Review of *Alongshore sediment transport analysis for a semi-enclosed basin: a case study of the Gulf of Riga, the Baltic Sea*, by Soomere et al.

This study examines the alongshore wave-induced transport of non-cohesive sediment along the shores of the Gulf of Riga. The authors use a triple nested version of the SWAN wave model as input to the CERC approach. They then examine the bulk and net sediment transport along the western, southern and eastern shores of the Gulf of Riga for the period 1990-2022. This study is interesting and clearly provides insights into sediment transport in the area, which is of interest for coastal management issues. However, it still needs some work before it can be published, so I recommend a major revision.

My main comments are as follows:

- The main novel results of the study need to be much better highlighted. Firstly, a more detailed overview of the previous work on the subject and its results and limitations is needed: this will help to highlight the remaining questions addressed in this study and the new insights provided by the present study. Secondly, it is also a question of writing: throughout the manuscript, it is not always clear whether the authors are discussing previous results or their own results; this needs to be made more explicit.

- The tool developed here would allow a much deeper and more quantitative analysis of the interannual variability of sediment transport along the different areas of the coast, both in terms of bulk and net transport, including an analysis of the relationship between this transport and the potential associated factors (variability of the wind regime as well as other human factors). For now, the authors only comment on the 1990-2022 average and some specific years, but they should use their 1990-2022 dataset to perform a more rigorous statistical analysis of interannual variability. For example, calculating the correlation between the time series over different areas, trends and interannual standard deviation, both over the whole period and over selected sub-periods, would allow to be more quantitative than just taking 2 particular years and thus draw much more robust conclusions.
- I would also recommend a more detailed discussion of the associated consequences in terms of erosion or deposition.

- The relationships between sediment transport results and wind and wave characteristics are often presented without illustration or justification. An overview of the wind and wave regime and its spatial and temporal variability over the area is necessary to make these analyses much more sound and convincing. One can also wonder if the resolution of ERAS is sufficient to correctly represent the spatial and temporal variations of the wind along the coast.

- Some choices in the model configuration need to be discussed or explained. Firstly, only along-shore transport is represented and analysed in the model, what are the implications of neglecting cross-shore transport? The authors mention, for example, storms during which sediment may cross certain structures. Secondly, the effect of man-made or small-scale structures is often mentioned in the manuscript. However, it is not clear how these can be represented in the 600 m resolution model. Thirdly, the relationship between the different grids should be better explained. How do the 3 resolution levels interact and how do the 3 highest resolution grids over the 3 parts of the coast interact.

- The English is generally OK but should be checked, there are some strange sentences with spelling mistakes.

Below are the detailed comments I made when reviewing the paper, many of which are redundant but should help the authors to some extent in responding to my main comments above.

- « The resolution, however, is too low to identify » p. 3 line 70. The resolution of what?
- « the northern and north-eastern parts of this water body » p. 3 line 77. Discuss however the hydrodynamic connexion between this area and the rest of the gulf
- p. 3 Figure 1: Is the red fame in the left panel the 2nd level model area ?
- p. 3 Figure 1 : The colormap in the right panel should be adjusted to make topography easier to visualize
- p. 4) Introduction: Review of existing literature is needed. Before that one would like to have an overview of the existing knowledge and the modeling work done over the gulf of Riga, focused on the gulf or done at larger scale
- « 600 m » p. 4. Resolution of which level ?
- « The presentation follows the classical structure of research papers. » p. 4 line 86. Can be removed
- « study area » p. 4 line 86. An overview of THE study area.
- « 2.1 Study area » p. 4) This part would more relevant in the introduction, with a more detailed analysis of previous work to highlight first the open questions and second the specific novel results of the study in the conclusion.
- « the maximum » p. 4 line 95. Remove « the » before "maximum"
- « The bathymetry » p. 4 line 97. A map with detailed bathymetry would help.
- « The 10 m and 20 m isobaths » p. 4 line 99. Show those isobaths on a map
- p. 4 lines 109113. Which period is covered what by these analysis?

What about the temporal (seasonal to interannual) variability?

