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Hydrology and Earth System Sciences Discussions

Interactive comment on "Transient flow between aquifers and surface water: analytically derived field-scale hydraulic heads and fluxes" *by* G. H. de Rooij

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Initial reply to Referee no. 2 (R2)

The referee mentions linear reservoir models as examples of large-scale discharge models, and suggests these models may not have to be redefined but possibly refined. An advantage of the approach presented here is that the solutions apply both to lateral flow from the aquifer to the surface water, but also for the opposite: infiltration form the stream. Linear reservoirs generally only treat discharge. Furthermore, the solutions can also handle leaky aquifers, and a more flexible set of external forcings. Thus, they

are much more general than linear reservoir models, and still relate the flux into or from the surface water to the average hydraulic head.

It is worth noting that the linearized simplifications of the relationships between the flux and the average hydraulic head cause the flux to be proportional to the difference between the average hydraulic head and the surface water level. This is the definition of a linear reservoir. Thus, linear reservoir models are simplifications of the full solution that ignore the higher-order terms. (I may add a few lines pointing this out in the revised text). The expressions for the proportionality factor provide more insight than the reservoir coefficients of linear reservoirs, in that they are fully defined in terms of porous media properties, aquifer dimensions, and aquifer geometry.

The link between linear reservoir models and the solutions given here can be made more clearly along the thoughts presented above. I thank R2 for bringing this to my attention.

R2 points out the pressing problem of relating local groundwater level measurements to the average storages calculated by reservoir type models, and appears to regret that I do not address the issue. One reason for this is that I developed this paper with another research community in mind (see my response to Dr. Hergarten). Still, although I do not explicitly mention this problem, it appears to me I address it implicitly by replacing the uniform hydraulic head of a linear reservoir (which basically is a water tank) with the full solution to a transient groundwater flow problem that provides the full map of the hydraulic head in space and time (Figs. 2, 3, 8, and 9). It is therefore straightforward to derive from the expressions for the hydraulic head the variation in time at any location, which facilitates a comparison to and possibly calibration on observations in monitoring wells. I am therefore not entirely sure how to best address this comment, since in essence, it has already been accommodated. I will peruse the text to see if I can clarify this.

Specific comments: 1. I will look into this. 2. Any equation with an 'odd' numbering

is repeated from an earlier occasion. Its number refers to its first appearance. 3. I am currently addressing exactly this issue. It turns out the subtleties of this problem require a paper of their own. I respectfully request the referee to bear with me for a while as the work progresses.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 8435, 2011.