1. Introduction

This is my first time reviewing this manuscript, and my assessment has been conducted independently without taking earlier versions and previous referee comments into account.

Using a numerical case study, this paper investigates the dispersal of river-derived sediment over a continental shelf. It does well to provide insights into the spreading of sediment from the river plume over the coastal shelf, taking several processes, such as tides, waves and wind into account. While I think the paper does provide new insights into these main dispersal mechanisms, I think the attempt to form a generalised interpretation is currently not attained, and it might be more appropriate to shift the focus more to the specific case that is investigated. As I do see the value of the developed model and the on/off sensitivity analysis of several model aspects, I think a more careful presentation of the results is required for suitable embedding. Therefore, I recommend publication of the manuscript after major revision.

2. General Comments

Clarification of "Overestimation" and "Underestimation"

The manuscript frequently refers to the "overestimation" or "underestimation" of sediment-related quantities (e.g., deposition, resuspension, retention, and bed shear stress) in several instances (e.g., lines 24, 27, 631, 667, 830, 1004, 1011, 1085, among others). These terms imply comparison with real-world field data, which, to my knowledge, is not available for validation (as also noted in lines 805–808). Instead, these quantities appear to be evaluated relative to the "Control" model run. To avoid potential misinterpretation, I recommend revising the phrasing to clarify that differences are being assessed within the model framework rather than against observational data.

Evaluation of Research Objective (2)

It is unclear whether research objective (2) (line 156) has been fully achieved. My interpretation is that the model is calibrated based on hydrodynamics to establish the "Control" run, but it remains uncertain whether the model continues to behave as expected when certain processes (NWS, NTS, NAS) are omitted. Additionally, it would be beneficial to clarify whether the chosen methodology is capable of addressing objective (2).

There is potential for deeper insights into the contributions and interactions of different processes in sediment transport. Since sediment transport exhibits nonlinear responses to environmental forcing, an analysis of how tides and waves interact to influence overall sediment dynamics could strengthen the study. Currently, the approach primarily isolates individual processes, but a more integrated interpretation of process interactions could add value.

Some of the study's findings may already be anticipated based on fundamental process-based reasoning. For instance, the following statements confirm well-known expectations:

- Lines 525–527: “With sediment load during winter nearly negligible, the suspended concentration of riverine sediment is significantly lower compared to the wet summer.”
- Lines 657–658: “For the NTS case versus the Control case, tides significantly affected bottom stress.”
- Lines 667–668: “However, NWS underestimated the nearshore bottom stress.”
- Lines 713–714: “This enhanced settling velocity resulted in an increased deposition.”

A more nuanced discussion of these results—particularly emphasizing interactions between multiple processes rather than confirming expected trends—would enhance the manuscript.

Numerical Model Performance and Limitations

The manuscript could benefit from a more detailed discussion of numerical model performance, particularly regarding:

- Grid sensitivity: While the hydrodynamic validation appears strong, has numerical behaviour and model convergence been tested under grid refinement?
- Model limitations: Section 4.3 primarily discusses the exclusion of certain physical processes but does not address intrinsic model limitations. Consider including a discussion on potential numerical constraints.
- Sigma-coordinates (Line 189): The sigma-coordinate system is known to introduce challenges in accurately modelling salt transport in regions with steep gradients, where Cartesian coordinates may perform better (Bijvelds, 2001). Given the importance of salinity in estuarine turbidity maxima (ETM) formation, it would be helpful to clarify whether ETM development is well captured in the model and whether any limitations arise from the chosen coordinate system.

The study presents interesting insights into sediment budgets and overall sediment dynamics. In particular, the introduction of the “Cycle” model run is a compelling aspect. It may be beneficial to highlight its implications more prominently, especially regarding the conclusions drawn in lines 730–731.

3. Technical comments

The level of significance reported for measured percentages is inconsistent across the manuscript. Given the model’s inherent (in)accuracy, the precision of percentage values should be adjusted accordingly. This applies particularly to the Abstract, Section 3.2, and Section 5 (Conclusions).

