



Review Report for

Observations of the dynamics of mixed sediments on a nourished beach in a mixed-energy environment

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Round 1 Review

Comments by reviewer 1 (Francisco Sancho)

Completed: 2025-03-13 05:00 PM

Recommendation: Minor revisions

Reviewer Comments

For editor only

The manuscript is of very high quality. I recommend accepting it, with very minor corrections, taking into account the specific comments written in the attached file.





Comments by reviewer 2 (Dominique Townsend)

Completed: 2025-03-31 08:15 PM

Recommendation: Minor revisions

Reviewer Comments

For author and editor

The paper seeks to expand our knowledge on mixed sediment sorting which is largely based on open coasts, in a sheltered mixed energy environment. It aims to understand any patterns in longshore or cross-shore sediment sorting/armouring in relation to the driving hydrodynamic conditions. It does this through the systematic sampling of particle size distribution and mean grain size and variation at a number of locations over time, as well as considering the mobility of bed sediments and sediment transport using wave and current data recorded across the site. The study concludes that there is little evidence of the surficial sediments becoming more sorted (in any dimension) overtime, despite observed net northwesterly transport.

This is an interesting piece of work with valuable detail in the understudied area of mixed sediments. The methods give valuable insight into variation in mixed sediment composition across the study site over short-medium time-scales in a mixed-energy environment, and the accompanying analyses are thorough. I think this work is relevant to the Geomorphica readership and merits publication with some minor revisions, largely relating to strengthening the discussion and in some instances detail/clarity for the reader, based on the general and specific comments provided below.

General comments:

The authors make a good case for investigating sandy retrofits in the introduction, however, this isn't revisited within the discussion at all. This makes the paper feel a little disjointed. What are the impacts of your learning for sandy retrofits? Do you recommend continued use mixed sediment/crushed shell, or not?

What in your definition is 'poorly sorted'? Can this be described somewhere or referenced. The use of D50 etc to describe bi and polymodal sediments is also not discussed.

Perhaps I have missed it, but grain sizes are consistently larger at the -0.8m NAP – is this discussed anywhere?

I would consider renaming your samples for something more memorable for the reader, or give them a table to summarize what data was recorded when and where. This could go in the introduction to the methods, as it was something that I kept having to go back and check.

You collected data in a five week period from September – October 2021. Had any large storms occurred prior to this period or were the antecedent conditions of the experiment representative of a typical summer (low energy) period?





Based on your final paragraph of the discussion, do you consider time to be the most important factor in sorting sediments? Or is it the ability of some of the sediment fraction to be transported some of the time as with sorting on seasonal composite beaches?

Minor Comments:

Line 34: is this sand more dynamic than other sand of the same size in another location, or has the material been placed in an area which suffers from chronic erosion?

Lines 39 -40: You are illustrating a general point with a specific example. Either simplify the statement (larger grains require greater energy) so that the statement is always true or change the sentence to show that it is referring to a singular site which is representative for a set of conditions (e.g. on macrotidal coasts).

Lines 41-43: when what is mixed together?

Line 47 (and 59): Sand diffuses in what sense? Do you mean transported? Or sandy retrofits are eroded?

Line 48 Use of word 'they' = what?.

Lines 47-51: Provide more detail on the sorting processes themselves. E.g. how does vertical sorting lead to spatial sorting across and along the coast.

Line 52: why is the previous century a relevant time period to consider? Remove if not giving context.

Line 54: Are abbreviations really necessary? GS is very similar to GravelSand which could be confusing for the reader.

Line 55: Two is not many.

Line 59 can you give a reference for this?

Line 62: even during calm periods, are these very dynamic coasts?

Line 64: reference?

Line 63: Replace "these" with tidal basins.

Line 67: Reference.

Line 68: is this in contrast to the tidal basins or are you talking about the beaches within tidal basins?

Line 70: Be more specific, what differences, what findings?

Line 84: Prince?

Line 85: i.e. does not need a comma after it, as goes for the others like this in the document. Also is Texel not an island? Replace mainland with southern.

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Line 99: to the west of the nourishment.

Line 114: Where is this?

