Authors' Response to the Reviewers' Comments

Manuscript No. egusphere-2024-2985

Title of Paper: "Investigation of complex coastline geometry impact on the evolution of storm surges along the east coast of India: A sensitivity study using a numerical model"

The reply to the comments is given below:

Reviewer 1

The work analyses the interaction between the shape of the coastline (convex/concave) and the trajectories of the cyclones in determining the exacerbation of the related storm surges. The modelling approach followed is robust and well-conceived, first with idealized test cases (regular coastline shapes) and straight cyclone tracks, then with real coastline and idealized cyclone tracks. Last a real case. My major remark is about this real case. I would suggest the author to move this case in the section 4 or at the beginning of section 5 to serve as validation of model setup which is then used for the idealized test cases and their discussion.

In the Results and Discussion, I would suggest summarizing the values of the MPS in tables, in order to make easier the reading of the text. The figures in my opinion need some small adjustments, which are suggested along the manuscript. Several other comments are highlighted along the text, in the attached PDF.

The manuscript is well referenced, well written and mostly easy to read and understand. For these reasons I recommend the manuscript to be eligible for publication after minor revision.

Reply: ***Thank you for your encouraging comments. Each comment is addressed as given below:***

Comment: Line no. 59: Vulnerability is an intrinsic characteristic of an area with a certain coastline. Maybe it is the shape of the coastline which determines its vulnerability. Please explain better or review the sentence.

Reply: ***As suggested by the reviewer, the shape of the coastline determines its vulnerability. The sentence is properly modified in the revised manuscript. Refer line no 60.***

Comment: Line no. 66: It is not clear to me what a cyclonic approach angle is. Do you mean a cyclone approaching parallel to a concave coastline?

Reply: ***Approach angle of the cyclone refers to the angle making between the tangent drawn at the landfall location and the cyclone track measured clockwise. For clarity, this is included in the revised manuscript. Refer line no 67-68.***

Comment: Line no. 79: who is it? Maybe it is emphasized?

Reply: ***Corrected. Changed to "emphasized" in the revised manuscript. Refer line no 89.***

Comment: Line no. 93: It would be helpful to show in a map the trajectory of the cyclone from the formation to the landfall.

Reply: ***As suggested, the trajectory of the cyclone track is added and shown in the revised Fig. 1. Refer line no 115.***

Comment: Line no. 114: Please explain, without too many details, what is the hybrid formulation and the reason why there a minimum value of the drag coefficient (stability reasons?). Please, add units for the drag coeff. Ramp function and weighting factor: please explain what is and what is used for.

Reply: ***As mentioned in Luettich et al. (1992), the hybrid bottom friction formulation is given as: FFACTOR = CF*[1+(HBREAK/H)*Exp(FTHETA)]*Exp(FGAMMA/FTHETA) for (H < HBREAK). Otherwise, the hybrid friction formulation reverts to a standard quadratic formulation, in which FFACTOR=CF. Here, the value of CF is chosen as 0.0015 for model stability. Generalized Wave-Continuity Equation (GWCE) weighing factor (tau0) weights the relative contribution of the primitive and wave portions of the GWCE. The Ramp function simply scales the applied forcing, with no units, varies from 0 (no forcing) to 1 (full forcing).***
In the above reference, detailed formulation for the hybrid friction is mentioned. The drag coefficient, Ramp function and weighing factor are having no units. This sentence is included in the revised text. Refer line no 128-134.

Reference: ***Luettich Jr, R. A., Westerink, J. J., and Scheffner, N. W. (1992), ADCIRC: An advanced three-dimensional circulation model for shelves, coasts, and estuaries. Report 1. Theory and methodology of ADCIRC-2DDI and ADCIRC-3DL (No. CERC-TR-DRP-92-6), COASTAL ENGINEERING RESEARCH CENTER VICKSBURG MS.***

Comment: Line no. 122: load is not appropriate: action or stress would be better.

Reply: ***Corrected, changed it to stress in the revised manuscript. Refer line no 139.***

Comment: Line no. 124: work out is not clear.

