Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2017-434-AC1, 2017
© Author(s) 2017. This work is distributed under
the Creative Commons Attribution 4.0 License.

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Impact of coastal forcing and groundwater recharge on the growth of fresh groundwater resources in a mega-scale beach nourishment" *by* Sebastian Huizer et al.

Sebastian Huizer et al.

s.huizer@posteo.nl

Received and published: 9 November 2017

"This manuscript deals with a relatively young but interesting field of expertise: the hydrology of large beach nourishments. There is limited scientific research reported to date dealing with this topic, apart from a few earlier papers by these authors (HESS, 2016; WRR, 2017). This manuscript presents interesting (modelling) insights on the development of freshwater bodies below these beach nourishments. The content is scientifically relevant, of good quality, and properly presented. Some minor revisions are, however, required."

We would like to thank the Referee for the comments, which are highly appreciated.

We will improve the raised issues.

General Comments

"1. Being the third modelling paper on this topic in a row. The reader would be pleased with a clear picture of what is presented in which paper and what the differences between the applied groundwater models are. The WRR paper isn't even mentioned in the current manuscript."

Yes, we fully agree with the Referee and have added a brief description of the outcomes of the previous studies, and the connection with this third paper to the introduction.

"2. The reader would be pleased with more quantitative information, mainly in Section 3, especially on the freshwater volume developed. For instance: not 'substantially higher fresh groundwater volumes' (P11, line 11/12), but a percentage of volume increase. Another example: P10, line 20 and 21."

We agree with the Referee, and have provided more quantitative information in Section 3.

"3. Parts of Section 3 would better fit in Section 2."

We agree with the Referee, and have moved parts of section 3 to section 2. See responses to the specific comments.

Specific Comments

"- Title (and rest of manuscript): is 'resources' really the best term? I would associate that with use (abstraction) of the freshwater, which is not the case. Perhaps 'lenses' or 'bodies' are better alternatives"

With this term we wanted to both describe the lens/body of fresh groundwater and stress the potential for the growth of fresh groundwater resources (for abstraction) in mega-scale beach nourishments. However, we agree that 'lenses' fits better with the content of the ms and have changed 'fresh groundwater resources' to a 'fresh ground-

water lens'.

"- Intro: first sentence can be removed"

We have removed the first sentence of the abstract.

"- P1, line 17: remove 'similarly,'"

We have replaced 'similarly' with 'whereas', to highlight the contrast with the previous line.

"- P2, line 2, replace 'clean' by 'high-quality'"

We have replaced 'clean' with 'high-quality'.

"- P2, line 14: do you really mitigate 'climate'? Suggest to replace 'climate' by 'climate change'."

Climate was added as a clarification: mitigating climate change. However, within the context of the paragraph we believe this is an unnecessary addition, and there 'climate' was removed.

"- P3, line 6. remove 'this study analyses' and add 'are analysed in this study' after 'fresh groundwater'"

In response to a comment of Anonymous Referee #2 we have deleted the entire paragraph (L5-12)

"- P3, line 7: remove e.g. and state only what you have analysed"

In response to a comment of Anonymous Referee #2 we have deleted the entire paragraph (L5-12)

"- P3, line 8: 'In this paper are described' instead of 'This paper describes'"

In response to a comment of Anonymous Referee #2 we have deleted the entire paragraph (L5-12)

"- P3, line 26: add 'groundwater' before 'model'"

We have added 'groundwater' before 'model' in line 26.

"- P3, line 29: add 'and salt' after 'fresh'"

We have added 'and salt after 'fresh in line 29.

"- P4, line 10: use 'Aquifer 1a' instead of 'aquifer 1a'. Some holds for 'Monitoring well'. Capitals"

In accordance with the Figures, we have change all references to numbered items (e.g. Aquifer 1a and Monitoring well 1) to capitals.

"- P4, line 24-28: Vague, please add a figure to support this section"

We have definitions of mentioned areas (e.g. foredunes) to Figure 2, and have added a dotted line to Figure 2 that signifies the initial salinity distribution (fresh/salt).

"- P4, 33: replace 'maintain' by 'keep'"

We have replaced 'maintain' with 'keep'.

"- P4, line 34: why is this control of groundwater direction needed?"