Line 120: prevent => reduce

Figure 2: You start at figure 2. Please update this and the other figures and text throughout the document. It would be helpful if you add onto the figure other areas which are mentioned in the text, e.g. the jetty.

Lines 127 to 131: reference the figure showing these locations and each respective method section here.

Line 132: a table or figure summarizing exactly what you collected over what dates would be really helpful.





Line 134: why did you chose these two heights?

Line 137: what is a top sample?

Line 190: 'carried out on behalf of the contractor' => 'carried out on our behalf by a contractor'.

Line 196: to what approximate depth?

Line 226: Give an overview of what is being described below. It is important to state clearly that you are only looking at bedload, and (perhaps later) consider the implications of this on your findings.

Lines 257 – 260: As with previous section, give references to other sections to help the reader.

Figure 3: Is it possible to include the particle size distributions for all longshore sites as you do with the current/wave roses? Where are S1-S8? Is the intertidal area not by definition the area between high and low tide?

Figure 4: What is the orange shading?

Line 287: Was there longshore variation in the shell content? In the introduction is it mentioned that more was placed in one location over which coincided with an exclusion of the 1m thick wear layer.

Line 291: across => along

Line 295: more comparable to what?

Figure 5: Include that A1-3 and B1-3 are recorded at different dates. Can you show the locations of bar and runnel on another figure? What date were they recorded?

Figure 8: Nice figure, it would be more helpful for the reader if they were placed in the order they are seen on the map (e.g. from West to East, rather than back to front).

Line 318: These are estimates not measured values, indicate that. Also please clarify what 'three beach average critical value' is for the reader.

Lines 329 – 333: other than guessing from Figure 8, do you explain these accronyms anywhere?

Line 371: as it flattened, the upper part of the beach also lowered, possibly by up to -0.5m looking at Figure 10a.

Line 399: This sounds like sorting was occurring?

Line 407-409: Is this what your work found? Refer to a figure.

Line 409: Why?

Line 412 – 413: Introductory material.

Line 415: How could the rates decline (infinitively) overtime? What would the steady state be?

Line 429: how is this indirectly?

Line 435: Is this what the samples showed? What does a typical planar laminae look like? How thick is it? Is the resolution of your sampling method high enough to detect this?

Line 441: Other sites have shown sorting to occur over very short timescales, so perhaps mature is not the appropriate word here.

Line 442: This statement is not a logical result of the prior sentence.

Line 443: What are you trying to say here?

Line 445: what was (quantitively) previously expected from the protective wear layer, and by who?

Line 464: define long term.





Recommendation by Associate Editor 2 (Yakup Niyazi)

Completed: 2025-04-08 08:02 PM

Recommendation: Minor revisions

Reviewer Comments

For author and editor

Dear authors,

I read with interest your manuscript entitled “Observations of the dynamics of mixed sediments on a nourished beach in a mixed-energy environment”, as well as the reviews from two anonymous reviewers. Based on my reading of your manuscript and the reviews, I would like to recommend for the manuscript to be accepted after minor revisions.

I had read the manuscript with great joy, as it was written in a logical way and transitioned from general to specific questions in a resealable way. I agree with the reviewers and the manuscript could be published after the comments are addressed well.

Best wishes

Anonymous Associate Editor





Decision by EiC (Alice Lefebvre)

2025-04-10

I would like you to undertake a minor revision of your manuscript.





Authors' responses to review comments

Response to the reviewers

[Line numbers] refer to the numbering in the 'tracked' manuscript version.

Reviewer 1

Comment 1: In order to improve the understanding of lines 92-101, I suggest presenting an additional figure with one or two (at a different transect) beach cross-shore profile(s), from the lower foreshore up to the sand dike or dune, ideally covering both the sand spit, the enclosed lagoon and the land-side beach plus dike. The profile shown in fig. 10a does not cover all these regions and is not referred to within those manuscript lines. Answer 1: We appreciate the reviewer's suggestion and agree that additional profiles could improve the reader's spatial understanding. However, as the focus of this study is specifically on the beach face, we have opted not to include more (extensive) profiles that go beyond this scope. In addition, given the already substantial number of figures in the manuscript, we tried to avoid overloading the reader with supplementary visuals.

