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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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Dr. Bierkens raised a valid issue that the recharge from GLDAS land models, which did not account for water table source for ET, could be over-estimated, and that this would at least partly explain the positive bias in the simulated water table height. However, an outer iteration, even if computationally feasible, may not give us the answer, for a few reasons.

First, the estimated capillary flux here is NOT suggestive of the real flux, but only the potential or maximum strength of the capillary force. (We now realize that we did not make this clear in the present manuscript, and will include a separate paragraph to discuss this and other limitations in the revised version.) This is the reason that

it can be higher than the highest ET flux measured, because the latter is limited by atmospheric demand and plant physiology. What we hoped to show here is what a water table, combined with fine textured soil, are capable of doing, all other factors removed. For this reason, the potential capillary flux cannot be simply subtracted from the net recharge and used to update the water table simulations.

Second, mean annual ET flux estimated by CLM, shown in the attached Fig.1b, is in the observed range (3-4mm/day, see Fisher et al., 2009, referenced in manuscript), suggesting that CLM soil is sufficiently wet to support the right ET for whatever reasons other than the water table. This suggests that the soil water balance, and hence the net drainage from the soil columns, is reasonable. This can be said at least for the case of CLM recharge, the lowest of the four and used to estimate the potential capillary flux.

Third, even if the CLM recharge is an over-estimate, the water table does not seem to be very sensitive to recharge reductions. The recharge difference is more than doubled between CLM to HTESSEL (Fig.3) but the water table difference is only 1.8m (Fig.5, manuscript). In addition, the capillary flux is not sensitive to water table depth once it drops below 5m or so. The water table difference of 1.8m over the Amazon only translated into a capillary flux difference of 0.4mm/day (Fig.13). The large recharge difference between HTESSEL and CLM only affected the water table on the high grounds where it is already deep, and the shallow water table in the valleys remained shallow because of lateral convergence.

In the revised manuscript, we will include a full discussion of the limitations of our simple approach, including the possibility that the recharge could be over-estimated. Most importantly, we will emphasize that the potential capillary flux presented here was only meant to demonstrate the strength of the capillary force if a water table is combined with fine-textured soils. The real capillary flux is most likely negligible in the real world if the top soil is never dry enough to turn on the capillary flux from the water table. We will also address Dr. Bierkens other comments, and include the missed reference (BTY, the paper of Bierkens and Van den Hurk (2007) was a main motivation for a recent paper: Schaller and Fan (2009), River basins as groundwater exporters and importers: Implications for water cycle and climate modeling, J. Geophys. Res., 114, D04103, doi:10.1029/2008JD010636). Finally, we thank Dr. Bierkens for his thoughtful and constructive reviews.

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

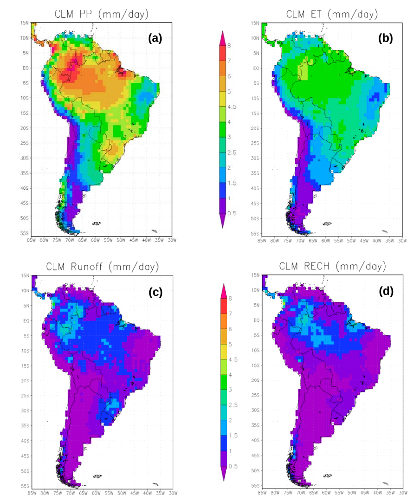

Figure 1. CLM long-term mean precipitation P (a), ET flux (b), surface runoff Qs (c) and water table recharge R (d), all in mm/day. The latter is estimated as R=P-ET-Qs.

Fig. 1. CLM long-term mean precipitation P, ET, surface runoff, and recharge