# Comments by Dr. Arnaut van Loon (Referee#3) and our responses

**Summary**
The ms presents time-series of groundwater levels and groundwater modeling results of two transects (one covered with mangrove and one not covered with vegetation) to identify the geohydrological key-processes important to mangrove persistence. The results provide evidence that the aquifer under the mangrove transect was recharged with fresh groundwater from upstream regions, whereas the aquifer under the bold beach transect was not recharged with fresh groundwater. This confirms the hypothesis that fresh groundwater recharge of semi-confined aquifers drained by the sea is essential to the mangroves. I find the general methodological set up, consisting of a comparison of two transects using observations and model results, very convincing. However, I have some concerns from this respect as outlined below. Besides I think that the ms is not always precisely written and lacks a clear focus, leaving a whole lot of open questions to the reader. Therefore, I suggest that the authors consider rewriting the ms given the remarks mentioned below and take my methodological concerns stated below into account, in order to make the ms suitable for publication.

**Response:**

We are very grateful to you for your recognition to our work. Following your suggestions, we have rewritten the manuscript to improve its focus. We have addressed your comments in detail below. Thank you.

**GENERAL COMMENTS**

**Original comment 3-1:**

1. As mentioned above, the ms is not always precisely written and lacks a clear focus, at least concerning the introduction, discussion and conclusion sections. I suggest that the authors consider rewriting the ms given the remarks mentioned blow.

a) The authors test some speculations about the regional geohydrological functioning of mangroves, however, the ecohydrological relevance remains unclear in the introduction and discussion sections. From the current ms I conclude that fresh groundwater under the mangrove transect is discharged into the tidal creek during low tide; the high resistance mud layer isolates the mangroves from the aquifer. So, how can then the mangroves benefit from the fresh groundwater at several meters depth? In my opinion, the ms would improve considerably if the underlying ecohydrological processes are well described in the introduction section and if they are confronted with the results of this study in the discussion section. Also, a figure which illustrates the conceptual hydrological models of both transects can be helpful for the reader.

**Response 3-1a:**

Closely following your comments, we have highlighted the ecohydrological relevance analyses in the introduction and discussion sections.

In the section "Introduction" of our revised paper, we have added the following sentences to show the existing studies of the ecohydrological processes in tidal marshes (lines 100-118):

"Recently a series of discussions on the ecohydrological feedback mechanisms or ecohydrological interactions were reported by many researchers in salt marshes (Ursino et al., 2004; Li et al., 2005; Marani et al., 2005; Wilson and Gardner, 2005; Marani et al., 2006; Gardner, 2009; Tossatto et al., 2009) and in riverine and island systems (Bauer et al., 2006; Bauer-Gottwein et al., 2008). In particular, Marani et al. (2006) linked the complex spatial patterns of vegetation to the relevant hydrological and ecological processes in oxygen-limited tidal marsh ecosystems by a model of coupling hydrogeomorphic and ecological dynamics. They found that the ecohydrological interactions contribute the patterns of vegetation colonization and spatial zonation, especially highlighted the roles of hydraulic conductivity and evapotranspiration in aerating the soils of tidal marshes. Ursino et al. (2004) and Marani et al. (2006) stated that the presence of a zone of aerated soil beneath the marsh surface could have profound implications for marsh ecology. However, Gardner (2009) pointed out that it would be true only if the subsurface air contains a permanent and significant concentration of oxygen for use in respiration and/or oxidation of organic matter. Bauer et al. (2006) and Bauer-Gottwein et al. (2008) presented the quantifications and modeling of ecohydrological feedback mechanisms (e.g., phytotoxicity, transpiration stream concentration factor) in semi-arid and arid regions (e.g., riverine and island systems). They concluded that precipitation and evapotranspiration are important processes in such systems and have a significant influence on subsurface flow and concentration patterns."