- « temporary reversals » p. 5 line 121: implies temporal variability
- « a specific balance between two predominant wind system » p. 5 line 133. Provide explanations of wind system in the area: spatial and temporal variability
- « of a certain location a » p. 5 line 134. Very vague
- « variation over time » p. 6 line 138. Very vague, some elements are needed to make this argument stronger and be more convincing
- « a triple nested version » p. 6 line 145:

Not clear where the nested grids are from figure 1: are there 3 independent grids within a larger mother grid? from the next paragraph it seems that there are 3 levels but the connection is not clear, as well the connection between the 3 high resolution grids

- « ERA5 wind » p. 6 line 147: is the resolution of ERA5 sufficient ?
- « of currents and varying water levels was ignored » p. 6 line 148: Can this affect the results?
- « a thorough description of the Gulf of Riga wave climate for 1990–2021 » p. 6 line 152: Summarize main results from those study
- « the Gulf of Riga a » p. 6 line 153. Red rectangle in figure 1 right ? This should be indicated in the caption of Figure 1
- « three realisations of a regular rectangular grid » p. 6 line 155: how are the 600 m resolution grids connected? Are they connected with the Gulf of Riga grid ? How are the 3 levels connected? Is this 1-way or 2-way?
- « covered with a similar grid with a resolution of about 300 m » p. 7 line 157. Why? Are simulations performed over this part?
- « sedimen » p. 7 line 163: what about sediment properties ? How are they considered ?moreover this method only applies to non-cohesive sediment this should be explicitly written.
- p. 7) This should be a clear part with a dedicated number 2.3 and title of 2.2 should be adapted accordingly.
- « wave data with 5.5 km resolution data» p. 7 line 174. Source of the data?

- « bathymetry data for proximity to estimated beach closure depth » p. 7 line 179. Reformulate for clarity
- « four-step » p. 7 line 179. Steps 1 and 2 are clear, but please explicitly state steps 3 and 4
- « this » p. 7 line 185. " The " instead of " this"
- p. 8 Figure 4 left: isoline labels are pixelized and can not be read
- « SWAN model simulations 1 » p. 8 Figure 4. Caption. The one with the gulf of Riga grid ?
- « These approximations are not perfect » p. 10 line 432: Is It possible to estimate the associated uncertainty ?
- p. 10 line 244:provide meaning of rhos (density of sediment), rho (density of water) and p
- « The bulk transport was calculated as the sum of absolute values of ... » p. 10 line 248: the bulk transport is the integral of absolute value of transport over the period right?over the day? OR the whole period of simulation?
- « up to 40 m deep area a few kilometres to the east of Cape Kolka » p. 12 line 297. That would really help to show bathymetric features along the coast here instead of referring to other papers...
- « This deep area becomes evident as a water depth 14–18 m in several selected wave model grid cells located less than 1 km from the shoreline » p. 13 line 298: the sentence seems strange (maybe a word is missing) and it is not clear at all to see to which area in figure 4 the authors refer
- « shoreline (Fig. 4). The 5 m and 10 m isolines meander noticeably 300 between Cape Kolka and Roja. This bottom structure apparently reflects streamlined topographical features in the area stem-ming from Late Weichselian glacial dynamics (Tsyrulnikov et al., 2008 » p. 13 lines 299_301. Same comment:how to visualize those features?
- « in terms of averages » p. 13 line 306: when averaging
- « presence of a small port and its wavebreakers. » p. 13 line 307: how are the port and the wavebreakers represented in the model?
- « shoreline. Still, it is likely that, at least in some years, the overall counter-clockwise sediment transport carries sand 310 around this headland to the south-east. » p. 13 lines 309.310 : this statement needs to be justified
- « The breakwaters of Port of Engure extend further from the shoreline than those of Port of Roja and Port of Mersrags and apparently discontinue this transport » p. 13 line 310,311: same comment, figure7 does not allow to see this
- « The years characterised by very intense (e.g., 1993) or very low (e.g., 2014) bulk transport along the northwestern shore of Cape Kolka are not mirrored along the coastal stretch to the east of Cape Kolka. » p. 13 lines 317.320:computing correlations between transport west of the cape and east of the cape would be more quantitatively convincing
- « transport. The characteristic feature of the net transport is that years with strong counter-clockwise transport to the west of Cape Kolka (e.g., 2011) correspond to almost zero counter-clockwise transport in the western Gulf of Riga. The change in the sign of the net transport at Cape Kolka in years with strong clockwise transport to the east of the cape (e.g., 2010) » p. 13 lines 321 - 323: again, this statement based on 2 particular years does not allow a robust conclusion. Performing correlations over the whole ensemble of years would be more convincing.
- « evidently reflects the role of northerly winds in such years » p. 13 line 323: without showing maps/ timeseries of wind it is not "evident" at all
- p. 13 Figure 7. It is very interesting that for the ratio and the net transport, maximum year west of the cape becomes minimum at the east, and vice versa. this should be commented, and again quantitatively checked considering correlations between east and west
- « Interestingly, there is no jump or discontinuity in the average net transport or the ratio of net and bulk transport at this location » p. 13 line 327 - 328: seems contradictory with the previous sentence
- « with previous findings. » p. 13 line 331. Reference is needed

