

# QUANTIFYING THE BENEFITS AND COSTS OF WETLAND RESTORATION PROJECTS FOR STORM SURGE DAMAGE REDUCTION

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## INTRODUCTION

Coastal wetlands protect communities during hurricanes by reducing storm surge flooding and damages. Previous studies have quantified surge reduction benefits of wetlands (Narayan et al., 2017), but there remain very few analyses of the benefits and costs of specific on-the-ground wetland restoration projects for storm surge risk reduction. In this analysis we combine coupled wave-flow models with spatial economic damage models to quantify the annual benefits, across multiple storm events, of three salt marsh wetland restoration projects in reducing storm surge risks in Galveston Bay, measure the benefit to cost ratio and return on investment of these restoration projects as nature-based risk reduction measures. These analyses are based on a newly developed methodology that is being developed for the estimation of coastal resilience credits for wetland restoration projects, analogous to established carbon credit methodologies.

Studies that explore wetland benefits also typically do not examine the influence of floodplain exposure on these values (Alattabi et al., 2023). In this study we explore how different storm, wetland and exposure variables may combine to ultimately determine the benefit to cost ratio of wetland restoration projects as nature-based defenses against storms.

## BENEFITS OF WETLAND RESTORATION PROJECTS AS NATURE BASED FLOOD DEFENSES

We use a coupled flow-wave model, DELFT3D-SWAN to assess the peak total water levels and flood heights across the Galveston Bay, TX region for four storm events of different return periods, for three ongoing and planned wetland restoration projects in the region. For each storm, we assess flood heights for two scenarios: a project scenario, after project completion, and a baseline scenario that provides a counterfactual baseline to the project. For each scenario, to study the impact of wetlands on storm surge flooding, these habitats were represented in the numerical model as Manning coefficients for surface roughness. Spatially explicit model results of flood extents and heights for each scenario are then integrated with publicly available data on property type and value to assess the economic value of storm surge damage for each scenario. The total expected damages in the floodplain for each scenario are aggregated to provide an estimate of the annual expected benefit for each project for storm surge damage reduction.

We quantify project costs using real-world data on these projects from the implementing institutions. We combine these cost data with the annual benefit values to obtain a benefit-cost ratio and return on investment for each project over an anticipated project life. Finally, we explore different storm, wetland and floodplain exposure variables that may influence these values, to better understand the contexts in which wetland restoration may make sense financially as nature based defenses against storms.

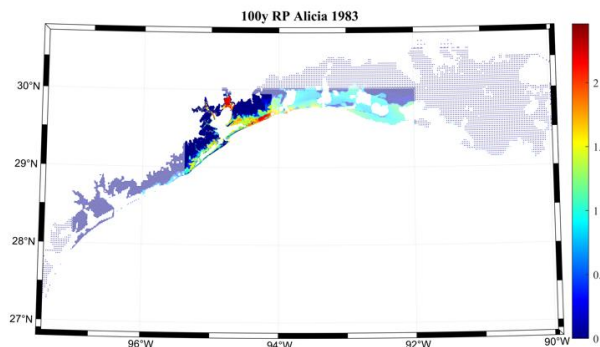


Figure 1 - Initial results for the baseline (counterfactual) scenario without a restoration project for a 100 year return period storm.

## REFERENCES

Narayan, Beck, Wilson, Thomas, Guerrero, Shephard, Reguero, Franc0, Ingram, Trespalacios (2016). Coastal wetlands and flood damage reduction: using risk industry-based models to assess natural defenses in the northeastern USA.

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