This control was needed to prevent a flow of previously infiltrated saline groundwater and possibly contaminated groundwater to the drinking water wells. This is briefly mentioned in the previous sentence as 'prevent any undesirable or unexpected effects of the construction of the Sand Engine to the groundwater quality (e.g. flow of saline groundwater towards pumping wells).

"- P6, line 16: where was the wave set-up and run-up based on?"

The simulation of the land-surface inundations (incl. wave set-up and run-up) was based on a method that was described and evaluated in a previous paper (Huizer et al., 2017). This method was based on the estimation of the wave set-up and run-up heights of a paper of Stockdon et al. (2006). We have added a statement and reference

to this paper to the start of section 2.5.1.

"- P6, line 18-22: make schematization and give max, min, average."

This method was described and evaluated more extensively in a previous paper (Huizer et al., 2017). We have added a statement and reference to this paper to the start of section 2.5.1.

"- P6, line 28: no water level measurements available in the lagoon?"

Yes, in the lagoon we only had water levels for the period of 2 to 23 October 2014 (see Figure 5).

"- P7, line 21: 'smaller-sized' –> quantify"

The model stress period varied between 10 minutes to multiple hours, dependent on observed changes in seawater level. For each stress period the average groundwater recharge was calculated with the hourly precipitation and evaporation. This is likely obvious for most readers, and therefore the line was removed from the ms.

"- P8, line 21: sentence missing?" No, the two dots were a result of a mistake in the handling of track changes. We removed one of the dots, and have rephrased the line after the dots, to create a better connection between the lines.

"- P9, line 8: did you check of these changes in abstraction rates might have occurred?"

No, we were unable to obtain a timeseries of extraction rates for the mentioned period.

"- P9, line 15-21: This part more or less just drops in here. Partly methods..."

We agree, and have moved the part that belongs in the method chapter (lines 15 – 18) to section 2.3, and have connected the remaining lines 18 – 21 to the next paragraph.

"- P9, line 28-29: Please provide more information on this initial groundwater salinity (figure)"

We have definitions of mentioned areas (e.g. foredunes) to Figure 2, and have added

a dotted line to Figure 2 that signifies the initial salinity distribution (fresh/salt).

"- P10, line 1-4: consider to move this to methods section"

We agree, and have moved these lines, together with lines 31-33 on P9, to the methods section.

"- P10, line 21-30: separate field observation and models results. Now, this part is confusing. Start with field observations."

We have modified and rephrased lines 21-30.

"- P11, line 21: A1 or A2? C1 or C2?"

We meant model scenario A2, C1, C2: the water level in het lagoon is less significant than wave set-up/run-up, and the extinction depth.

"- P11, line 29: replace 'will be' be 'was'"

We have added a line before line 29, and replaced 'will be' with 'was therefore'.

"- P12, line 29: quantify"

We have rephrased the line to: '... in the Sand Engine, at the monitoring wells the underestimations range between -0.4 and -0.6 m.'

"- P13, line 6: North Sea salinity: speculative, you don't know if this can really explain deviations"

We agree that we don't know if this can explain the observed deviations, and here the potential influence was probably small. Therefore, we have deleted this statement from the sentence.

"- P13, line 9: Why aren't there more measurements?"

We would have liked to get more salinity measurements, however during the research on the Sand Engine we prioritized other measurements (see previous paper in WRR).

"- P13, line 31: any reference to studies with comparable approach?"

We found a few studies (Falkland and Woodroffe, 2004 and Post and Houben, 2017) that used a comparable approach and added them in section 2.5.3.

"- P14, line 2: what is the basis for 'one to three monthly'"

The topographic surveys were executed every 1 to 3 months in the period of 2011-2016. We have rephrased the sentence to create more clarity.

"- P14, line 3: what is a 'unsaturated groundwater model'?"

We have replaced 'model' with 'flow'. The sentence refers to models that specifically include unsaturated groundwater flow (e.g. Richards equation).

"- P14, line 6: 'the study area' by 'a mega-scale beach nourishment (the Sand Motor)'"

We replaced 'the study area' with 'a mega-scale beach nourishment (the Sand Engine)'

"- P14, line 10: Please introduce these bullets with one sentence."

We have replaced the last dot with a colon to show the connection with the line above the bullets.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2017-434, 2017.