- « It is likely that breakwaters of the Port of Roja largely stop alongshore sediment flux. » p. 14 line 339: same comment as above concerning the port
- « Their impact is not resolved by the model. » p. 14 line 343: again, how could this be considered?
- « even » p. 14 line 346: remove "even"
- « The sandy beach becomes evident again about 10 km to the south of Mersrag » p. 14 line 351. Are there observations that support this sentence?
- « Similar to the described pattern, » p. 14 line 352: what do you mean ?
- « almost fully stop the wave-driven sediment transport. » p. 14) 355 - 357: not visible in figure 7 so how do the authors support this statement?
- « northerly winds while the predominant driver near Riga (Daugava River mouth) and further to the east are south-westerly winds » p. 14 line 361 - 362: a presentation / overview of wind characteristics in the region, and its spatial and seasonal variability, would really help to show the link between the actual wind regime and the wave and shore configuration and the sediment transport
- « The massive breakwaters at the river mouth » p. 15 line 365: again, how are those wavebreakers represented in the model?
- « Port of Engure » p. 15 Figures 7 and 9 suggest a continuity of sediment transport at the port of Engure which is not in agreement with what the authors mention above line 355. This raise the question of how is the connection between the 3 grids dealt with?
- « As the orientation of the coastline changes more to the east at Kesterciems, it is natural that bulk sediment transport slows t » p. 15 line 372-373 and in the whole paragraph: be more specific
- « both predominant wave » p. 15. Same comment
- p. 15 line 369-380. A description of wind and wave regime and direction would help a lot to support affirmations in this paragraph
- « predominantly » p. 15 line 381: this seems true on average and for most of the years but the opposite is observed for some years. This highlights the need to further analyse the interannual variability in a more comprehensive way, based on the analysis of the 1990-2022 set.
- p. 15 Figure 7 and the following ones could be used to better discuss the interannual variability and also to perform statistic analysis over the whole period, to support statements made from the analysis of single years and produce more robust conclusions
- « The data for grid points that follow the orientation of breakwaters of the Port of Engure and jetties at the Daugava River mouth are omitted » p. 16 Figure 9 caption. Not clear.
- « the historical in situ estimates; » p. 16 line 394: reference for these historical estimates?
- « simulations » p. 16 line 394: configuration of those earlier simulations ? how do they differ from the current one?
- « The alongshore variations in transport » p. 16 line 397: Please be more specific mentioning those alongshore variations. Is this the small bump near Jurmala ?
- p. 17. Compute correlations over the years between identified cells would help to better characterize the link between those cells.
- « long-term » p. 17 line 399; how is this riverine sediment flux taken into account in the model?
- « sediment transport is high along the entire coastal stretch in years of intense transport (e.g., 1992) and low along the entire stretch in years of less intense transport (e.g., 1994) » p. 17 line 402: again, using statistical analysis over the whole period would make those conclusions drawn from 2 particular years much more robust.
- « this property along the entire coastal segment » p. 17 line 404: not obvious after jurmala. More generally, the segments east and west of jurmala seem to show distinct behaviors, which seems logical when considering the geographical position of jurmala in figure 4.