Comment 2: Line 133: Can the authors elaborate why they chose 5cm deep for the sediment sampling, instead of a deeper core? Answer 2: A compromise had to be made between the quality and quantity of the sediment data. Deeper sediment samples would require less manageable instruments, be more labor intensive and take much longer to process, while a high sample density was crucial for this study. Furthermore, it was assumed that this upper part of the sediment bed represents reasonably well the 'active layer' exposed to and interacting with the flow. This explanation has been added to section 3.1.1. [169–171].

Comment 3: Line 203: The sediment density is given as 2650 kg/m³. Was this a measured value or just assumed? If the latter, couldn't the average density be different (greater or smaller) given the fact that the sediment encompass both carbonates (/shells) and (quartzitic?) sand? Answer 3: The densities of the siliciclastic and carbonate particles at the study site have not been measured directly. However, in another (flume) study, related to this one, we measured the particle densities of typical North Sea sand and shells with a pycnometer. These turned out to be quite similar, mostly varying from 2600 to about 2800 kg m⁻³ (Haarbosch et al., 2023; <https://resolver.tudelft.nl/uuid:55717f87-9db6-4236-a11a-2388ae8444f7>). Based on this information, we decided to assume equal densities for the two types of particles. This explanation has been added to section 3.1.1. [203–205].

Comment 4: Lines 263-265: Please, verify whether you mean “marked ebb dominance” instead of “marked flood dominance”. In my understanding of the figures and site location, fig. 3b shows higher southwest oriented velocities (at L1, L3, L4, L5) than northeastern ones. That is, southwest flows (occurring at ebb flow towards the closed wester inlet) are stronger than northeast (during floods) flows.

Answer 4: The spokes in the rose diagrams indicate the direction from which the currents and waves came, implying that they propagated in the opposite direction. This is briefly mentioned in the figure caption. Nevertheless, we have added an extra line [330] in the main text to clarify this.

Comment 5: Fig. 3: since fig.3a is rotated approx. 45° clockwise, so that the north points towards N-45-E, I suggest that It would improve the reading if all sub-figures b) and c) were also rotated the same amount, to facilitate compatibility and easiness of relation between fig.3a and the others. Answer 5: The reviewer raises a valid point here, which also initiated a discussion among the (co-)authors. We initially decided to keep the rose charts upright, as we felt that tilting them to match the elevation map might make them harder to read for some viewers. However, this feedback has made us





reconsider, and we have now adjusted the orientations of the rose charts to align with the tilted elevation map.

Comment 6: Fig. 3d caption: Reference is made to sampling at 7 october 2021, but in Fig. 6 there is no reference to the 7 october campaign (only 6th and 8th). Please, check and correct if necessary. Answer 6: We thank the reviewer for this sharp observation. We fixed the date, which should actually be 21 September 2021. This sampling session is also indicated in Fig. 4a.

Comment 7: Fig. 6: I suggest to include in the caption a final “note” such as “Note the horizontal axis scale differences in the line plots”. Answer 7: Completely agree. Suggestion adopted.

Comment 8: Fig. 8: I suggest swapping L1 graph with the L6 one, in order to (mentally and spatially) relate with the W → E locations. Also, the horizontal axis labels are missing. Answer 8: Suggestions adopted. Labels fixed.

Comment 9: References: please, check whether all references are complete. For instance, reference in lines 486-487 seem to be incomplete. The same for Nordstrom et al. (lines 530-531). Answer 9: Reference data checked and added where necessary.

Reviewer 2

Comment 1: The authors make a good case for investigating sandy retrofits in the introduction, however, this isn't revisited within the discussion at all. This makes the paper feel a little disjointed. What are the impacts of your learning for sandy retrofits? Do you recommend continued use mixed sediment/crushed shell, or not? Answer 1: The reviewer raises a valid point here. We now address the implications of

our findings to sandy retrofits in the final paragraph of the Discussion section [546–555]: The effectiveness of implementing a coarse, poorly sorted sediment mixture and initial armor layer is highly dependent on the local forcing conditions at the nourishment site and requires a tailor-made approach, especially if ecological goals are also involved. Even on the relatively sheltered PHZ beach, the applied armor layer was quickly mobilized, resulting in surface characteristics that more closely resemble the underlying sediment core. While this study does not provide definitive insights into long-term morphologic changes, the observed response to a higher-energy event – particularly changes in the cross-shore bed profile and grain sizes exposed at the surface – suggest that storm frequency and the duration of calm periods could play a substantial role in the system's evolution over time.

