Loss of Coastal Marshes Due to Projected Sea Level Rise in Connecticut

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Introduction

As global temperatures increase due to climate change, sea level rise (SLR) is becoming more of a concern, especially for coastal populations and ecosystems. Even more alarming is the fact that the rate of global SLR is increasing in recent decades as shown in Figure 1 (Rahmstorf 2006). Rahmstorf also demonstrated that the rate SLR in the late 20th century has been at the highest level projected by the Intergovernmental Panel on Climate Change.

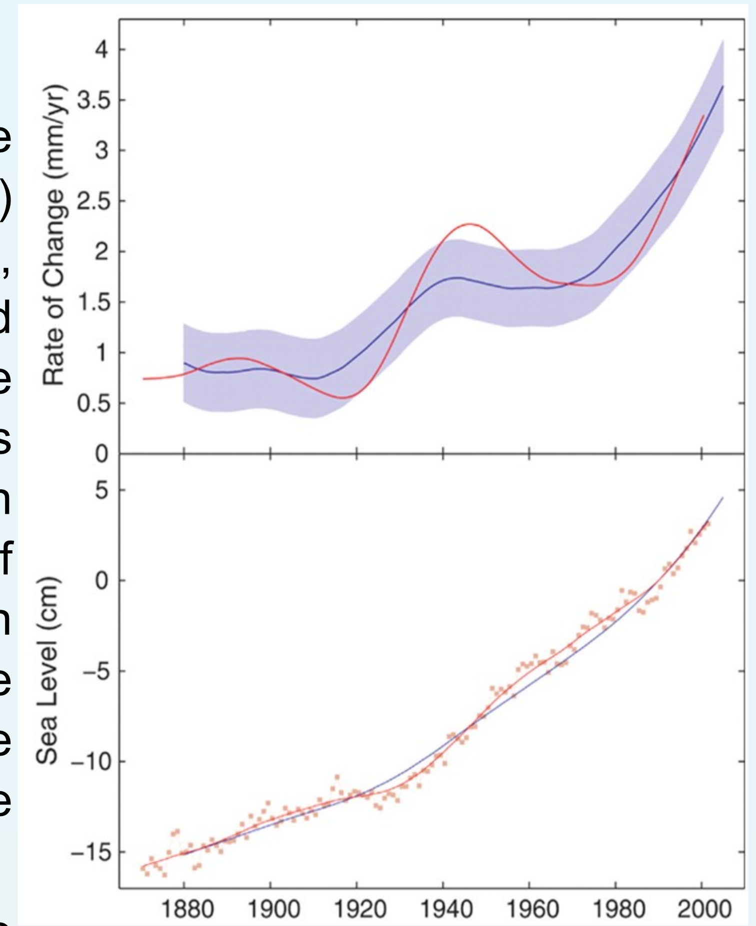

Figure 1. Top: Tidal gauge sea level rise rate observed in red and computed seal level rise rate in blue from global temperatures. Bottom: Observations of sea level relative to 1990 levels in red and computed sea level rise in blue [Rahmstorf, 2006].

In Connecticut (Figure 2) the ecosystem that has been historically affected by SLR is the coastal marsh. Marshes are known to have historically kept pace with SLR by "accumulating organic matter and trapping inorganic sediment" (Morris et al. 2002). This does not account for the acceleration of SLR which may exceed the equilibrium levels rate for plant growth. One study in Guilford, CT found that marshes have been slightly submerging relative to sea level in the past 350 years (Nydick et al. 1995). This fact in addition to the projected acceleration of SLR requires an evaluation of the potential loss of marshes in the next few decades.

The goal of this project was to calculate the potential loss of marsh areas in Connecticut using two different scenarios of low and high greenhouse gas emissions (DEEP 2013a). This study assumes that the rate of SLR in the next 3 decades will likely exceed the accumulation ability of marshes.

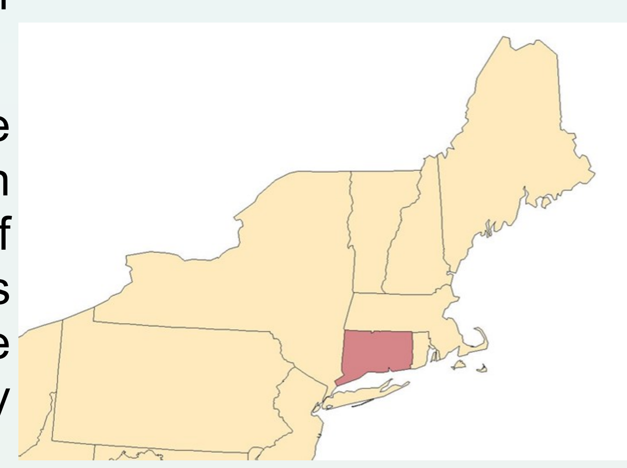

Figure 2. Extent map showing the location of Connecticut in pink.

