Manuscript **hess-2024-196: "***Effects of boundary conditions and aquifer parameters on salinity distribution and mixing-controlled reactions in high-energy beach aquifers.*"

Correspondence to Rena Meyer (rena.meyer@uni-oldenburg.de)

Author responses to the Editor,

Dear Editor, we thank you for taking the time editing and reviewing our manuscript. We address your valuable comments below point-by-point as indicated by Author Comments (AC) in blue, changes to the manuscript are indicated by "speech mark" and line numbers correspond to the clean version of the revised manuscript.

Kind regards, Rena Meyer

Editor Comments (EC):

1. Line 16. Substitute "twenty-four" with "24".

AC: L.16 has been changed as suggested.

2. Line 37. "The" with lower case after ":"-

AC: L.37 has been changed as suggested.

3. Line 45. Substitute "small" with "fine". I know that "small/big scale" is often used in the scientific literature to denote small or big scale-lengths, but this is wrong, in my opinion. Think to geographical maps. A map at scale 1:1,000,000=10-6 does not show many details: topographic maps at scale 1:10,000=10-4 (i.e., 100 times greater!) provides many more details. Therefore, I prefer to use "fine/large scale".

AC: L.45 has been changed as suggested.

4. Line 58. Substitute "effect" with "affect". "in the field of STE research" could be erased.

AC: L.58 has been changed as suggested.

5. Line 70. Substitute "and analysed the development of redox zones. Greskowiak

et al. (2023)" with ", analysed the development of redox zones, and".

AC: L.70 has been changed as suggested.

6. Line 89. Correct "boundary conditions and parameters a varied".

AC: L.88 has been changed as suggested.

7. Line 90. Rephrase "a specific location. Specifically".

AC: Specifically has been removed.

8. Line 93ff. Substitute "spec. stor." with a symbol, e.g., "Ss".

AC: In the entire manuscript "spec. stor." has been substituted by S_s.

9. Line 105. Substitute “of 350-400 mm/a” either with “of about 350 mm” or with “varying between 350 mm/a and 400 mm/a”. Similar modifications should be introduced in the rest of the paper, where ranges of values are mentioned. Please, follow the recommendation by NIST (https://www.nist.gov/pml/special-publication-811/nist-guide-si-check-list-reviewing-manuscripts), in particular those at point #7.

AC: L.106 has been changed as suggested. The whole manuscript has been checked for inconsistencies in ranges of values and the presentation has been updated according to the mentioned recommendations, throughout the manuscript.

10. Lines 105 & 108. Substitute “approx..” with “approximately”.

AC: Lines 106 and 109 have been changed as suggested.

11. Line 125. Substitute “700 m long” with “700-meters-long”. Substitute “of 2 m each” with “with a uniform horizontal length of 2 m” or something similar.

AC: L. 125 has been changed as suggested.

12. Lines 130 to 132. Such a flux corresponds to the Qf value defined at line 174, doesn’t it? But Qf is not kept constant, it varies for some test cases, as shown in Table 1.

AC: We added (Q_f) to l. 130. Indeed, Q_f is varied in the 24 model cases. As we describe in l. 112 the model set up is described based on the base case and the respective changes made in the 24 model cases are presented in Table 1. The value of the prescribed flux boundary in l. 130 to 132 hence refers to the base case.

13. Lines 131 & 132. Substitute "specified flux of 0.5 m3/day per meter coastline” with “prescribed flux per unit coastline length of 0.5 m3/(d m)”. Correct the measurement units also in Table 1.

AC: L. 132 and Table 1 have been changed as suggested.

14. Line 139. Substitute “Feb-Jul” with “February to July XXXX”, where XXXX should be replaced with the year in which the survey has been conducted.

AC: Lines 139 and 140 has been changed as suggested.

15. Lines 139 & 140. Unify the format for “1m resolution”, “six-month period”, “20a simulation”, and similar expression throughout the whole paper. I would prefer “one-meter resolution”, “six-month-long period” or “ a period of six months”, “simulation for a period of 20 years”.

AC: Throughout the manuscript the format was changed as suggested.

16. Line 161. What is “PHT3D Eq. 1”? Probably, it is sufficient to erase “Eq. 1”.

AC: Eq. 1 has been erased.

17. Line 163. Substitute “;” with “,”.

AC: L. 163 has been changed as suggested.

18. Line 164. Add “,” before “and”. Word “formation” could be substituted with “production” or a synonymous.

AC: Line 164 has been changed as suggested.

19. Line 167. I would prefer “10-7” instead of “1e-7”. Analogous corrections could be done at line 170.

AC: Lines 167 and 171 and Table 1 have been changed as suggested.