In the section "Discussions" of our revised paper, we have added the following discussion regarding the influence of the vegetation (evapotranpiration) on the hydrologic processes and our experiment results (lines 541-559):

"The presence of the vegetation tends to increase the salinity due to evapotranpiration, and thus may increase the pore water salinity and decrease the water table. However, the observed constant water table elevation very close to the ground surface at wells M2, M3, M4, M5 and M6 during low tides indicated that the evapotranspiration during the field work was less than the measurement error of the water table elevation. And the observed low salinity at several wells along the mangrove transects indicated that the increasing effect of vegetation evapotranspiration on the salinity is overwhelmed by the freshwater recharge.

The salinity of the groundwater recharge into the high-permeability zone near M0 is very low (may be even fresh in deep part of M0). On the other hand, the salt through the vertical leakage of the mud zone into high-permeability zone is limited owing to the fact that the permeability of the mud is several orders of magnitudes less than that of the high-permeability zone (Fig. 8). Therefore, the salinity of the pore water in the whole high-permeability zone may be significantly lower than that in the mud zone.

Thus, the high-permeability zone may provide opportunity for the plants in the mangrove marsh to uptake freshwater through their roots extending downward into the high-permeability zone, which may prevent the accumulation of salt in mud zone caused by plant evapotranspiration. As a result, it may be concluded that the bald beach (not covered by mangrove plants) is due to the lack of freshwater recharge for generating a brackish beach soil condition essential to mangrove growth."

We closely followed your suggestions and illustrated the conceptual hydrological models of both transects in Fig. 2.

b) The objectives stated in the introduction section are rather broad and could be specified more precisely. One of the reasons is that a clear hypothesis is missing in the introduction section. A hypothesis can be formulated given the literature mentioned, and may sound something like the speculations firstly mentioned in section 5.

**Response 3-1b:**

We closely followed your suggestions and proposed a clear hypothesis like the speculations mentioned in section 5, it reads (lines 141-145) "Based on the observations, the following hypothesis is proposed: the hydraulic structure of tidal marsh and freshwater availability may be the main hydrogeological factors critical to mangrove development. The finite element model MARUN (MARine UNsaturated, Boufadel et al. (1999)) was used to corroborate the observations for hypothesis testing."

c) Section 6 "Numerical verification" starts with resuming two "speculations" about the functioning of the geohydrological system of both transects. As these two speculations do not exclude each other, they should be seen as 1 "speculation" and described as such (see 1b).

**Response 3-1c:**

We closely followed your suggestions and combined the two speculations as one hypothesis throughout the revised manuscript. Please also see **Response 3-1b.** Thank you.

d) The discussion starts with a description of the similarity of the two transects. This section reads as a bunch of statements, without clearly explaining their mutual relations. Also, I would expect more emphasis on groundwater hydrology of both transects, and how the outcomes relate to situations described elsewhere (which are both only briefly given).

**Response 3-1d:**

By coupling the discussion of salinity difference along the two transects, this section has been updated into "Comparison between the two transects". The revised section "Discussions" has presented more emphasis on groundwater hydrology of both transects, and how the outcomes relate to situations described elsewhere. Please see lines 529-559 and lines 607-622 in our revised manuscript. Thank you.

e) The conclusion section (page 5140) reads more like a discussion about mangrove conservation and should be focused more on the objectives of this ms. For instance, salt buildup under influence of evapotranspiration and the removal of salt by fresh groundwater seepage (r 21 and 23) is not considered in this study and typically should be part of the discussion. Some conclusions are given in the first paragraph (p 5140, r11-23). However, the conclusions are not explained very well, leaving many questions to the reader. What is the key-role mentioned at r14 exactly? How come that the lack of freshwater recharge results in aerated beach soil conditions (it seems to me that aeration can prevail under both freshwater and salt water recharge) at r 19? Why is fresh groundwater recharge a decisive factor for generating brackish groundwater?