Methods

Clipping areas: The most current topographic and bathymetric data for the Connecticut coastline (DOC & NOAA 2013) were mosaicked. The two selected areas of Marine and Estuarine Wetlands (DOI 2016), shown in blue and green in Figure 3, were used to clip the LIDAR data creating in two rasters in western and eastern CT.

Sea level rise effects: Two different projections of SLR for 2050: +0.5 feet in CT for a low greenhouse gas emission scenario, and +1.5 feet for a high emission scenario (DEEP 2013) were then applied to the rasters by subtracting 0.5 feet and 1.5 feet from each unit in the rasters (Figure 4).

Reclassification: The raster elevation data was then reclassified into 3 categories. All elevations less than zero were classified as below sea level. The periodically flooded areas were less than 5.72 feet for the western marsh and less than 7.53 feet for the eastern marsh, the maximum water levels in recorded history for the nearest NOAA station (NOAA 2017b, sec.Bridgeport; NOAA 2017a, sec.New London). The unaffected areas include elevations above the maximum water level (Figure 5).

Results

The areas of the marsh lost in Table 1 were calculated as the percent of marsh that would be below sea level in 2050. The results show a larger percent of the western marsh would be lost due to SLR. A rise of 0.5 or 1.5 feet did not significantly affect the amount lost in the western marsh. In the eastern marsh, the amount of SLR strongly affected the amount of marsh lost, most likely due to the artificial ditches. The Great Meadows Marsh occupying most of the western marsh area is the only marsh in CT without artificial ditches (Anon 2017). Most importantly, each marsh is uniquely affected by sea level rise, so all future models should include individual factors for each marsh, rather than averaging across a state's coastline.

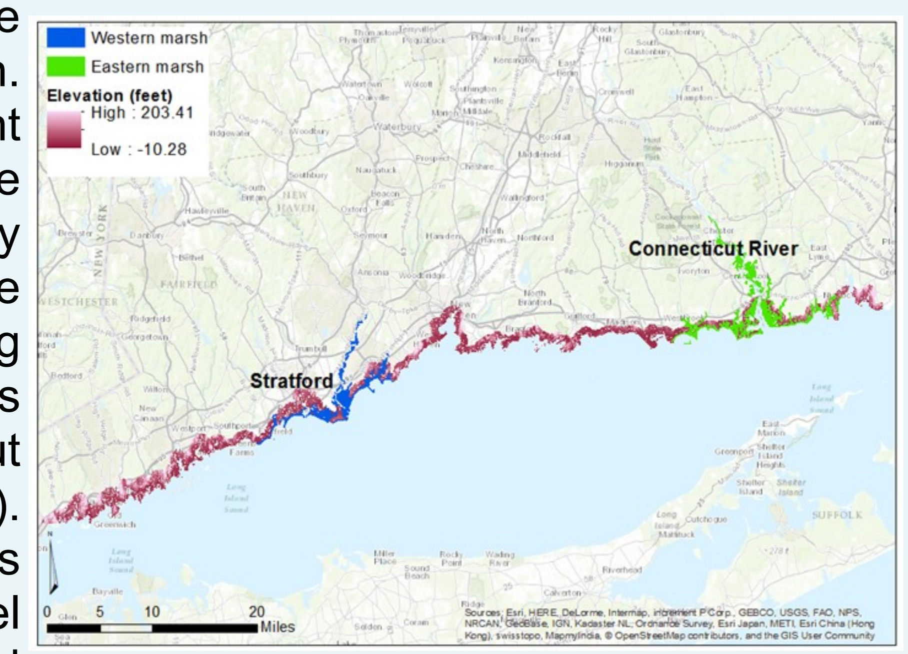

Figure 3. The compiled LIDAR data for the CT coast and two selected coastal marshes in blue and green.