20. Lines 167 to 169. Rephrase the sentence “As Rf and Rs… from the value of k”.

AC: We rephrased the sentence to (lines 168 to 171):

“As Rf and Rs were not removed by this processes, the relative differences of the mixing-controlled reaction potential between the different simulation cases are independent from the value of k. Thus the value of k has no further meaning, as long as it is greater than zero.”

21. Line 171. Parentheses are needless.

AC: L. 171 has been changed as suggested.

22. Table 1. I do not understand the 9th column. If there are 3 storm floods per year, with 30 days between storm floods, does this mean that the storm flood has an average duration of about 92 days? In fact, (92 d + 30 d) x 3 = 366 d. Moreover, the description of storm flood modeling is missing, isn’t it?

AC: The duration of each storm flood is 1 day. Usually few storm floods may occur from mid-September to mid-April. Three storm floods with each 30 days in between means that there are three storm floods within the winter season (at day 1, day 31 and day 62). In lines 147-150 the modelling of the storm floods is described. We extended the description by (l. 104):

“The northern beach can be affected by storm floods that reach up to the base of the dunes from mid-September to mid-April, with storm floods most likely to occur in the winter months and lasting for one or two days.”

23. Lines 186 to 189. Expression “(RPc = model cases (Fig. 5)” is quite confusing, it should be rephrased.

AC: we rephrased the section to (l. 188-196):

“The model results were evaluated according to (1) the flow regime visualized as flow lines (Fig. 2, Fig. 3); (2) the TDS distribution shown as snapshots at the end of the simulation (Fig. 3), as well as the standard deviation of the TDS concentration (SD) in each cell over the last 10 years of the simulation period (Fig. 4); and (3) the reaction potential RP_c (Eq. 2) normalized to the absolute maximum Mp_C concentration across all model cases (Fig. 5). Here, RPc is the sum of the accumulated mixing products in each cell (Mp_C) over the last 10 years of the simulation period, calculated by subtracting the accumulated mixing concentration of the first 10 years from the final concentration at the end of the 20 year simulation period .The decision to evaluate SD TDS and RP_c based on the last 10 years of the simulation period was taken to avoid the potential influence of the initial distribution of TDS, Rs and Rf. Therefore, the first 10 years of the simulation period serve as a model spin-up.”

24. Line 192. Erase “Eq. 2”.

AC: L.193 has been changed as suggested.

25. Line 194. Erase “Eq. 3”.

AC: : L.195 has been changed as suggested.

26. Line 198. Erase “Eq. 4”.

AC: : L.200 has been changed as suggested.

27. Figure 2, second line of the figure caption. Add “s” to “month”. Substitute “3” with “three”.

AC: : The caption of figure 2 has been changed as suggested.

28. Line 223. Substitute “finer”, possibly with “more finely”.

AC: L. 225 has been changed as suggested.

29. Line 224. Is “but results otherwise” correct?

AC: L. 226 “otherwise” has been removed .

30. Line 244. Check “focused to”.

AC: The sentence in l. 245 has been changed to:

“The high RP zone was concentrated in the area affected by the storm floods, the deeper USP and the wedge interface (Fig. 5, case 6).”

31. Section 3. I am afraid that comparative adjective (e.g., higher, lower) are often used instead of superlative adjectives (e.g., highest, lowest). Please, check!

AC: We are not sure if we understand this comment correctly. In section 3 we present the results of the 24 simulation cases and compare the cases to the base case. Therefore we use the comparative adjectives. We are not aware of what should be changed here. We added (l.210):

“The results of the different model variants were compared to the base case.”

32. Lines 322 & 323. Rephrase sentence “Cluster A (red circles) had a γ (+/- 20%) and RPM (+/-20%) similar to the base case (located at the coordinates 1,1 in the plot in Fig. 6)”, possibly as “Cluster A (red circles) is characterized by relatively small variations of γ and RPM with respect to the base case, namely variations in the range from -20 % to +20 %. In Figure 6, the base case corresponds to the point with coordinates (1,1)”.

AC: Lines 324 to 325 have been changed as suggested.

33. Line 324. Substitute “40-95 %” with “by more than 40 %”. Substitute “30-70 %” with “by more than “30 %”. See comment # 9.

AC: L. 326 has been changed as suggested.

34. Lines 327 & 328. Expression “was characterized by a lower γ, reduced by 40-80%, while keeping a RPM (+/-20%) similar to the base case” should be rephrased, possibly as “was characterized by values of γ reduced by more than 40 %, while RPM remains close to the base case (variations in the range from -20 % to +20 %)”.

AC: Lines 327 and 328 have been changed as suggested.