**Response 3-1e:**

Thank you. Closely following your comments and suggestions, we have moved original statements about mangrove conservation to the Discussions section, and added new discussions on salt buildup and removal in the section of Discussions. We have detailed the conclusions as well. The rewritten section of Conclusions reads (lines 624-655)

"This paper identified the hydrogeological factors critical to mangrove development among the mangrove marshes in Dongzhaigang National Nature Reserve, China. Based on the field measurements and numerical simulations of water levels, the two transects investigated were found to have a mud-sand two-layered structure: a surface zone of low-permeability mud and an underlying high-permeability zone that outcrops at the high and low tide lines. The hydraulic conductivity of both beach transects was found to be several orders of magnitude greater in the high-permeability and loose bank zones than in the mud zones. The mud-sand two-layered structure plays a key role in the hydrological regime of study areas. It is indicated that seawater infiltrates the high-permeability zone through its outcrop near the high intertidal zone, and discharges from the tidal river bank in the vicinity of the low tide line, thereby forming a tide-induced seawater-groundwater circulation which provides considerable contribution to the total submarine groundwater discharge (SGD). Both the observed water tables and salinities at wells in inland and high intertidal zone indicated zero inland freshwater recharge into the bald beach transect. Salinity observations and numerical simulations demonstrated that significant freshwater recharge occurred in the mangrove transect. These results suggest that the bald beach is most probably due to the lack of freshwater recharge for generating brackish and aerated beach soil conditions essential to mangrove growth. The existence of the high-permeability zone is a critical factor for the mangrove development, because the high-permeability zone may provide opportunity for the plants in the mangrove marsh to uptake freshwater and oxygen through their roots extending downward into the high-permeability zone, which may help limit the buildup of salt in the root zone caused by evapotranspiration, and enhance salt removal which may further increase the production of marsh grasses and influence their spatial distribution.

Finally, there are many issues that have not been considered here but should be examined urgently. These include, e.g., the long-term observations of precipitation, evapotranspiration, pore water salinity and water table variations along the mangrove transect, the quantifications and modeling of eco-hydrological feedback mechanisms based on these observations (e.g., Bauer et al., 2006, Bauer-Gottwein et al. 2008), and the effects of the mixing and diffusion of solute inside the observation well on the groundwater flow that are essentially three-dimensional or at least locally radial, i.e. the well effects on the density-dependent groundwater flow near and within the observation wells."

**Original comment 3-2:**

2. I think that the general methodological setup can be described more clearly and convincingly if the sections 3 and 6 are merged into one section named "Methods", starting with an methodological overview. Now, the method seems to consist of two separate parts, while the modeling exercise clearly has an added value to the field observations.

**Response 3-2:**

In the original manuscript, Section 3 is about the method for field measurement, and Section 6 is about numerical method and numerical simulation results. We agree that the general structure of a paper should specify one section for describing methodological setup for the field experiments and numerical simulation. We merged the necessary part of section 6 into section 3 (see lines 212-217 in our revised manuscript). The major part of section 6 such as the initial and boundary conditions and simulation domains, however, is based on the field measurement results, so it has to be presented after the introduction of the field measurement results in section 5.

**Original comment 3-3:**

3. Conform the previous remark, I would prefer a results section consisting of two paragraphs, namely (1) Mangrove transect, (2) Bald beach transect. In each paragraph, the field data and the model results are subsequently outlined, including their consistency.

**Response 3-3:**

The reviewer suggested to merge Sections 3 and 6 into one. As we have addressed in **Response 3-2,** section 6 is based on the field measurement results (section 5), so it has to be presented after section 5.

**Original comment 3-4:**

4. The authors use 2D groundwater flow modeling to corroborate a hypothesis obtained from observed trends and patterns in groundwater levels along two transects. Given this modeling aim, I have the following concerns about the suitability of the experimental set up:

a) The boundary conditions that principally force the model (those assigned to the ground surface during submergence, the left boundary representing regional groundwater flow from upland and the tidal creek) are defined according to the observed groundwater levels. In other words, the results of the groundwater model are, strictly seen, not independent of the observed groundwater levels, which makes the model's corroborating evidence that supports the hypothesis under study less convincing. Hydrochemical monitoring results (e.g. Cl or EC) and/or measured fluxes are required to support the argumentation that the model captures the hydrological key-processes.

