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Hydrology and Earth System Sciences Discussions

Interactive comment on "A combined field and modeling study of groundwater flow in a tidal marsh" *by* Yuqiang Xia and Hailong Li

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GENERAL COMMENTS

This paper presents an intersting combination of field and modeling studies of the tidally induced flow dynamics on a mangrove beach and a bald beach. The authors postulate that the freshwater recharge at the mangrove beach enables mangrove vegetation to grow, and that absent freshwater recharge at the bald beach prevents vegetation from existing. Numerical simulation results are also presented that reproduce field measurements of groundwater table at the two beaches very well. Both field and numerical studies helped to identify a low-permeability mud layer close to the surface, and a high-permeability aquifer below the mud layer (at both beaches).

The authors do a good job at interpreting their field observations in hydrogeological terms. It is also noteworthy that the numerical results reproduce the field measurements very well.

This being said, I am putting two points of criticism on the table:

1. The postulation that no freshwater recharge occurs at the bald beach is, in my opinion, not supported by the field observations. As a consequence, the no-flow boundary condition imposed on the landward (left) side of the bald-beach transect is not justified. The interpretation of the numerical results is too much driven by the imposed boundary condition. This should be changed, and the effect of different boundary conditions should be evaluated.

2. Much of what the authors explain is already known. The authors very correctly refer to existing literature when interpreting results or observations. The reader therefore wonders, what the novel aspect of this manuscript is? While I do see that field and numerical results are in excellent agreement, I would like to ask the authors to better highlight the novel aspect of their study.

SPECIFIC COMMENTS

1. P5125 L19. tides

2. P5125 L20. have, effect ON the, exchange

3. P5126 L20,21. Permeability has dimension L2, while the number you give is a conductivity value in L T-1. Also, it is unclear whether 0.1 m day-1 is for the sand strata or for the mud layer.

4. P5127 L10,11. Replace “by mean of comparisons of” by “Comparing”.

5. P5127 L23. What is a “shoalwater bay”?

6. P5127 L27. What do you mean by “best” reserve in China?

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7. P5128 L1. An average value is just one value, not a value range.

8. P5128 L2. Delete “around”.

9. P5128 L13+17 and other places in the ms. Delete “.0”.

10. P5132 L5. ...higher than that of the...

11. P5132 L11-16. Not exactly clear what you mean by “discharge tube”. You simply mean the high-K zone below the mud layer.

12. P5133 L3-6. What is mean sea level at transect B?

13. P5133 L7,8. Why do you say “during falling tides and low tides” and not simply “during falling tides”, which is what Fig. 4 suggests?

14. P5133 L7-21. What observation makes you conclude that water near B1-B3 drains seaward? I do see that the scale for B1 in Fig. 4 is different from those for B2 and B3. Considering this, it seems like the water table in B3 is higher than in B2 than in B1. So we have a hydraulic gradient that points landward, not seaward. Could you explain this?

15. P5134 L8-15. Your observations so far do in my opinion not support conclusion (2). What physical observation makes you conclude item (2)?

16. P5135 L1. Given my previous comment, I do not see why a no-flow BC is justified.

17. P5135 L8-11. I do not see from Fig. 2 that there is a “bed of the tidal river”. Please clarify.

18. P5135 L24-26. Not clear what is symmetric. Please indicate better in Fig. 2.

19. P5136 L1-7. Should indicate more clearly where all these zones are. Maybe in a figure showing the complete conceptual model?

20. P5136 L12ff. I am unsure what a time-averaged plot of fluxes is telling us. Is this really the net flow of water? I think not because you are averaging extremes. I think it

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would be more appropriate (and interesting) to focus on time-dependent fluxes across a cross-section, for example at x=50 m. Then you could average that Q-t graph to give an average Q across that cross-section. If the averaged Q is positive, the net flow of water is indeed seawards.

21. P5136 L22. Could you show locations of all M in Figs. 7,8 (same for B)?

22. P5136 L23-25. While I agree that the conceptual model of two layers having different permeability is supported by the results, I still do not see that having freshwater recharge for M, and no freshwater recharge for B is shown.

23. Figs 8+10. If you put your hand over results between x=0 and x=20 m, then the two results look very alike. This gives rise to the question, why you imposed different flow BC along the left boundary, and by what this different choice is supported?

24. P5136 L28. "except that there was no inland freshwater recharge in the bald beach". You only observe the BC that you imposed! This is not a physically relevant observation but rather a numerical issue (BC) that you require to solve differential equations. Should be careful here not to mix physics with numerics.

25. P5137 L12. Again, I wonder what physical observation justifies the no-flow BC, and I also wonder what the results might look like if you change the left BC from Neumann no-flow to Dirichlet constant-head. I would expect that the results would actually be quite similar. Plus, I would argue that there is always freshwater recharge, simply because freshwater falls over land, and because land is higher than sea level.

26. P5138 L3-16. The logical implication of the vast similarity must be that BCs of M and B are also identical.

27. Conclusions. So the key point of the paper is that B exists because there is no freshwater recharge, and that M exists because there is freshwater recharge. First, I wonder how impactful this finding is. Quite obviously, living organisms thrive when getting (fresh) water, and they disappear when there is not (fresh) water input. Second,

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I still wonder what hydrological observation supports your assumption of the BCs along the left boundary. Third, while I do believe that freshwater recharge at M is larger than that at B, could this difference be associated with the mere fact that plants use up water, thus creating a lack of water in the subsurface which attracts freshwater to flow in? Hence the difference in freshwater recharge?

28. Fig. 1. I wonder whether transect M is actually a “beach”. It looks like M is already situated within land. Could you have picked a location that is about 600 m east of M on the beach? That location looks more comparable to B because then both would be situated in the Dongzhaigang Bay. I wonder what effect the choice of location of the Mangrove transect on your observation is, and whether M and B can actually be compared. Please address this.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 5123, 2011.