

# Comments on “Statistical characterization of erosion and sediment transport mechanics in shallow tidal environments Part 1: erosion dynamics”

## 1 Summary

This work introduced the idea of using random processes to model the wave-tidal-induced erosion events along the coastal area. The Venice Lagoon, Italy is chosen as the study site due to the availability of multiple bathymetry surveys over the past centuries. The numerical model Wind Wave Tidal Model (WWTM) is used to simulate hydrodynamics conditions, and statistics are extracted from simulation results. The author found that the interarrival time of the erosion events follows an exponential distribution, hence the events can be modeled as marked Poisson process. This work paved a new way to upscale short-term simulations in a wave-tidal environment to long-term, while following the statistical characteristics. This statistical model-based upscale technique is the major scientific contribution of this work. My main comments on this work are on the boundary conditions, that are used in the upscale analysis (erosion work). I believe when dealing with a time scale over 4 centuries, the climate can play an important role, the analysis and boundary conditions should take into consideration of it. There are some details such as knowledge gaps that need to be improved, which are listed below. I also recommend the authors show more details on how the model is set up and validated; show the reasoning behind the choice of several important constants such as critical shear stress and erosion coefficient. Overall, I think this work is of high quality, and it should be rated as a minor revision or on the editor’s decision.

## 2 Major comments

1. The knowledge gap is not clear from the literature reviews. The author stated in Line 53 that the main goal of this work is to figure out whether the wave-induced erosion events can be modeled as marked Poisson. However, in previous paragraphs, the author didn’t show there is a knowledge gap that requires to verify. For example, is there another study using random processes to model erosion events? What do other researchers usually do, when they need to simulate/upscale long-term morphodynamics in coastal areas? etc.
2. Line 104. It will be nice to show more details in WWTM model, such as showing the equations. For example which form of the shallow equation is solved, how bottom friction and wave energy are simulated, etc. Is there a turbulence closure used in this model?
3. Line 120. Will be more convincing to show the comparison of numerical modeling results in this study and the measured data.
4. Line 126-129. The method is not clear, please rephrase this sentence.

5. Line 130. Thinking about the time scale over 4 centuries, the climate has changed, e.g., the sea level, and mean temperature. Do you think the old morphology is the result of the old climate and the new morphology is the result of the new climate? If so it makes more sense to also consider the climate in the design of the boundary conditions.
6. Line 150. Why choose KS test? There are multiple statistical tests, such as, Anderson-Darling or Cramer Von Mises, etc. Do all these tests give similar results?
7. Line 166. The choice of critical shear stress is very important in this study. Please show more details on how 0.4 Pa is calculated/estimated.
8. Line 166. Is the outcome of this study sensitive to the choice of critical shear stress?
9. Line 270. Is there a way to validate the choice of  $e$  in the “erosion work”? Maybe using the differences between these bathymetry data, the “true” erosion rate can be estimated? And then use it to estimate  $e$ ?
10. Line 292. Again, do you think these complications are due to using a modern climate and ancient bathymetry?
11. Line 324 Similarly, if the sea level is lower in the past, wouldn't that increase the interarrival times? Will this consideration change the increasing trend?
12. Line 289, 305. Since the goal of this study is to upscale short-term simulations, and there are 6 surveys over a long period of time, is it possible to use an older survey and this statistical model to predict a newer survey? If so what does the comparison of the results look like?

### 3 Other comments

1. A typo in the second affiliation “Department of Geosciences ...”
2. In the captions in Figure 2, 3, 5, 6, The description of subfigures is confusing. Recommend switching the order of the year and sub-figure numbering. For example, use “(a) 1611; (b) 1810; ...” instead.