**Response 3-4a:**

Closely following your suggestions, we have included extra field observation (observed salinity data) in the revised paper to support our speculation. However, we do not have any data of measured fluxes.

b) A no-flow boundary is assigned to the left boundary of the bald beach transect model. This boundary condition is only constrained by measured water levels in one observation well. Therefore, it seems to me that other boundary types might be suitable here as well. The author's argumentation would be much stronger if the authors could show that the observed patterns can not be reproduced using realistic parameter settings if other boundary conditions are assigned to the model.

**Response 3-4b:**

In the revised paper, the postulation of no freshwater recharge into the bald beach has been documented sufficiently based on the combined analyses of the information from sediments of the well cores, observed water table, and salinity data. The new texts that we have revised to justify the no-flow boundary condition at the landward side of the bald beach are (lines 318-344 in the revised paper):

"From the panel for B0 in Figure 4b, one can clearly see that the observed water table at B1 was always greater than that at B0 during the whole observation period, indicating a landward groundwater flow direction, i.e. seawater intrusion. Thus there should be no inland freshwater recharge along this transect. Besides, the observed salinity at B1 was high during the whole observation period (almost constant about 28 ppt), but the observed salinity at B0 was very low (almost constant about 5 ppt, see panel B0 and B1 of Fig. 4b). On the other hand, during high tides the water table at B1 was ~1.4 m higher that at B0 (See Fig. 4b). Although the horizontal distance between B1 and B0 is small (~27 m), such a large head difference of 1.4 m did not cause significant variations of the water table and salinity at B0. These observations indicated that the well B1 is located in a high-permeability zone with good hydraulic connection with the tidal water but well B0 is in a much less permeable zone with very poor hydraulic connection with the tidal water. The soil properties around the two wells (Table 4) also support this conclusion. From Table 4 one can see that the sediments around B0 are mainly compacted clay, while that at B1 are dominated by sandy materials. Therefore, there was neither inland freshwater recharge during low tides nor seawater intrusion during high tides at the landward boundary of the bald beach. Otherwise, if there had been freshwater recharge from the inland, the freshwater recharge would have diluted the pore water at B1 during low tides, so that the salinity there would have decreased, rather than almost constant. On the other hand, if there is freshwater recharge from inland, which equivalently means that there had been good hydraulic connection between B0 and B1, then at high tides, the seawater at B1 would have definitely enhanced the salinity at B0 significantly.

In short, the landward side of the bald beach transect can be simplified into a no-flow boundary because this can quantitatively describe the observed significant tidal water table variations and high salinity data at B1, and also qualitatively explain the observed very low and almost constant water table and low salinity at B0."

In lines 379-386 of the revised paper, we also added the following discussions:

"During low tides, the salinities of both the deep and shallow locations at B7 remained high (about 26.5 ppt) and there was essentially no variation with depth. This was in great contrast with the large salinity difference between the shallow and deep locations at M8 and once again indicated that there was no inland freshwater recharge along the bald beach transect (otherwise, a freshwater discharge path near under the low tide line might dilute the salinity of shallow pore water at B7 and resulted in large salinity difference between shallow and deep waters at B7, which is not the case)."

In addition to the above modifications of our manuscript to justify the no-flow boundary condition, we have the following remarks as well:

(1) The most intuitive way for the landward boundary of the bald beach is to set B0 as the landward boundary and to use the observed water table at B0 as the Dirichlet boundary condition of the groundwater flow in the transect. This boundary condition will, however, conceal the important fact that the inland freshwater recharge is negligible, and highlight the anomaly that the observed water table elevation at B0 was lower than the water table at B1 (see Fig. 4b).

(2) It is very interesting to explore the anomaly that the observed water table elevation at B0 was always lower than at B1. We have provided a possible explanation of unknown pumping of groundwater in inland area near the bald beach transect (lines 304-306 in the revised paper). It is, however, beyond the scope of this paper to quantitatively simulate the anomaly due to great, unknown uncertainties that caused this anomaly.

