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Hydrology and Earth System Sciences Discussions

Interactive comment on "Potential groundwater contribution to Amazon evapotranspiration" *by* Y. Fan and G. Miguez-Macho

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Review of the paper "Potential groundwater contribution to Amazon evapotranspiration" by Fan and Miguez-Macho.

General

This is a very interesting paper following a research line that was set out by these authors a few years ago in a series of papers in the Journal of Geophysical Research based on the idea that groundwater contributes to land-surface atmosphere feedbacks and related work by e.g. Maxwell and Kollet (Nature Geoscience, 2008) and Bierkens and van den Hurk (GRL, 2007). From this assumption this paper provides an origi-

nal and much needed hydrological contribution to the discussion whether the Amazon increases productivity during drought or not and what the response to a future drier climate will be. The paper is well written and the amount of data the authors use to make their case is impressive. I think this paper should be published after some minor revisions.

Specific comments

- page 5133, line 9: Change to: First, soil water storage is far greater than in nature then assumed in most land surface models. . .,dry season; in these models . . .

- Page 5139, line 25: "solved iteratively": please explain more how this is done. Are you visiting cell after cell and making small adjustments per cell, i.e. a relaxation method, or are you solving the complete set of coupled linear equations using a Newton-Raphson type of method?

- Page 5140, line 19: this convergence may be happening in a catchment, but not that flow rates can be small so that the present groundwater distribution is the results of a convergence process that happens at a time scale of decades or more. Of course, a steady-state approach is used here, so it is not of much consequence.

- Page 5141, line 6: a zero mean stochastic process does not have to be Gaussian. It is likely to be symmetrical, but it can e.g. be uniform or beta-distributed. So leave the word Gaussian out.

- Page 5141, lines 17-28 and also line 24 on page 5143: this is my most serious comment. Here the positive bias by the model is completely attributed to possible pumping of many of the wells. However, it may also be caused for an important part by an over-estimation of groundwater recharge. Land surface models that have been used to calculate to estimate recharge do not account for capillary rise. However, the authors estimate the capillary rise to be, on average, 2.2 mm day-1. So, the calculated recharge in each cell should be corrected for capillary rise. Obviously, one can only

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calculate capillary rise if the groundwater depth is known, so in fact the authors should have included an outer loop, first calculating groundwater depth based on an initial estimate of groundwater recharge, then correcting that per cell for capillary rise based on the first estimate of groundwater depth, then calculating a new groundwater depth etc. In short: I move that the over-estimation may be due to lack of including this outer iteration loop. Obviously, I will not ask the authors to extend their calculations this way, as they are computationally extremely demanding and are not needed for the authors to make their point. However, they should admit that their water table depths may be too shallow and estimated capillary fluxes too high due to this problem as well.

- Page 5143, line 2: leave out the word “unbiased” here because it assumes some statistical treatment of the estimates.

- Page 5143, lines 5-15: please provide a scatter plot showing for each validation area a point plotting estimated versus observed water table depth (or height) (9 points in total) where the variation of different model cells and piezometer data can be shown by using bars showing the interquartile range within the catchment.

- Page 5144, Figure 10: state (also in Figure head) that you are showing potential or maximum capillary flux.

References

Bierkens, M. F. P. and Van den Hurk, B. J. J. M.: Groundwater convergence as a possible mechanism for multi-year persistence in rainfall, Geophysical Research Letters, 34, 5, 2007.

Maxwell, R. M. and Kollet, S. J.: Interdependence of groundwater dynamics and land-energy feedbacks under climate change, Nature Geoscience 1, 665–669, http://dx.doi.org/10.1038/ngeo315, 2008.

ps, in reaction on the author’s response to the first review: I feel it would be a shame to omit the capillary flux from the paper. Just mention that it is a first order estimate

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based on ignoring dynamics and the problem with omitting the outer iteration loop as described above.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 5131, 2010.