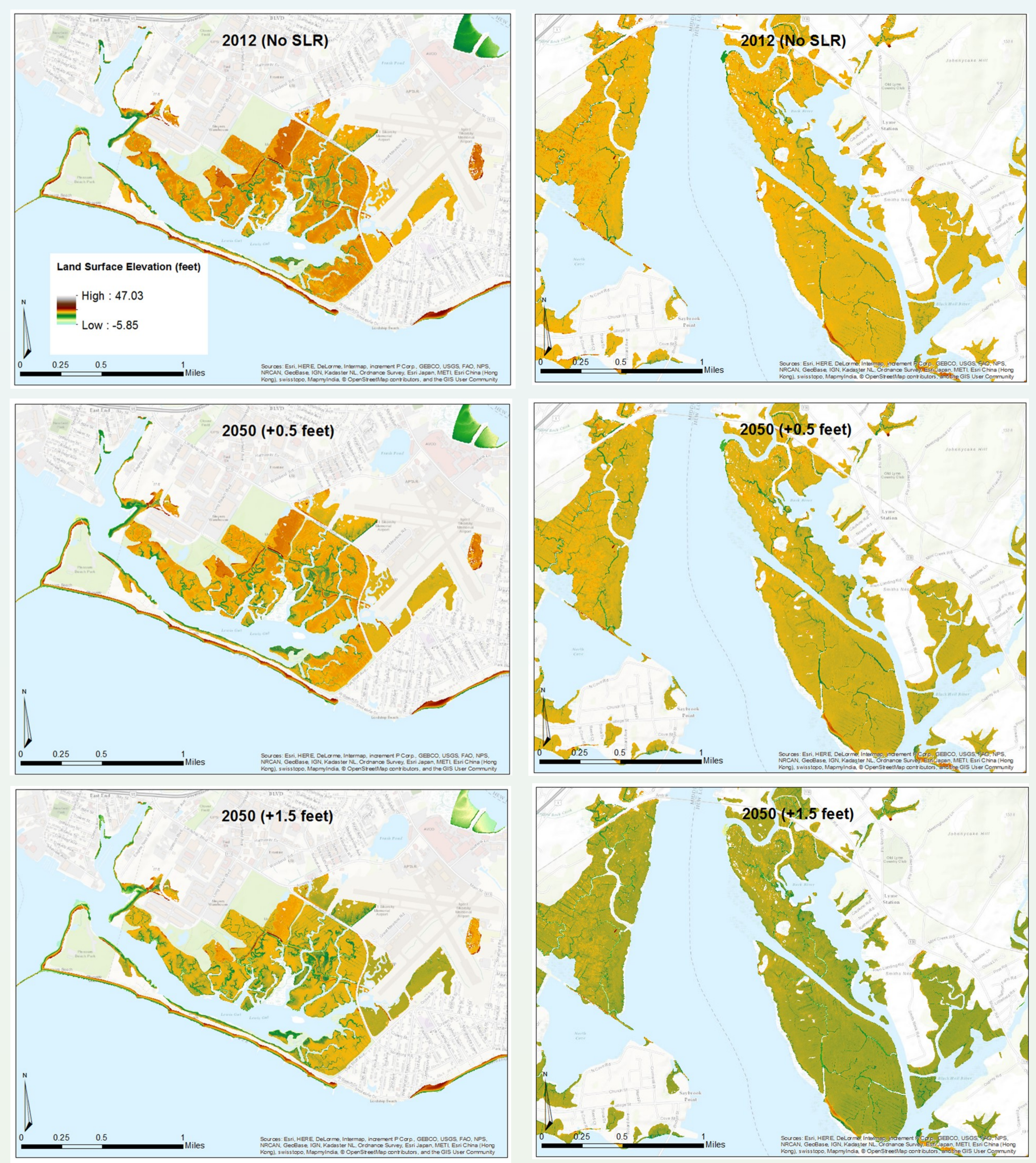

Figure 4. The elevations of the marsh areas in 2012 and in low and high sea level rise scenarios. Right = western marsh, Left = eastern marsh.