(3) In order to eliminate the great, unknown uncertainties related to the observed water table anomaly at B0, we excluded B0 from the simulation domain and chose the vertical line 10 m landward of the high tide line (well B2) as the landward no-flow boundary of the bald beach.

(4) The vertical boundary between B0 and B1 in Fig. 2b is only an approximate conceptual model representing the lower-permeability zone around B0 and the high-permeability zone near B1. For our purpose to compare the groundwater hydraulics along the two transects, the most important fact is that the bald beach transect has negligible freshwater recharge from inland, which is sufficiently evidenced by the sediments, pore water salinities and tide-induced water table fluctuations at wells B0 and B1. The low salinity and weak tidal signal in well B0 have been qualitatively explained as results of the low permeability zone

around B0.

c) The observations and models concern only a three day period, while long term dynamics (for instance due to monsoon precipitation and evapotranspiration) can also be important for fresh groundwater recharge of the mangrove's source aquifer. This should be discussed in the discussion section.

**Response 3-4c:**

We agree that, in the long run, the long-term dynamics such as precipitation and evapotranspiration are very important for fresh groundwater recharge of the mangrove's source aquifer. However, our field observation only lasted three days and was conducted in winter, during which the evapotranspiration was insignificant and could be neglected. Therefore, quantitative study of the long-term dynamics such as precipitation and evapotranspiration is beyond the scope of our current study. Despite this, in the section "Discussions" of our revised paper, we have added the following discussion regarding the influence of the evapotranspiration (vegetation) on the hydrologic cycle and our experiment results (lines 541-559):

"The presence of the vegetation tends to increase the salinity due to evapotranpiration, and thus may increase the pore water salinity and decrease the water table. However, the observed constant water table elevation very close to the ground surface at wells M2, M3, M4, M5 and M6 during low tides indicated that the evapotranspiration during the field work was less than the measurement error of the water table elevation. And the observed low salinity at several wells along the mangrove transects indicated that the increasing effect of vegetation evapotranspiration on the salinity is overwhelmed by the freshwater recharge.

The salinity of the groundwater recharge into the high-permeability zone near M0 is very low (may be even fresh in deep part of M0). On the other hand, the salt through the vertical leakage of the mud zone into high-permeability zone is limited owing to the fact that the permeability of the mud is several orders of magnitudes less than that of the high-permeability zone (Fig. 8). Therefore, the salinity of the pore water in the whole high-permeability zone may be significantly lower than that in the mud zone. Thus, the high-permeability zone may provide opportunity for the plants in the mangrove marsh to uptake freshwater through their roots extending downward into the high-permeability zone, which may prevent the accumulation of salt in mud zone caused by plant evapotranspiration. Thus, it may be concluded that the bald beach (not covered by mangrove plants) is due to the lack of freshwater recharge for generating a brackish beach soil condition essential to mangrove growth."

In the revised paper, we have also stated the issues that have not been considered in the present study, please see the last paragraph of our revised manuscript (lines 648-655). It reads:

"Finally, there are many issues that have not been considered here but should be examined urgently. These include, e.g., the long-term observations of precipitation, evapotranspiration, pore water salinity and water table variations along the mangrove transect, the quantifications and modeling of eco-hydrological feedback mechanisms based on these observations (e.g., Bauer et al., 2006, Bauer-Gottwein et al. 2008), and the effects of the mixing and diffusion of solute inside the observation well on the groundwater flow that are essentially three-dimensional or at least locally radial, i.e. the well effects on the density-dependent groundwater flow near and within the observation wells."

## SPECIFIC COMMENTS

1. The abstract lacks a statement about the ecohydrological key mechanism that justifies the presumption that fresh groundwater in semi-confined aquifers can be essential to the existence of mangroves.