Comment 2a: What in your definition is ‘poorly sorted’? Can this be described somewhere or referenced. Answer 2a: The definition of ‘poorly sorted’ was briefly indicated in line [311] of the original manuscript but we agree that this could have been explained earlier in the Methods section. Therefore, a few extra lines [194-196] have been added for clarification, stating that the threshold for considering a mixture as poorly sorted is $\sigma G \geq 2$.

Comment 2b: The use of D50 etc to describe bi and polymodal sediments is also not discussed.

Answer 2b: We acknowledge that the D50 can be problematic for describing bi- and polymodal sediments. Nevertheless, given its widespread use among sedimentologists and engineers, and its role as a standard input parameter in most transport equations, we chose to use D50 and other standardized metrics in this study to ensure consistency and comparability. That said, additional descriptors, such as modal grain sizes, can also provide valuable insights and we plan to incorporate them in future work. This explanation has now been added to the Discussion section [525–529].

Comment 3: Perhaps I have missed it, but grain sizes are consistently larger at the -0.8m NAP – is this discussed anywhere? Answer 3: That is largely correct. A line [375] is added describing this; Overall,





grain sizes were larger at the lower (-0.8-m) isobath, except for the two southernmost locations (Tmb-L6).

Comment 4: I would consider renaming your samples for something more memorable for the reader, or give them a table to summarize what data was recorded when and where. This could go in the introduction to the methods, as it was something that I kept having to go back and check. Answer 4: The reviewer is thanked for this helpful suggestion. We agree that the sample naming could be more intuitive, and we have now added a summary table (new Table 1) at the beginning of the Methods section. This table clarifies the sample name prefixes

and includes details such as location, timing and total number of samples. Please note that the timing of the cross- and longshore samples is also indicated in Fig. 4a.

Comment 5: You collected data in a five week period from September – October 2021. Had any large storms occurred prior to this period or were the antecedent conditions of the experiment representative of a typical summer (low energy) period? Answer 5: The last major storm to impact the study site occurred in February 2020, as reported by the Royal Netherlands Meteorological Institute (<https://www.knmi.nl/kennis-en-datacentrum/uitleg/archief-code-oranje-rood-in-2021>), well before the start of the field campaign. Furthermore, water level data recorded by the official measuring station in Oudeschild, located some 3 km northeast of the PHZ, show no evidence of significant storm surge events in the months prior to the fieldwork period. This aligns with the typical seasonal pattern in the Netherlands, where the storm season runs from 1 October to 1 April. We therefore conclude that the antecedent conditions of the experiment were representative of a typical summer low-energy period. This information has now been added to section 3.1 [160–166].

Comment 6: Based on your final paragraph of the discussion, do you consider time to be the most important factor in sorting sediments? Or is it the ability of some of the sediment fraction to be transported some of the time as with sorting on seasonal composite beaches? Answer 6: We thank the reviewer for this insightful question. While time is certainly essential in developing well-sorted sediment patterns, it is most effective under relatively stable forcing conditions. Similar to what has been described for seasonal composite beaches, the sorting patterns (or lack thereof) on the PHZ beach face appear to be governed more by the intermittent transport of specific sediment fractions, driven by the local hydrodynamic variability and episodic high-energy (storm) events, than by time alone. A key distinction between the PHZ and seasonal composite beaches may be the degree of intermittency. At the former, intermittent transport likely occurs more frequently, as the critical motion thresholds for the range of grain sizes in this mixture (medium to very coarse sand) are closer together compared to those on a typical sand-gravel beach. This likely promotes more continuous reworking and results in more transient sorting patterns. We have now included this discussion point in the Discussion section [532–540].

Comment 7: Line 34: is this sand more dynamic than other sand of the same size in another location, or has the material been placed in an area which suffers from chronic erosion? Answer 7: Mostly the latter. The sentence [34–35] has been modified to emphasize this.

