Dear Editor,

Please find enclosed our response to the reviewer 2's comments regarding the manuscript entitled, "Morphological Response of Vegetated and Urbanized Barrier Islands to Hurricane Ian" for publication in Natural Hazards and Earth System Sciences (NHESS).

We appreciate the constructive comments on our manuscript. We will adopt most of their suggestions, but we also have identified some suggestions that we do not agree with. In those cases, we have tried to be very clear about why we differ from the reviewer's opinion and we have made an effort to clarify our writing and explanations. In the following paragraphs we detail our rebuttal (in blue) regarding the modifications we made to the manuscript to the reviewers' comments (in black).

Overall Comments from Reviewer #2:

Reviewer's Comment: This paper investigates the effects of vegetation and built environments on modelled barrier island morphodynamics in a case study in southwest Florida. The sensitivity of the model XBeach to dune vegetation cover and non-erodible surfaces was tested, using a baseline constant Manning's roughness value, and two datasets of land cover (varying in resolution) from the National Oceanographic Partnership Program and NOAA. Using the 2022 Hurricane Ian event, the authors demonstrate firstly that including variable surface roughness in the XBeach boundary conditions significantly improves the skill of the sediment transport predictions. Secondly, using the two land cover datasets as different scenarios, they show lower resolution land cover data does not significantly impact the prediction skill. This is particularly impactful for land cover data availability when modelling coastal storm responses. What is also appreciated is the added test of the most successful model setup, which involves including vegetation patches to assess the morphodynamic response to revegetation. These results may be useful for modelling nature-based solutions to erosion in a coastal management context.

With the above being said, it would be interesting to see the study expanded beyond the dune elevation metrics used. Change in elevation maps and dune profiles are helpful for assessing before- and after-event topography, but I agree with the other reviewer that shoreline position change (and the seaward limit of vegetation) would build a richer picture of surface/environmental change being modelled by XBeach. Furthermore, the discussion does not delve into the uncertainties and potential flaws for consideration in the methodology, particularly where combining different datasets is concerned.

The manuscript makes a short but useful contribution to the field of barrier island modelling, but could be enhanced with broader analyses, to solidify its impacts suggested in the discussion.

Authors' Response: We appreciate the recognition of the study's contribution in demonstrating the importance of spatially variable surface roughness and evaluating the sensitivity of XBeach to land-cover resolution, as well as the potential relevance of the revegetation scenario for nature-based coastal management applications.

We agree that incorporating additional morphologic metrics, such as shoreline position change and seaward vegetation limits, would provide a broader assessment of storm-driven coastal change. However, consistent with our response to Reviewer 1, the present study was designed to focus specifically on dune morphodynamics as a controlled framework for evaluating land-cover-dependent roughness parameterization in XBeach. In addition, XBeach is not designed as a shoreline model rather than a dune erosion model. To clarify this scope, we have revised the relevant section headings and discussion text to explicitly emphasize dune-focused metrics rather than broader island-scale morphologic change.

Regarding uncertainties and methodological limitations, particularly those associated with combining multiple datasets, we agree that further clarification is warranted. The revised manuscript will include expanded discussion of dataset collection methods, spatial resolution, vertical referencing, and reported uncertainties

Specific Comments from Reviewer #2:

Authors' Response:

For the specific comments (*), each has been addressed by first restating the reviewer's comment, followed by the original text from the manuscript and the corresponding revised text, as presented below.

[Line 58]*: Please adjust the wording or grammar of this sentence, the phrasing is hard to understand.

Existing Text [Line 58]: Note that the increased Manning's coefficients directly affect the hydrodynamics but only indirectly, through reduced velocities, affect the sediment transport and morphology.

Revised Text: Note that increased Manning's coefficients do not directly affect the hydrodynamics; rather, they indirectly influence sediment transport and morphology by reducing flow velocities.

[Line 104]*: Is there a reason for the inconsistent numbering of the transects? Do these come from another source with breaks in the transect numbering? It might be helpful to just do 1–8 if these are contained within this study.

Authors' Response: The transects retain the original numbering assigned during the CEC field survey to maintain consistency with the source dataset. All additional datasets (e.g., LiDAR-derived profiles and modeled outputs) were plotted along these same numbered transects. Renumbering the transects sequentially (e.g., 1–8) would limit the analysis to only the northern portion of Fort Myers Beach and could create confusion when cross-referencing the survey data. Therefore, the original CEC transect numbering has been preserved for clarity.

[Line 115]*: Is there a difference in the capture date between these two datasets? If so, it would be worth explaining the potential impact of mismatched conditions between bathymetry models.