**Response:**

Thank you for your suggestions. We have added the following statements in the revised abstract, it reads "The high-permeability zone may provide opportunity for the plants in the mangrove marsh to uptake freshwater and oxygen through their roots extending downward into the high-permeability zone, which may help limit the buildup of salt in the root zone caused by evapotranspiration, and enhance salt removal which may further increase the production of marsh grasses and influence their spatial distribution."

2. Figure 4 can be improved by printing the time series for the mangrove transect in one column, and the time series for the bald beach transect in the other. Also, time series observed at a comparable location in each transect can be plotted next to each other (i.e., in 1 row), which would allow readers to analyse differences in hydrological behavior between the mangrove transect and the bald beach transect.

**Response:**

We appreciate your suggestions very much. Actually, we had tried this before but failed since there are 1 inland well (M0) and 8 intertidal wells (M1-M8) in the mangrove transect while three inland well (B0, B1 and B2) and 5 intertidal wells (B3-B7) in the bald beach transect, which makes it impossible to group the wells of both transects into pairs of comparable locations. Thus, we would like to decline this suggestion.

3. At page 5136, the authors mention that they estimated hydraulic conductivities through trial and error. More information should be provided about this process. Was a range of parameter settings defined prior to the calibration? When did the authors stop the trial and error process? Were the conductivities of each layer adjusted alternatively?

**Response:**

The similar method of trial and error was also used in *Li and Boufadel* [2010], *Xia et al*. [2010] and *Guo et al*. [2010]. First a range of parameter defined prior to the calibration, for example, the range of hydraulic conductivity ($K$) for the low-permeability layer was tested from $10^{-5}$-$10^{-10}$ m/s, and $K$ of the high-permeability layer ranged $10^{-1}$-$10^{-5}$ m/s. The $K$ values for each layer were adjusted alternatively, and the location of the two layers' interface was also adjusted for calibration. The trial and error process was stopped when the observed data and simulated results were matched satisfactorily. We have added such explanations in our revised manuscript (lines 454-462).

*Citations:*

Guo, Q. N., Li, H. L., Boufadel, M. C., and Sharifi, Y.: Hydrodynamics in a gravel beach and its impact on the Exxon Valdez oil, J. Geophys. Res., 115, C12077, doi:10.1029/2010JC006169, 2010.

Li, H. L., and Boufadel, M. C.: Long-term persistence of oil from the Exxon Valdez spill in two-layer beaches, Nature Geoscience, 3, 96-99, 2010.

Xia, Y. Q., Li, H. L., Boufadel, M. C., and Sharifi, Y.: Hydrodynamic factors affecting the persistence of the Exxon Valdez oil in a shallow bedrock beach, Water Resources Research, 46, W10528, doi:10.1029/2010WR009179, 2010.

4. In many places, the authors resume the speculation that "the low-permeability marsh soil is underlain by a high permeability zone" in the mangrove transect (e.g. p 5136, r10 and 23). This speculation, however, has by itself no relevance to the existence of mangroves. I think that should be added that seaward drainage of fresh groundwater from upland through this high permeability zone also is a critical factor. Only then mangroves can benefit from the presence of fresh groundwater conform the authors postulation.

**Response:**

We appreciate your comments and suggestions. We have added such statements in our revised abstract and conclusions, it reads "The high-permeability zone may provide opportunity for the plants in the mangrove marsh to uptake freshwater and oxygen through their roots extending downward into the high-permeability zone, which may help limit the buildup of salt in the root zone caused by evapotranspiration, and enhance salt removal which may further increase the production of marsh grasses and influence their spatial distribution." In addition, we have followed your previous comments to merge the two speculations into one.

5. I prefer a figure of simulated patterns of fresh and brackish groundwater (e.g. Clconcentrations) in stead of Figs 7 and 9.

**Response:**

Since we did not simulated the salinity, we instead provided a figure (Fig. 6) in our revised manuscript to show the averaged values of observed salinity (ppt) of pore water over the 3-day observation period in wells in the intertidal zones of the mangrove and bald beach transects.

p. 5125, r 13: "surface and ground freshwater"→"fresh surface and groundwater"

**Response:**

Corrected as advised. Thank you.

p. 5125, r 20: “Effects on” and “nutrients”. What is meant with “material”?