Comment 8: Lines 39 –40: You are illustrating a general point with a specific example. Either simplify the statement (larger grains require greater energy) so that the statement is always true or change the sentence to show that it is referring to a singular site which is representative for a set of conditions (e.g. on macrotidal coasts). Answer 8: The latter proposal has been adopted, and we now start this sentence with “On macrotidal coasts...”.





Comment 9: Lines 41-43: when what is mixed together? Answer 9: We now understand the confusion resulting from this sentence. The phrase in line [43] has been changed to “when fine and coarse grains are mixed together”.

Comment 10: Line 47 (and 59): Sand diffuses in what sense? Do you mean transported? Or sandy retrofits are eroded? Answer 10: Both are true in a sense. In the short term, it is the rate at and distance over which the various sand fractions are transported that matters. This in turn creates spatial differences in the bed composition in the long term, which further affects the sediment pathways and thus how sandy retrofits are eroded. To clarify this in the manuscript, we changed ‘diffuses’ to ‘transported’ [50] and ‘diffusion’ to ‘transport’ [69].

Comment 11: Line 48 Use of word ‘they’ = what? Answer 11: ‘They’ is changed to ‘These mechanisms’ [50].

Comment 12: Lines 47-51: Provide more detail on the sorting processes themselves. E.g. how does vertical sorting lead to spatial sorting across and along the coast. Answer 12: We have rewritten part of this paragraph [50-55] to more clearly address the relationship between vertical and spatial sorting.

Comment 13: Line 52: why is the previous century a relevant time period to consider? Remove if not giving context. Answer 13: Phrase removed.

Comment 15: Line 54: Are abbreviations really necessary? GS is very similar to GravelSand which could be confusing for the reader. Answer 15: GS (grain size) is no longer abbreviated.

Comment 16: Line 55: Two is not many. Answer 16: Removed ‘e.g.’ and added more references [60, 64] to substantiate that claim.

Comment 17: Line 59 can you give a reference for this? Answer 17: Reference added [71]: Arriaga et al., 2020; doi:10.3390/jmse8120965.493.

Comment 18: Line 62: even during calm periods, are these very dynamic coasts? Answer 18: This does not apply to coarse gravel beaches. However, along the Holland Coast, the beaches are composed primarily of fine sand and are known to be morphologically very dynamic. We have revised the sentence to make it more specific [74-75].

Comment 19: Line 64: reference? Answer 19: This statement is also based on the references given at the end of the sentence.

Comment 20: Line 63: Replace “these” with tidal basins. Answer 20: Suggestion adopted and phrase slightly rewritten [77]: “Tidal basins are mixed-energy environments often characterized by strong tidal currents”.

Comment 21: Line 67: Reference. Answer 21: Reference added [82]: Vila-Concejo et al., 2024.

Comment 22: Line 68: is this in contrast to the tidal basins or are you talking about the beaches within tidal basins? Answer 22: Sentence clarified by specifying ‘beaches in tidal basins’ [82].

Comment 23: Line 70: Be more specific, what differences, what findings? Answer 23: Differences are now explicitly mentioned [85].

Comment 24: Line 84: Prince? Answer 24: That is correct. Changed ‘Prins’ to the English translation ‘Prince’ [101].

Comment 25a: Line 85: i.e. does not need a comma after it, as goes for the others like this in the document. Answer 25a: The use of a comma after ‘i.e.’ follows standard style guides such as APA, Chicago and MLA, and is also used this way in the Geomorphica manuscript template.

Comment 25b: Line 85: Also is Texel not an island? Replace mainland with southern. Answer 25b: The term ‘mainland’ could indeed be ambiguous in this context. Changed it to ‘Wadden Sea (basin) side’ rather than simply ‘southern’, as this conveys both the orientation and the intended contrast with the North Sea side [103].





Comment 26: Line 92: NAP? Answer 26: That is correct, we missed that one. Added the vertical datum and made it slightly more specific [111].

Comment 27: Line 94: Opposite of what? Also 'On the seaward side'. Answer 27: Clarified the morphologic situation [114]. Changed 'sea side' to 'seaward side' [116].