Existing Text [Line 115]: The bathymetry was generated by combining the NOAA Pre-Ian DEM, which extends to depths of up to 7 meters, with the 1-meter-resolution Continuously Updated Digital Elevation Model (CUDEM) dataset (NOAA, 2018) to provide coverage of deeper waters.

Authors' Response: The NOAA Pre-Ian DEM and the CUDEM dataset were not collected on the exact same date; however, the deeper-water bathymetry incorporated from CUDEM represents comparatively stable offshore morphology, where short-term storm-driven variability is typically lower than in the nearshore zone.

[Line 128]*: Lovers Key shows a higher post-peak wave height than Fort Myers, but it sits (at least from Figure 1) behind the barrier and is mainly bay. If these timeseries are both taken from the seaward nearshore, this should probably be reflected more clearly in Figure 1. In any case, it might be helpful to briefly suggest reasons for this difference.

Authors' Response: The slightly higher post-peak wave heights at Lovers Key are related to differences in offshore bathymetry and local exposure along the Gulf-facing boundary. Although Lovers Key includes back-barrier environments, the wave time series presented here correspond specifically to the open-coast boundary conditions rather than the bay side, where wave energy is substantially reduced.

[Line 132]*: It would be worth clarifying that the Manning's roughness coefficient values used come from empirical studies in similar environments (both the uniform value and the LULC specific ones). Also Line 141 has a typo in how Salgado is cited (no brackets around author).

Authors' Response: We thank the reviewer for this suggestion. The existing manuscript (Lines 50–58) highlights the studies in which both the uniform Manning's roughness coefficient and the LULC-specific values were applied in comparable coastal environments. In particular, the LULC-specific Manning's coefficients used in this study follow the approach applied by Salgado (2023), and the relevant citation will be corrected in the text.

[Line 184]*: It would be helpful to specify that the lack of difference between Scenario 2 and 3 are between each other, and not in relation to Scenario 1. This is clearer in Figure 4 but a slight rewording would help in the text.

Existing Text [Line 184]: The application of the two different LULC datasets in Scenario 2 and Scenario 3 do not result in significant different sedimentation and erosion patterns, despite the differences in land use classification (Fig 3c and d).

Authors' Response: We thank the reviewer for this clarification. The comparison in Line 184 refers specifically to differences between Scenario 2 and Scenario 3. As noted in Lines 150–152, the differences in land-cover classification between these two scenarios are described; however, their morphodynamic responses are similar.

[Figure 7]*: I appreciate the choice in colour ramp for topography, but in the context of this study (which includes land cover as a metric), I feel it is misleading to include green as a colour for topography thresholds. It is partially true that higher topography tends to be because of the existence of vegetation cover in digital surface models, but not in all cases and not for these barrier islands. I would suggest steering from blue and green which are suggestive.

Authors' Response: We thank the reviewer for this thoughtful comment regarding the color ramp used in Figure 7. The selected colormap was chosen to ensure accessibility and compatibility with color-vision deficiencies, and it was verified using colorblindness simulation tools to maintain distinguishability across elevation thresholds. While we acknowledge that green tones can sometimes be associated with vegetation, in this case the colormap represents elevation values only and is not intended to imply land-cover characteristics

[Line 278–282]*: This feels repetitive/redundant, consider shortening.

Existing Text [Line 278–282]: In this section, we discuss the sensitivity of different XBeach input parameters and forcing conditions that affect morphodynamic response, as well as the role of supplemental vegetation. We used default parameter settings and tested sensitivity to Manning's n value, wave skewness and asymmetry (facua), morphological acceleration factor (morfac), water levels, and offshore wave heights. In addition, we investigated how supplemental vegetation influences bed-level changes under similar forcing conditions, as discussed in the sections below.

Revised Text: In this section, we discuss the sensitivity of XBeach to key input parameters and forcing conditions influencing morphodynamic response, including Manning's n roughness coefficients, the wave skewness and asymmetry , the morphological acceleration factor , water levels, and offshore wave heights.

[Figure 9]*: I would suggest colouring the added vegetation pixels in a different colour from the original primary vegetation green, to help the reader differentiate between existing and simulated veg cover.

Authors' Response: We thank the reviewer for this helpful suggestion. In Figure 9b and 9c, the existing vegetation and the added vegetation patches are highlighted in the legend to clarify their locations along the transects. However, we agree that this distinction is less clear in Figure 9a. Accordingly, we will revise Figure 9a to use a distinct color for the added vegetation patches to improve visual differentiation from the original primary vegetation cover.

[Lines 347 and 353]*: Please address the spacing typos.

Authors' Response: We will address the spacing typos in the revised manuscript.