Hydrology and Earth System Sciences Discussions

Interactive
Comment

Interactive comment on "Response to recharge variation of thin lenses and their mixing zone with underlying saline groundwater" *by* S. Eeman et al.

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Received and published: 8 August 2012

Review by Alexander Vandenbohede

Reactions are in between the comments, we refer to the supplemented PDF for better visibility: reactions are in Italic there.

I found this an interesting paper about the dynamics of shallow freshwater lenses. It is a very relevant subject from a theoretical point of view, but also from a very practical point of view. I have only some minor comments and therefore recommend publication by HESS.

Dear Dr. Vandenbohede, Thank you for this positive review. We used your comments

in the revision of our MS to improve our text. Reactions are below.

- Recharge is treated as a sine function. This is indeed to a certain extent the case for northwest Europe with higher recharge in winter and (almost) no recharge in summer. However, as for instance figure 3a shows, recharge consists of peak values superimposed on this sinuous evolution. These peaks can be substantial. Can the authors comment on the influence of this on their conclusions. Do these peaks are of too low frequency to have any substantial effect on the rainwater lens dynamics? Was this testes?

We are grateful for this insightful comment, as, indeed, the world is not sinusoidal. In section 4.2 we tested what the effect of using sinuses instead of natural recharge patterns was. Indeed there is an influence of peaks. Also in 4.1 we show that high frequency (1 week-1month period) events do have some effect, although it is very small for the volume of fresh water in the lens. However, the thickness of the mixing zone is very strongly influenced by these peaks, which cause relatively large movements of the average interface, thereby causing longitudinal dispersivity to play a major role in the mixing process (see also Eeman et al. 2011). This effect on mixing zone thickness is linear over a longer term (section 4.2). We have adapted our text in this section to clarify our findings further.

- Authors state that volume of freshwater includes the freshwater in the unsaturated zone. I do not understand how this is implemented in the analyses. Flow in the unsaturated zone is include in the SUTRA calculations? Thickness and soil type of the unsaturated zone must have an influence on the results? This is implemented to the extent that SUTRA does take the unsaturated zone into account. For the calculations in this paper we used a typical clay-loam soil. However, indeed, we did not investigate the effect of different soil types in depth; a test was done for the given reference and due to the shallowness and mostly wet conditions of the unsaturated zone, the differences between a sandy, loamy, and clayey soil were negligible. We stated this explicitly now in section 3.2 and in the conclusions: as long as you make your reference run using

the right soil type, we do not expect significant errors in the calculated scenarios, even if the unsaturated zone is somewhat thicker and dryer. Of course this thickness is limited in practice given the upward flowing saline water, inherent to the studied system.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/9/C3669/2012/hessd-9-C3669-2012-supplement.pdf

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 1435, 2012.

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