Comment 28: Line 99: to the west of the nourishment. Answer 28: Suggestion adopted and sentence slightly rewritten [122].

Comment 29: Line 114: Where is this? Answer 29: Replaced the name of the shoal ('Schanserwaard') by what it is ('the underlying subtidal platform') [137], so that the reader knows what is meant right away.

Comment 30: Line 120: prevent => reduce Answer 30: Suggestion adopted [144].

Comment 31a: Figure 2: You start at figure 2. Please update this and the other figures and text throughout the document. It would be helpful if you add onto the figure other areas which are mentioned in the text, e.g. the jetty. Answer 31a: Fig. 1 is referred to twice before [104, 126] Fig. 2 is mentioned [146] in the original manuscript, which means the current order of figures is correct. The current close placement of Figs. 1 and 2 can lead to confusion. This can be remedied by the editors in the final version.

Comment 31b: Figure 2: It would be helpful if you add onto the figure other areas which are mentioned in the text, e.g. the jetty. Answer 31b: Additional labels added to Fig. 1.

Comment 32: Lines 127 to 131: reference the figure showing these locations and each respective method section here. Answer 32: Added references to the figures in the corresponding data descriptor paper [152-157].

Comment 33: Line 132: a table or figure summarizing exactly what you collected over what dates would be really helpful. Answer 33: See Comment/Answer 4.

Comment 34: Line 134: why did you chose these two heights? Answer 34: The NAP-0.8m samples were collected at approximately the same elevation as the longshore ADV array, allowing the measured flow characteristics to be directly associated with the local bed properties. This information has now been added to the Methods section [173-175]. In addition, the 0-m isobath was selected to provide comparative data in the cross-shore. Due to a tight field schedule, it was not feasible to collect additional samples at that time.

Comment 35: Line 137: what is a top sample? Answer 35: Changed it to 'surface sediment samples' to increase clarity [179].

Comment 36: Line 190: 'carried out on behalf of the contractor' => 'carried out on our behalf by a contractor'. Answer 36: The nourishment contractor actually hired an outside party to perform these measurements, but on second thought this is redundant information. Changed the phrase to 'carried out by the dredging contractor' [241].

Comment 37: Line 196: to what approximate depth? Answer 37: Added 'at approximately NAP-1.5m' [248] to specify the approximate depth.

Comment 38: Line 226: Give an overview of what is being described below. It is important to state clearly that you are only looking at bedload, and (perhaps later) consider the implications of this on your findings. Answer 38: The reviewer is thanked for this valuable suggestion. We agree that it is important to clarify the focus on bedload transport. We have now explicitly stated at the beginning of Section 3.2.2 that our analysis considers only bedload [279-282] and why: For gravel-sized particles (>2 mm), transport occurs almost exclusively as bedload. Even for coarse sands (>0.3 mm), bedload remains the dominant transport mode and is only accompanied by suspension under extreme wave and current conditions (Soulsby and Damgaard, 2005:





<https://doi.org/10.1016/j.coastaleng.2005.04.003>). The implications of this are now also briefly addressed [282–284]: Total transport during extreme weather events may be underestimated if suspended load is not considered (Huisman et al., 2018:

<https://doi.org/10.1016/j.coastaleng.2017.11.007>).

Comment 39: Lines 257 – 260: As with previous section, give references to other sections to help the reader. Answer 39: Section references are added [319, 321, 323, 326].

Comment 40a: Figure 3: Is it possible to include the particle size distributions for all longshore sites as you do with the current/wave roses? Answer 40a: Including particle size distributions for all longshore locations in Fig. 3 was considered but would have significantly increased the visual complexity of the figure, potentially making it more difficult to interpret. To maintain clarity and focus, we chose to present only a representative subset. For the complete set of sediment data, the interested reader is referred to the associated data paper (Van der Lugt et al., 2024: <https://doi.org/10.5194/essd-16-903-2024>).

Comment 40b: Figure 3: Where are S1-S8? Answer 40b: Sampling locations S1-S8 coincide with L2 on the map.

Comment 40c: Figure 3: Is the intertidal area not by definition the area between high and low tide?

Answer 40c: We defined the intertidal area as the zone between mean high water and mean low water, so that the maximum tidal range indicates the recorded extremes (during spring tide).

