in the central United States. The modeling approach appears to be overly simplified calling into question the validity of the results. Publication is not recommended unless authors can address/explain these concerns.

Specific Comments:

English grammar needs attention. Here are a few examples from one paragraph. Page

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7786: line 5, "...water and energy budgetS..."; line 8, "... will help IN understanding ..."; line 8, "... over WHICH? scales ...". The authors should give the paper a careful read for these details.

Page 7787, line 10. The authors are correct that many models treat recharge, ET etc. as fixed during the simulation, but codes do exist and are applied that are more sophisticated than this. For example, the authors should consider referencing the MODFLOW Farm Process (details here: <http://water.usgs.gov/nrp/gwsoftware/fmp/fmp.html>) which models groundwater, surface water and crop irrigation and ET processes.

Page 7788, line 11. Please make clear the location of the gauge from which the date in Figure 2 is taken. Perhaps placing it on the map on Figure 3 would be useful.

Figure 3: It appears that this figure was taken from the Republican River Compact Administration (RRCA). The RRCA definition of the Frenchman Creek Basin is the light brown area in the upper left portion of the RRB. However, the pop-out map on Figure 3 seems to indicate a shape that is not the same as the brown area. As a result, the Frenchman Creek Basin defined by the RRCA is not the same as the basin used by the authors. This is important because the RRCA-defined Frenchman Creek Basin has, at its northern boundary, a connection to the Platte River. This river provides significant recharge to the basin.

Page 7789, line 19. From where was the data shown in Figure 4 collected? How is it related to the Frenchman Creek Basin. The authors assert that the decrease in DRT is due to irrigation and site the Adegoke paper, but does this paper cover a different area than the data shown in Figure 4? More explanation is needed.

Page 7790, the model for baseflow (equations 2 and 3) appears to be poorly suited to model the complex space and time relationships between pumping and baseflow change for this site. Apparently, the recharge, ET and pumping terms are spatially averaged over the entire basin. Also, it appears that the baseflow recession coefficient is a single, scalar parameter that does not depend on space or time. It is hard to see

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how such a simple model can be expected to capture the spatial and temporal variability in this basin. As the authors show, the total volume of pumping has changed over the decades and pumping rates vary seasonally. For much of the RRB, streams may take years to respond to distant groundwater pumping. Indeed, water table decline and subsequent streamflow depletion can be significantly affected by pumping in adjacent basins. And, of course, the aquifer is heterogeneous, both in conductivity and in thickness. All this suggests that a more sophisticated model is needed to represent the impacts of pumping on baseflow and that the proposed model is inadequate.

Page 7791, line 12: why were these particular time periods selected for calibration? Would it not be more useful to use to very different periods (such as, the 1960s, 1970s period of rapid change in pumping).

Figure 5: if the total flow here is model generated it would be useful to plot the actual streamflow (for the irrigation case) as a means to provide validation of the model. Figure 8 (showing change in aquifer storage) would provide another chance for model validation since the RRCA has this spatially distributed data).

The authors (following SWAT) distinguish between subsurface and baseflow. In a basin of this size, all non-overland flow is baseflow, unless the authors are using a different definition of subsurface flow than is typical (that is, perhaps it is really a component of surface flow).

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 7783, 2013.

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