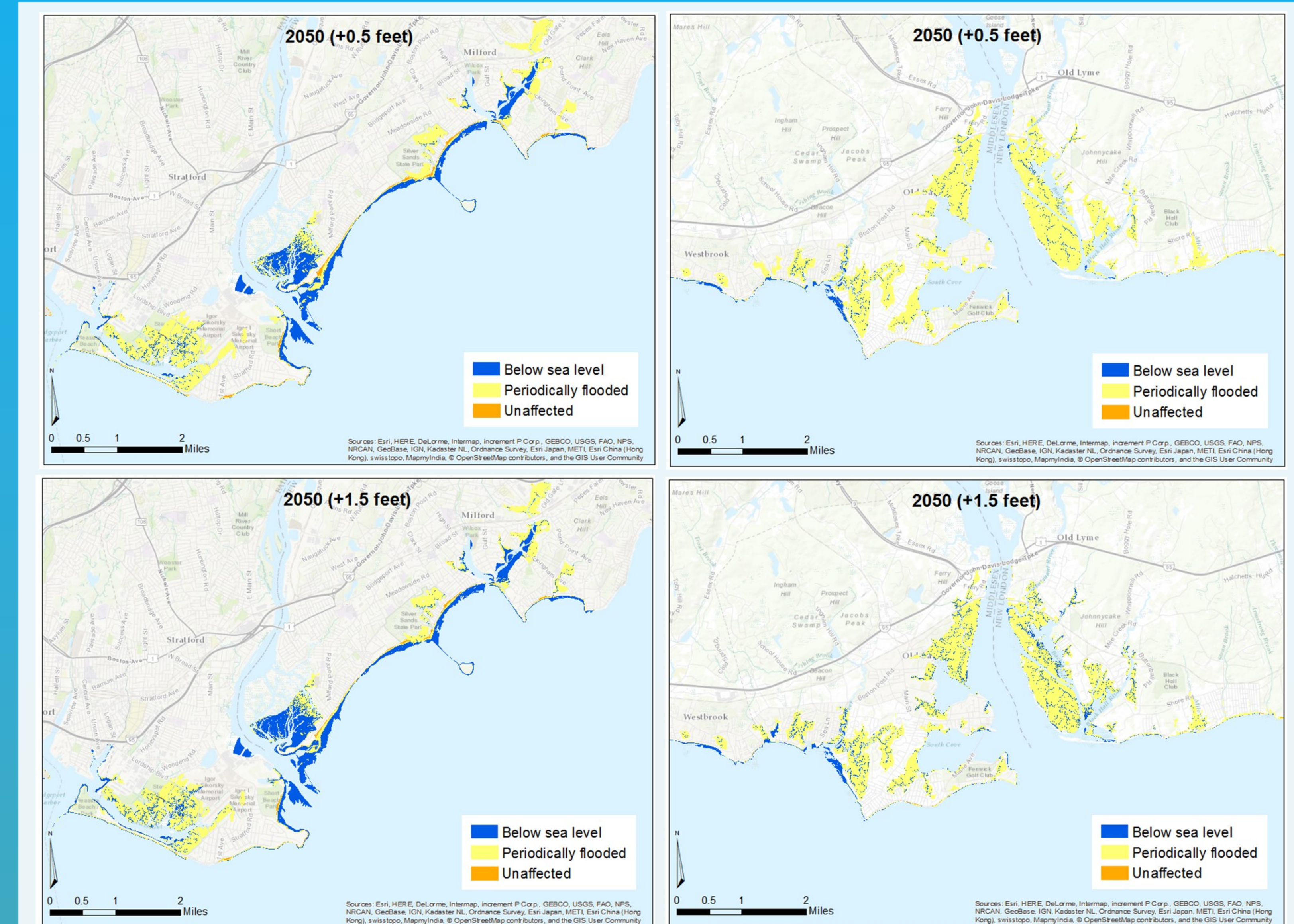

Figure 5. The new status of existing marshes with low and high sea level rise projections. Right = western marsh, Left = eastern marsh.

Table 1. The marsh areas lost in two different sea level rise scenarios

	Western marsh lost		Eastern marsh lost	
	Acres	Percent	Acres	Percent
Low SLR (+0.5 ft)	89.6	**40.6%**	28.4	**9.7%**
High SLR (+1.5 ft)	102.9	**46.6%**	56.2	**19.2%**

Conclusions

The loss of these marshes due to accelerated SLR is significant because of the ecosystem services that would be lost. The Great Meadows Marsh in Stratford, CT is a critical habitat for wildlife and was once called the "best coastal bird habitat in the United States." It is also a seed area for fisherman. The Great Island Marsh in the eastern marsh area is also an important bird breeding and feeding site, as well as a fishing and crabbing site for local fisherman (DEEP 2013b).

The major assumption in this study was that modern SLR would exceed the ability of marshes to accumulate mass. The study would be improved by using the current aggradation rates of these marshes. The data is also limited to each marsh area because the results show that each marsh is unique in its response to SLR. The amount of SLR is highly dependent on future emissions, so this model would need to be adjusted based on changes in fossil fuel use.

References

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