Reply: ***To make it more meaningful, the word "work out" is replaced by "compute" in the revised manuscript. Refer line no 141.***

Comment: Line no. 192: Coriolis?

Reply: ***It is not Coriolis? The sentence is modified as "It is noticed that the trend is seen linearly decreasing with the increase in curvature of the domain from the track T_{-2} to T_2."in the revised manuscript appropriately. Refer line no 252-253.***

Comment: Line no. 210: I do not see this increase. I see that MPS increases from T2 to T0. Between T-2 and T0 it is almost the same.

Reply: ***Yes. there is no much change in MPS from CC1 to CC4 from the tracks T-2 to T0, However, the values increase for the more curvature shapes of CC5 and CC6. Refer Fig.6***

Comment: Line no. 231: All the analyses refer to the MPS, which is fine for me. I am also wondering on the average value of the SS along the coastline, and eventually its persistence. In other words, the combination which has the highest MPS, does it produce also the highest SS along a certain coastal area? A SS can be dangerous either for its MPS but also if it is widespread with high values along the coast.

Reply: ***It is true that the MPS includes highest SS along the coastal area. Also, true that SS can be dangerous for its MPS as well as widespread. However, the widespread of the peak surge along the coast increases with the curvature. The maximum spread is seen with the highest curvature.***

Comment: Line no. 248: In Figure 5 it is not clear the time when MPS occurs. I guess there should be a MPS for each T. The black dot is the time of the landfall, but not the time of the MPS. It would be interesting to have a vertical line indicating it.

Reply: ***We have not shown the time of occurrence of MPS in the figure. It is just 1 or 1.5 hours before or after the landfall time based on the curvature of the coast. As suggested, we replaced the black dot with a vertical black line. Refer: Revised Fig. 8.***

Comment: Line no. 254: This is not evident.

Reply: ***As this line is little ambiguous, the sentence is appropriately modified in the revised text. The revised sentence is "The onshore wind decreases and alongshore wind increases from track T_{-2} to T_2 for CC6, which is consistent with the MPS" Refer line no. 320-321.***

Comment: Line no. 270: There is no Figure 4(b)

Reply: ***Corrected, it is Fig. 4 (revised Fig. 7). In the revised manuscript it is Figure 7. Refer line no. 331.***

Comment: Line no. 278: This sentence is not clear. Please revise. I understand it is a matter of extension of the domain: if this is true, then the resulting discussion is weekend by this issue.

Reply: ***This sentence is modified suitably for more clarity. This can be attributed to reduction of available domain on the right side of any track in CC6 to drag water masses by the onshore winds towards the coast as we consider from T_{-2} to T_2. Refer line no. 351-352.***

Comment: Line no. 281: In CC1 the surges first converge and then diverge. In CC6 they move parallel. I do not see only convergence. Please explain and discuss this. Sentence at line 283 is not enough.

Reply: ***We agree with the reviewer's comment. To avoid confusion, we modified our discussion in the revised text. Refer line nos. 345-347 and 353-354.***

Comment: Line no. 302: I assume that the EB is plotted at the time of the landfall and not for instance at the time of the MPS. Why?

Reply: ***Corrected. Yes, it is during the time of MPS not at the time of landfall. Refer line 377.***

Comment: Line no. 308: I would expect the funneling effect to concentrate the energy more in CC6 than in CC1, which has a higher peak value, but the other values are more spread and lower than those in CC6. The scale of the energy in Fig7 should be revised to show more clearly this.

Reply: ***To avoid confusion, the sentence is suitably modified based on the simulations. For track T_0, the funneling effect is not seen in terms of surge generation (refer Table 1). The peak energy density per unit length is associated with the radius of maximum winds (Rmax) in either case. However, the spread/extent of the peak energy is seen more in CC6 compared to CC1 due to funneling effect. Corrected Fig.7. Refer line 382-384 and revised Fig. 10***

Comment: Line no. 335: Maybe northward would be better? Consider in the following paragraph to use north-south instead of left-right.

