

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

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Author responses to Reviewer #1.

Dear Reviewer #1 we are happy that you are overall satisfied with the changes of our revised manuscript. We thank you for a second round of review and address your valuable remaining 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

Reviewer Comments (RC)

1. As a suggestion, it might be worth adding a small sentence at the end of the abstract that describes the impact these findings have on coastal science in a broad sense.

AC: We extended the abstract and highlight the broader relevance of our findings for costal research:

“ The present study advances the understanding of subsurface flow, transport and mixing processes that are dynamic beneath high-energy beaches. These processes control biogeochemical reactions that regulate nutrient fluxes to coastal ecosystems.”

2. The authors added the sentence, “The decision to assess SD TDS and RP_c based on the final 10a of the simulation period was taken in order to circumvent the potential influence of the initial distribution of TDS, R_s , and R_f .” In line 185. Although this sentence addresses the possible influence of initial conditions, it is not clearly mentioned that the accumulated mixing concentration before the 10 years was subtracted from the final 20-year simulation concentration. I recommend adding this information as it might cause some confusion for the reader.

AC: We added the explanation how M_{pc} of the last 10a was calculated to the corresponding sentence in line 185:

“The model results were evaluated according to [...] (3) the reaction potential (RP_c = sum of the accumulated mixing products in each cell (M_{pc}) over the last 10a of the simulation period, calculated by subtracting the accumulated mixing concentration of the first 10a from its final concentration of the 20a simulation) normalized to the absolute maximum M_{pc} concentration across all model cases (Fig. 5).”

3. The sentence in line 320: “Cluster B included the less dynamic and more stable cases with a lower γ ,...” sounds redundant; consider rewording it.

AC: We rephrased the sentence to (l. 321):

“ Cluster B (dark blue circles) showed a lower γ , reduced by 40-95%, and a lower RPM, reduced by 30-70%, compared to the base case. Cluster B contained the less dynamic and more

stable cases with either changing topography only (and no storm floods, case 21) or only storm floods (and no changing topography, case 2) or neither (case 1) and the low K case (case 5). Cluster C (light blue circles) was characterized by a lower γ , reduced by 40-80%, while keeping a RPM (+/- 20%) similar to the base case.”

4. In the sentence in line 370: “... resulting in less variable salt patterns and less reactive conditions than the base case (cluster B) or less variable salt patterns but still reactive conditions compared to the base case (cluster C).” What do the authors mean by “still reactive conditions,” consider removing the word “still.”

AC: We removed “still” as suggested (l.371).

Dear Reviewer #2, we are happy that you are satisfied with our revised manuscript and accepted it.