Comment 41: Figure 4: What is the orange shading? Answer 41: The orange shading was added to aid visualization of wave approach angles, with darker (lighter) tones indicating more perpendicular (oblique) wave incidence. However, we now understand that it may cause confusion. To improve clarity, we replaced the shading with a horizontal dashed line indicating the direction of shore-normal wave approach.

Comment 42: Line 287: Was there longshore variation in the shell content? In the introduction is it mentioned that more was placed in one location over which coincided with an exclusion of the 1m thick wear layer. Answer 42: A thin shell layer with patches of shells on top was initially placed on top of the spit (Fordeyn et al., 2019), leaving the southern beach relatively sparse in shell material. However, shell fragments quickly dispersed across the site, including the southernmost area. We observed both longshore and cross-shore variations in shell content, largely driven by transient shoreline formations formed through wave action. It should be noted that shell content was measured in only a limited selection of samples.

Comment 43: Line 291: across => along Answer 43: Suggestion implemented [360].

Comment 44: Line 295: more comparable to what? Answer 44: Added 'to each other' [366] to clarify that the statement is about the sediment samples taken on the same isobath.

Comment 45: Figure 5: Include that A1-3 and B1-3 are recorded at different dates. Can you show the locations of bar and runnel on another figure? What date were they recorded? Answer 45: Added dates and location data to the figure caption. In addition, the sampling location of the bar and runnel is now shown in Fig. 3a, indicated by an asterisk, and mentioned in the caption.

Comment 46: Figure 8: Nice figure, it would be more helpful for the reader if they were placed in the order they are seen on the map (e.g. from West to East, rather than back to front). Answer 46: Suggestion adopted: plot order is changed.

Comment 47a: Line 318: These are estimates not measured values, indicate that. Answer 47a: The reviewer raises a valid point here. Changed 'Time series' to 'The estimated time series' [390].





Comment 47b: Line 318: Also please clarify what ‘three beach average critical value’ is for the reader. Answer 47b: Changed the phrase to ‘the average critical values for the D10, D50 and D90 grain size percentiles’ [390] to clarify what it is about.

Comment 48: Lines 329 – 333: other than guessing from Figure 8, do you explain these accronyms anywhere? Answer 48: The acronyms were explained in the caption of Table 1. However, we agree that they require a more prominent placement and have therefore added an explanation to the main text, in lines [401-403].

Comment 49: Line 371: as it flattened, the upper part of the beach also lowered, possibly by up to - 0.5m looking at Figure 10a. Answer 49: Although a lowering of the upper beach was implied by the term ‘flattening’, we recognize that specific amount of lowering was not clearly stated. This is now added in line [449].

Comment 50: Line 399: This sounds like sorting was occurring? Answer 50: ... Fig. 12b → Fig. 12. The reviewer raises another valid point here. We agree that the original wording may have overstated the absence of correlation. Fig. 12 indeed shows a recurring pattern in the two 2nd quadrants (upper left planes), which suggests some degree of sorting. However, given the relatively large spread in the data and the expectation that sorting processes would lead to increased sample uniformity (i.e., negative $\Delta\sigma G$), we chose to interpret these patterns cautiously.

Comment 51: Line 407-409: Is this what your work found? Refer to a figure. Answer 51: These lines do not necessarily form a statement evidenced in this manuscript, as no measurements are compared between the PHZ and an open-coast beach. Instead, they repeat something from the Introduction, serving to set the stage for the subsequent discussion. We now refer to Fig. 8 to substantiate this [489].

Comment 52: Line 409: Why? Answer 52: Threshold conditions, combined with a significant contribution from (tidal) currents, facilitate preferential transport of the more easily entrained finer sediment fractions – particularly under conditions of tidal asymmetry and a dominant wave incidence angle. As this was not clearly explained in the original text, we have revised a few lines [491-493].

Comment 53: Line 412 – 413: Introductory material. Answer 53: We agree with the reviewer’s comment and have removed these lines.

