

# ***Interactive comment on “Reconstructing patterns of coastal risk in space and time along the US Atlantic Coast, 1970–2016” by S. B. Armstrong and E. D. Lazarus***

## **Anonymous Referee #1**

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Manuscript Review: Reconstructing patterns of coastal risk in space and time along the US Atlantic Coast, 1970-2016 by S.B. Armstrong and E.D. Lazarus Submitted to Hydrology and Earth System Sciences, June 2019.

Paper summary: In this paper uses a model to investigate the interactions between exposure, vulnerability and hazard in aggregate coastal risk. The model uses data on shoreline changes, beach renourishment and housing value to estimate the effects of shoreline loss, sea level rise, and beach renourishment on coastal risk. Coastal risk is an important topic in a time of climate change when there are many, growing interactions between human and natural systems. Therefore, this paper addresses an

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important subject in global change and coastal hazards.

General comments:

Overall, this paper is well written, but needs major work on the structure, data analysis and narrative. Major Issues:

1) Introduction speaks very broadly about risk and vulnerability, when the model is based on shoreline change and vulnerability that is defined by beach width and renourishment. Although this paper does contribute to the discussion about coastal risk, it is a very narrow framing of this problem (for example, your vulnerability measure does not include things like social vulnerability or built environment vulnerability). I think you need to reframe the introduction to talk about what this does do well – investigate geomorphic risk and the impacts of renourishment - rather than what it doesn't.

2) Results need to be rewritten to talk about the major findings and not just describe the figures.

3) Data analysis is unclear at times (for example, how many counties are in the analysis? Do figures 7 and 9 show a count of counties or transects?). Please make sure the main details are discussed in the methods (like the statistical analysis in Figures 8 and 10).

4) To really hit home the interesting interactions between risk and renourishment, I think you need to add a spatial component – how does risk change in the model over the coastline, regionally (a color-coded map would be a great way to show this).

Specific Comments:

Title: I would reframe coastal risk throughout the paper as geomorphic or shoreline erosion risk.

Abstract: Overall: The abstract does not give any description of what kind of data goes into the model or major findings. If you reframed the abstract and intro around

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geomorphic hazard and beach renourishment, this abstract could be a lot more specific and interesting. At the moment it is way too broad and says little about the actual study.

Line 12: What do you mean by “indications of feedbacks”?

Page 2: Introduction generally: It is good to start out broad with risk analysis, but the introduction does not really address geomorphic risk or beach renourishment. I think you could reframe in along these lines and set the reader up much better for what is coming. At the moment it stays too broad.

Lines 4-7: Add citations to these sentences

Lines 14-18: I think you can elaborate on this paragraph more and perhaps make it more about geomorphic change.

Line 24: Put the parenthetical and the citation in the same parentheses

Line 25: This paragraph needs more connective tissue and elaboration. Also needs to be focused more on geomorphic hazard. Could also talk about “levee effects” as another example of safe development paradox.

Lines 30-36: This paragraph still doesn’t tell the reader what to expect going forward. Need to add objectives and specify that you are looking at shoreline change and beach renourishment as a subset of coastal risk.

Page 3: Line 7: How many counties?

Line 20: Are there different points in time for the first survey?

Page 4: Lines 20-28: The exposure you define here is capital exposure. Could you add in number of structures as a way to estimate count or some variable related to population number. Additionally, you are using the whole county as a way to get at the value of just beach front properties. This assumption could be wrong in places where there is less of a beach front community or tourism. You are assuming that the whole county is exposed to beachfront erosion.

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Line 23: How are you dealing with uncertainty in this dataset? If there are whole counties missing, how much of other counties is missing? Would it be valuable to only use counties with low missingness?

Line 31: The vulnerability you are talking about here is just geomorphic vulnerability. These terms do not capture social vulnerability or built environment vulnerability. You should be clear about this from the beginning of the paper.

Page 5: Lines 7: What dataset is the beach width coming from?

Line 13: What about places that have a beach shoreline and then an interior shoreline (i.e. coastal lagoons)?

Line 18: Does the size of the renourishment play a role in the vulnerability change? Seems like the size would determine the change in vulnerability across the county.

Page 6: Result Overall: The results section needs to be rewritten. At the moment, much of it just describing figures without much narrative. Start your paragraphs out with a verbal description of the main finding for the paragraph and then get into the details. Additionally, there are results described here that are not discussed in the methods section (statistical analyses). Also some paragraphs are very short – two sentences in not a paragraph.

Page 7: Line 18: Table 1 is a great example of why this risk analysis needs to be reframed. Although Miami-Dade is subject to high probably of hurricane and king tides and high social vulnerability, it has a coastal risk of 0.08. This shows how this analysis is not a full reflection of total coastal risk, but more of geomorphic or shoreline erosion risks.

Lines 35-37: Your findings would be more realistic if you only included parts of the county that were most at risk of hazards from the coast and not the whole county.

Page 8: Line 11: Could you add some numbers about the peak of mode or the skewness to add some quantitative metrics to this description?

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Lines 13-15: Add these statistical steps to the methods section.

Lines 25-27: Again add numbers about modes and skewness to add quantitative metrics to the description.

Lines 28-34: Much of this paragraph seems like discussion.

Page 9: Discussion overall: Again, this goes very broad and general for a study that is on geomorphic risk. I think you should really find those 2-3 results you want to highlight and talk about them here without taking it too broad. Would also consider making the analysis explicitly spatial (see comment below).

Lines 7-9: This is a great finding! And should be highlighted in the abstract.

Line 20: Also no measures of social or built environment vulnerability. . . .

Line 29: I think you could really hit this out of the park with some spatial discussion. What are the regional trends? What types of counties seems to be most at risk? A map color coded for risk would also be a great addition.

Figure 1: Why does it seem that some counties have more rows than others? Are you just labelling some of them? Or do some counties have multiple rows?

Figure 5: How are these rates calculated? What is the difference between historical and long-term?

Figures 7 and 9: How are the counts so high in these figures? If you only have 51 counties, shouldn't they be lower? Otherwise you are applying the same county level exposure number across multiple shoreline transects? I would suggest making these figures over counties and not transects. Additionally, is exposure normalized by area? Because otherwise this just shows that bigger counties with more resources for nourishment are adding more property, if I am reading this correctly (not sure if I am reading it correctly because of the count issue I brought up above).

Figure 8 and 10: The p-value part of the figures is a bit unnecessary. I think you could

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use words in the results section to describe this. Also the y-axes, particularly in Figure 8, are misleading. It makes it look like the difference in exposure is huge, when in reality it is less than 0.1. Please make axes consistent (across historical and recent) and bigger range on the figure to better represent what is actually happening.

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