- « While sediment from the easternmost system can be transported across the headland at Ragaciems, reverse transport is highly unlikely at an annual scale » p. 17 line 408 - 409: not clear can you explain how you deduce this from figure 9 ?
- « similar to the Latvian and Lithuanian Baltic proper shores, under a delicate balance of two predominant wave systems (Eelsalu et al., 2024b) that in this case work exactly again » p. 17 lines 422-423. Provide details.
- « properties of waves generated by the north-north-western winds » p. 17 line 425: see comments above about wind and waves
- « Figure 10 » p. 18. In figures 7,9,10, what is the meaning of no data?
- « along the eastern shore of the Gulf of Rig » p. 18. For figures 7,9,10 that would be also useful to indicate the distance in km, in addition to points
- « The data for grid points that follow the orientation of breakwaters of the Port of Skulte, Salacgriva, Kuiviži, Treimani and at Kosmos are omitted. » p. 18. Same comment as for figure 7
- « of several man-made structures, » p. 19 line 449 : same comment as above how. How are these human made structures represented in the model at 600m resolution ?
- « waves from the northern directions dominate the wave-driven transport over this more than 30 km long » p. 19 line 466. Same comment as above about wind and waves
- « likely that wave-driven sediment flux passes this headland on many occasions and that the coastal segment from the Port of Skulte to 470 Cape Kurmrags is a connected compartment. » p. 19 line 468-470: how do you support this statement?
- « almost did not become evident on the shores of the 500 Gulf of Riga where bulk potential transport even decreased to some extent 1990–2007 but net transport was at an almost constant level (Viška and Soomere, 2013a). » p. 20 lines 499-501. not very clear.
- « A possible reason …» p. 20 line 502. Do the authors refer to the study of Somere et al 2015 or to this study?
- « of climate change » p. 20 line 503. How is it related to climate change? Wind? Could there be other factors?
- « As these shores are oriented very differently with respect to predominant wind directions, it is likely that such a signal is present on some of these shores only. » p. 20 lines 504-505. Same comment as above about wind and wave regimes and coastline configuration
- « …cell is larges… » p. 20 line 505. Add "In the present study"
- « shore and only about 30 % of that on the southern shore » p. 21 line 512. I guess you mean that transport on the southern shore is about 30% of the one on the western and even less of the eastern?
- « combination of the direction of predominant winds and orientation of the coastal segments » p. 21 lines 513-514. Same comment as above about wind
- « does not increase gradually » p. 21 line 519 . It would help to compute the trend on figure 11: over the whole period and between 1990 and 2005 then 2005 and2022
- « trend 2005–202 » p. 21 line 520. "Over 2005-2022" missing, here and in other places.
- « along western, southern and eastern s » p. 21 Figure 11. What are the limits of those segments?
- « …from, or even in counterphase, with respect to… » p. 21 line 528. To be reformulated
- « interannual variations 1990–2005 but has been almost steady since then » p. 22 line 534. This needs to be more quantitatively and statistically analysed (compute standard deviation, trends, ec...) and factors should be discussed (stormy years?)
- « so-called storm season » p. 22 line 538. Differences and similarities with annual values should be discussed.
- « does not exhibit any significant trend » p. 22 line 542. Needs to be computed
- « course of this quantity signals that the decrease in annual values of the bulk transport along the western shore in the 1990s simply reflects improper clustering of the underlying data into annual values. » p. 22 line 543-544. Not clear.

- p. 22 Figure 12. I recommend to compute correlations between shores to see if they are statistically related
- « long-term and decadal change » p. 22 line 550: should be quantified
- « the three coastal segments. Wh » p. 23 line 552. Western and eastern shoes seem to be negatively correlated in figure 12?
- « vital update … » p. 23 line 558. Needs to be clearly explained: what are the new results here compared to previous studies
- « Figure 13 » p. 24 Figure 13: erosion and accumulation areas should be highlighted.
- « mismatch of decadal variations in the wave-driven sediment transport in the interior of the Gulf of Riga (Viška and Soomere, 2013a) from those identified for longer segments of the eastern Baltic » p. 24 line 589-587. Not clear, should be more explicit
- « the specific orientation of some shore segments of the gulf with respect to the predominant moderate and strong wind » p. 24 line 594-595. Same comment, this needs an overview of wind regime
- « largely follows variations in… » p. 25 line 613. Same comment
- « mirrored pattern of time periods of high and low net potential transport on the western and eastern shores of the Gulf of Riga » p. 25 lines 618-619. Compute correlations to obtain more robust conclusions
- « almost regular fluctuations in the role of northerly winds in the system with almost constant amplitude and with a time scale of 3–4 years» p. 25 line 621 - 621. Not clear