Reply: ***Corrected in the revised manuscript. Refer line nos. 404-420.***

Comment: Line no. 340: It would be also interesting to see the location of the negative surge. Maybe this would be achieved with a different scale of diverging colors?

Reply: ***The output file from the ADCIRC known as maxele gives only the maximum surge at each node during the whole cyclonic period. Some nodes may have the negative surge at some time, but it will eventually assign 0 m (highest value). Since the model stores only positive peak surges during the cyclone period, negative surges are not shown here. However, negative surges can be shown at a particular time as a snapshot. However, the Fig. 9 gives both maximum negative and positive surges along the coast with time.***

Comment: Line no. 341: Same as above

Reply: ***Corrected in the revised manuscript. Refer line 419.***

Comment: Line no. 359: I would suggest adding north-center-south on the left side at each row of Figure9, and the angles at the top of the three columns. This would help the comprehension of the paragraph, which is a hard to follow.

Reply: ***Corrected in the revised manuscript. Refer revised Fig. 11***

Comment: Line no. 374: Why there are names in red color? Please avoid as much as possible to overlap names over the colored map.

Reply: ***Corrected in the revised manuscript. Refer revised Fig. 11, 12 and 13***

Comment: Line no. 388: Same comment as previous figure. Names could be smaller.

Reply: ***Corrected in the revised manuscript. Refer revised Fig. 11, 12 and 13***

Comment: Line no. 395: Does the increase of Rmax affect the magnitude of the wind? Please comment this. A brief recap sentence at the end of the paragraph would be appreciable: something like. the closer the track, the higher the PS, The larger the radius, the larger the PS

Reply: ***The increase of Rmax does not affect the magnitude of the wind but modifies the cyclonic horizontal wind distribution. It is expected higher surges are generated at far off coastal places from the landfall point as the Rmax increases. This is included appropriately. Refer line no. 468-470.***

Comment: Line no. 399: Is this test case simulated with the same model/domain configuration of the idealized cases? I guess so. If this is true, I would consider moving this paragraph before the idealized test cases. The reason is that this real case could provide the proof of the model validation. Once the model is validated can be used for the idealized cases.

Reply: ***Corrected in the revised manuscript. Moved this section to the start of the Results and Discussion section. Refer to revised section 4.1***

Comment: Line no. 401: Which is the amplitude of the spring tide? It would be interesting to compare the local tide at the time of the cyclone with the local spring tide.

Reply: ***The cyclone was passing the station "Krishnapatnam" at the time of spring tide and its value was 0.5m. It means local tide and the spring tide was the same at the time of cyclone. This sentence is modified to include this fact. Refer Line no. 220.***

Comment: Line no. 403: I would prefer west and east.

Reply: ***Corrected in the revised manuscript. Refer revised line 222.***

Comment: Line no. 412: Please calculate some statistics such as BIAS, MAE, RMSD for the time series in Fig11(ii). Those values can be inserted also in the graph.

Reply: ***Corrected and included in the figure as well in the revised manuscript.***

"The computed correlation coefficient, mean absolute error (MAE), mean square error (MSE), mean bias error (MBE) and root mean square error (RMSE) are 0.91, 0.146 m, 0.032 m, 0.04 m and 0.16 m respectively."

Refer to line no 234-235 and revised Fig. 5 (ii).

Comment: Line no. 421: Which is the time of this map? The landfall time? Please specify.

Reply: ***No, it does not signify storm tide at the time of landfall. This is the plot of maximum storm tides generated during the entire cyclonic period. Refer line no 227 and revised Fig. 5(i).***

Comment: Line no. 451: Is the authors still discussing the Exps1? I guess no because of the line break. So, if the Exps2 are going to be introduced, please review this sentence.

Reply: ***Yes, here we are discussing Exp2. The corrected sentence is "Exp2 is carried out with the real coastline of having complex geometry covering from Kothapatnam to Antervedi, which is one of the most prominent cyclone prone regions along the east coast of India". Since in the revised manuscript, previous Exp2 has become Exp3. Refer to line 508.***