Comment 54: Line 415: How could the rates decline (infinitively) overtime? What would the steady state be? Answer 54: The reviewer is correct that the original sentence was incomplete and could be interpreted wrongly. To improve clarity, we replaced ‘progressively’ with ‘gradually’ and added the phrase ‘...until a steady state is reached, in which the finest fractions are gone’ [498].

Comment 55: Line 429: how is this indirectly? Answer 55: The effect described is indeed ultimately a direct consequence of wave action. However, our original intention with the term was to highlight that, beyond the direct mobilization of grains by waves, by initiating sediment movement on a slope, which then continues under gravity, waves indirectly lead to grain accumulation, hence bed composition change, at the base. To avoid confusion, we have removed the word ‘indirectly’ from the sentence.

Comment 56: Line 435: Is this what the samples showed? What does a typical planar laminae look like? How thick is it? Is the resolution of your sampling method high enough to detect this? Answer 56: The sand scraper samples had a vertical resolution ranging from 2 to 6 mm, which is sufficient to detect less than cm-scale stratification features. Typical laminae formed in swash zones are often several mms to cms thick, which is within the detectable range. The observed layering in our beach face samples is to a certain degree consistent with swash-laminated sands (Shan et al., 2015:





<https://doi.org/10.1016/j.sedgeo.2015.04.010>). This explanation has been added to the Discussion [519–520].

Comment 57: Line 441: Other sites have shown sorting to occur over very short timescales, so perhaps mature is not the appropriate word here. Answer 57: Sorting indeed occurs over very short timescales, also on the PHZ. However, the emerging sorting patterns on the PHZ are never long lasting. We replaced the phrase ‘mature sorting patterns’ with ‘stable sorting patterns, [532] to emphasize the intended condition of sustained sorting over an extended period.

Comment 58: Line 442: This statement is not a logical result of the prior sentence. Answer 58: The reviewer is thanked for pointing that out. The statement in line 442 is not a consequence of the preceding sentence but rather offers a more detailed explanation. Removing the phrase ‘As a result,’ has eliminated this ambiguity.

Comment 59: Line 443: What are you trying to say here? Answer 59: The key message is that the PHZ system maintains its own continuous accessibility to ‘transportable’ grains, while gradients in forcing drive morphologic dynamics. Considering the reviewer’s multiple comments on the final paragraph of the Discussion, we recognize that the original text may have caused confusion. To improve clarity and better convey our intended message, we have revised the paragraph accordingly.

Comment 60: Line 445: what was (quantitatively) previously expected from the protective wear layer, and by who? Answer 60: There is no documented quantitative expectation regarding the protective wear layer over the timescales considered in this study. This initial statement was based on personal communication with the contractor and expert judgment. In retrospect, we recognize that our original wording was too specific. A broader perspective, considering the poorly sorted nature of the PHZ beach face, would have been more appropriate. This has been addressed in the revised text [543-545].

Comment 61: Line 464: define long term. Answer 61: By ‘long term’ we referred to a period exceeding 5-10 years. We initially believed that, since our field data comprises a broad range of weather conditions, our

observations could be extrapolated over a longer timeframe. However, upon further consideration, we recognize that this assumption may be too strong for the scope of the present study. Therefore, we have replaced ‘long-term’ with ‘short- to medium-term’ [573].

Managing editor

Comment: The “Land Recognition” and “Permission to Reproduce Material from Copyrighted Sources” sections are missing from your submitted title page. All sections in the title page template are required upon submission and acceptance. Please refer to our Author Guidelines and the instructions provided in those sections of the title page template. Answer: The two missing sections have now been added to the title page.





Round 2 Review

Recommendation by Associate Editor 2 (Yakup Niyazi)

Completed: 2025-06-09 05:20 AM

Recommendation: Accept

Reviewer Comments

For author and editor

Dear authors,

I read with interest your manuscript entitled "Observations of the dynamics of mixed sediments on a nourished beach in a mixed-energy environment", as well as your response to the comments from reviewers. Based on my review of your revised manuscript, I recommend that the manuscript be accepted.

Best wishes





Decision by EiC (Alice Lefebvre)

2025-06-12

Congratulations! I am pleased to inform you that your manuscript entitled "Observations of the dynamics of mixed sediments on a nourished beach in a mixed-energy environment" has been accepted for publication in Geomorphica.