Line 192: Song and Haidvogel (1994) introduce a new s-coordinate system, not the general sigma-coordinate system introduced in the manuscript. It is unclear which system is actually used and what the two θ-values are, as these are not explicitly described in Song and Haidvogel (1994). Please clarify and revise accordingly.

Lines 303-305. The statement “*The realistic spin-up greatly reduced the irregularities and prepared a more suitable seabed sediment particle size distribution field for subsequent simulations than the initial prototype (Figures 2d-f vs. 2g-i).*” needs further clarification.

Could you elaborate on why this “realistic reworking” is necessary and why it results in a more suitable initial sediment distribution? The figures suggest the presence of spurious oscillations in the model interior and near the open southern boundary, which raises concerns.

Line 483-487. The precise definition of a “river plume” is unclear. How is it quantitatively defined, and what correlation does it have with regions of high suspended sediment concentration (SSC)? Additionally, a more in-depth analysis of the freshwater plume’s role in transporting riverine sediment—relative to the overall sediment transport—would strengthen this section. Could you expand on this aspect?

Line 493: Please explain how the sediment flux is determined. Is it computed purely as advective horizontal transport, or are other processes included? Please specify.

Line 541. Figure 6 shows significant salinity gradients near the estuary, which suggests the potential formation of an estuarine turbidity maximum (ETM). Is such an ETM captured in the model? If so, could you comment on its role in sediment transport within the system?

Line 639: the term “probably being artefacts” is vague. Could you clarify what kind of numerical artifacts these are? While they appear as local deviations in deeper regions, they span several kilometres and multiple grid cells. Given their scale, could they significantly influence hydrodynamics across the domain? Furthermore, how does this uncertainty impact confidence in the NAS model results? A more detailed explanation would be helpful.

Line 694+733. Figures 9 and 10 include arrows that are somewhat unclear. While the colours indicate differences between model runs, it appears that the arrows represent only the non-Control run. Could you clarify their specific purpose and whether they provide a direct comparison with the Control case?

Lines 728-731 describe the deposition seen in Figure 11f but provide no reason for it by the driving hydrodynamics. To me, it is unclear why the sediment distribution would change. What is the process behind this? Does this not provide us with the conclusion that a more complete sediment spin-up, as performed in Cycle, is necessary for robust results?

Line 793. The caption of Figure 12 explains the significance of magenta values, but it is unclear what the other values (black, blue, red) represent. Could you specify their meaning?

4. Textual remarks

Line 25: The term “distal retention” may not be appropriate in this context. If sediment is never transported to distal regions in the first place, it does not necessarily imply a lower distal retention. Consider rephrasing for clarity.

Line 219: The abbreviation Hsig appears without an introduction. If it refers to significant wave height, please define it properly when first mentioned.

Line 298: I am not sure what “realistic reworking” means, could you explain or rephrase?

Line 495: The sediment flux is not strictly westward and eastward. Please consider rephrasing for accuracy.

Line 502 and 504. The units used for sediment flux are not correct -> g/m/s

Line 524: The term “salinity front” is somewhat vague. Does this refer to a specific isohaline? Please clarify.

Line 542. Figure 6e: “2D riverine Flux” is unclear phrasing to me. Perhaps “Horizontal sediment flux” would be a more precise alternative, as “riverine” may be ambiguous without additional context..

Line 542. Figure 6f. The term “riverine Deposition reworking” is unclear. Consider rephrasing to include “difference,” “change,” or another term that better captures the intended meaning.

There are some inconsistencies in terminology throughout the manuscript. For example, “Distal” regions is sometimes written in quotation marks, while in other places it appears as distal regions without emphasis. Similarly, “Gulf” regions and gulf regions are used interchangeably. Please ensure consistency in terminology throughout the text.

References

Bijvelds, M. D. J. P. (2001). Numerical modelling of estuarine flow over steep topography. Doctoral dissertation, TU Delft, Delft University of Technology. Ipskamp. Retrieved from http://resolver.tudelft.nl/uuid:39c0c858-579a-47fa-a911-4a4114949a11