**Response:**

Corrected as advised. Thank you. The “material” means salt, carbon, trace metals, and other organic and inorganic materials.

p. 5125, r 21 -24: this sentence misses a verb. Omit the long name of the research site

p. 5125, r 26-28: “advection prevents infiltration” … “removes solutes” … “the wetland”.

p. 5125, r 27: “nutrient concentrations”

**Response:**

We have corrected the above-mentioned points as advised. Thank you.

p.5126, r6-8: This sentence misses a statement: what was concluded?

**Response:**

Thank you. We have added a statement in our revised manuscript (lines 91-93), it reads “They concluded that the hydraulic properties largely influence the ecological functions of marsh and determine the groundwater discharge rate from the marsh to the estuary.”

p. 5126, r28: “mangroves are distributed along”

**Response:**

Corrected as advised. Thank you.

p5127, r2: Isn’t it better to focus on the mangroves? I would state something like “critical to mangrove development”.

**Response:**

Thank you very much for your suggestion. We have made the changes as advised.

P 5127, r10. I suppose that the modeling exercise has a higher goal then only simulating water levels, namely to corroborate the observations for hypothesis testing.

**Response:**

Thank you very much for your suggestion. We have made the changes as advised.

P 5127, r27: what is meant with “Best mangrove”? the best preserved?

**Response:**

Yes, Dongzhaigang National Nature Reserve is the largest mangrove forest nature reserve in China, holds the most abundant mangrove species, and has been giving the best preservation. We have added such descriptions in our revised manuscript, it reads (161-163): “and (it) is the largest mangrove forest nature reserve in China, holds the most abundant mangrove species, and has been giving the best preservation.”

P5129, r15: “data are” Section 4: modify to present tense. E.g. p. 5130, r. 12 “transects are reported”
P5131, r 15: replace “possible” with “the”
P5131, r 16: replace “underlain” with “underneath” … “and drainage by the sea”?
P 5132 r6-10. This sentence is too long, and the statements require more explanation. I suppose the authors attempt to argue why the seepage face is not permanently located at the creek bed.
P 5132 r 25: replace “but” with “, whereas”
P 5133, r11: this explanation is only reasonable if the high-permeability zone has a good hydraulic connection with the tidal creek, isn’t it? If so, add a statement like this.
p 5135, r 12-16: reallocate towards the end of this paragraph, so that all information about the boundary conditions is provided sequentially.

**Response:**

Thank you very much for above-mentioned comments and suggestions. We have made the corresponding changes as advised.

P 5136, r 1. The first sentence is part of the methods. Which hydraulic conductivities were estimated?

**Response:**

We closely followed your suggestion and reorganized in our revised manuscript (please see lines 454-462). We estimated the saturated freshwater hydraulic conductivity.

P 5138, r3 and 4: Add the unit of the mean gradient
P 5138, r11 “their outcrops” instead of “its outcrop”
P5139, r6. Here starts a very long sentence, which should be split in two or three sentences.
P5139, r15. replace “but” with “Whereas” … “zones”
P5139, r18-19: “…below the ground surface at M7, but remained near ground surface at M1-M6”
P5139, r20: “…filling of the soil pores with air, which improved…”
P5139, r26: replace “a scenario” with “a pattern”
P5140, r11: as mentioned above, I would focus on mangrove development, instead of on bald beaches.
P5140,r13: “water levels”

**Response:**

We closely followed your above-mentioned comments and suggestions and made the corresponding changes as advised. Thank you.

P5140, r15: Explain why the two-layer structure plays a key role (this is not straight forward when having read the current text).

**Response:**
We closely followed your suggestion and improved the section of Conclusions in our revised manuscript, please see **Response 3-1e.** Thank you.

P 5140, r20: “aerated”
**Response:**
Corrected as advised. Thank you.