

Sea Level and Storm Surge Trends for the State of the Park Report Boston Harbor Islands National Recreation Area

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Historical Trends

Sea level in the region has shown a significant increase over the past century (NOAA 2014). Analyses of causal factors attribute 20th century global temperature, precipitation, and sea level changes to greenhouse gas emissions from vehicles, power plants, deforestation, and other human activities (Intergovernmental Panel on Climate Change (IPCC) 2013). Data from NOAA (2014) show that sea level has risen around Boston, MA over the last 92 years at the rate of 0.11 in/yr over 1921–2012. In addition, a large number of tropical storms and hurricanes have passed through the region. Approximately five tropical- or extratropical storm paths have directly moved over BOHA since 1842. The strongest storm path to move directly over BOHA belonged to an unnamed tropical storm that struck in 1923. The strongest tropical storm to pass within 10 miles of the park belonged to tropical storm Bob in 1991. Despite Bob's downgraded status from a hurricane to a tropical storm, gusts reached up to 89 mph when it passed BOHA (IBTrACS 2010).

Future Projections

The IPCC has coordinated research groups in projecting possible future climate under defined greenhouse gas emissions scenarios (IPCC 2013). All emissions scenarios show that sea level will substantially increase over the next century (Table 1). Global sea level projections by the IPCC (2013) show increases in the rate of sea level change overall (Table 1). Sea level data downscaled to Boston, MA indicates that the rate of rise is projected to be higher than the global average rate of sea level rise under most climate change scenarios (Figure 1; Table 1).

The IPCC (2012) has stated that storm intensity is likely to increase in the future. It can be expected that storm surges will increase as storm intensity increases, however the number of storms and their paths may not change. Presently, storm surges are predicted to reach up to 19.3 ft at the Spectacle Island visitor center if a category 4 hurricane struck at high tide (Figures 2 and 3; Table 1). While a category 4 hurricane is unlikely to occur over the next century, a category 1 and 2 hurricane is more likely to reach BOHA over the next century as storm strengths increase due to climate change.

Status, Trends, Confidence

Based on these data, it is recommended that both sea level rise and storm surge should be considered a significant concern to BOHA and the surrounding region, especially the islands. It is expected that both of these factors will continue to increase in the future. The condition is expected to deteriorate as more land-based ice melts and ocean waters continue to warm. We

have a very high degree of confidence that both storm surges and sea levels will rise in the future.

References

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Table 1. Boston Harbor Islands National Recreation Area sea level and storm surge trends.

	Mean	Units	Source
Historical			
Sea level, Boston 1921–2012	0.11 (2.79)	in/yr (mm/yr)	NOAA (2014)
Number of tropical storms, depressions, and subtropical storms to directly strike BOHA, 1842–2011	5	n/a	IBTrACS (2010)
Number of tropical storms, depressions, and subtropical storms paths within 10 miles of BOHA, 1842–2011	12	n/a	IBTrACS (2010)
Number of hurricanes to directly strike BOHA, 1842–2011	0	n/a	IBTrACS (2010)
Number of hurricanes paths within 10 miles of BOHA, 1842–2011	0	n/a	IBTrACS (2010)
Global Sea Level Projections			
RCP2.6 global sea level scenario by 2100	1.31 (0.40)	ft (m)	IPCC (2013)
RCP4.5 global sea level scenario by 2100	1.54 (0.47)	ft (m)	IPCC (2013)
RCP6.0 global sea level scenario by 2100	1.57 (0.48)	ft (m)	IPCC (2013)
RCP8.5 global sea level scenario by 2100	2.07 (0.63)	ft (m)	IPCC (2013)
USACE Sea Level Projections for Boston, MA			
<i>Low (historical rate) scenario:</i>			
2030	0.32 (0.10)	ft (m)	USACE (2013)
2050	0.48 (0.15)	ft (m)	USACE (2013)
2100	0.90 (0.27)	ft (m)	USACE (2013)
<i>Intermediate scenario:</i>			
2030	0.45 (0.14)	ft (m)	USACE (2013)
2050	0.78 (0.24)	ft (m)	USACE (2013)

2100	1.94 (0.59)	ft (m)	USACE (2013)
<i>High scenario:</i>			
2030	0.85 (0.26)	ft (m)	USACE (2013)
2050	1.73 (0.53)	ft (m)	USACE (2013)
2100	5.22 (1.59)	ft (m)	USACE (2013)

Estimated Storm Surge Heights¹ By Location

Spectacle Island visitor center

Saffir-simpson category 1 @ mean tide	5.4 (1.6)	ft (m)	NOAA SLOSH ²
Saffir-simpson category 2 @ mean tide	10.2 (3.1)	ft (m)	NOAA SLOSH
Saffir-simpson category 3 @ mean tide	14.1 (4.3)	ft (m)	NOAA SLOSH
Saffir-simpson category 4 @ mean tide	17.5 (5.3)	ft (m)	NOAA SLOSH
Saffir-simpson category 1 @ high tide	7.5 (2.3)	ft (m)	NOAA SLOSH
Saffir-simpson category 2 @ high tide	12.1 (3.7)	ft (m)	NOAA SLOSH
Saffir-simpson category 3 @ high tide	15.6 (4.8)	ft (m)	NOAA SLOSH
Saffir-simpson category 4 @ high tide	19.3 (5.9)	ft (m)	NOAA SLOSH

Fort Warren, Georges Island

Saffir-simpson category 1 @ mean tide	4.5 (1.4)	ft (m)	NOAA SLOSH
Saffir-simpson category 2 @ mean tide	8.3 (2.5)	ft (m)	NOAA SLOSH
Saffir-simpson category 3 @ mean tide	11.9 (3.6)	ft (m)	NOAA SLOSH
Saffir-simpson category 4 @ mean tide	15.3	ft	NOAA SLOSH

¹ Storm surge heights are projected on top of current mean sea level. It should be expected that potential storm surge heights will change over time based on changes in mean sea level.

² Based on NOAA SLOSH MOM projections run by M. Caffrey using Providence/Boston (pv2) basin data.

	(4.7)	(m)	
Saffir-simpson category 1 @ high tide	6.5	ft	NOAA SLOSH
	(2.0)	(m)	
Saffir-simpson category 2 @ high tide	10.2	ft	NOAA SLOSH
	(3.1)	(m)	
Saffir-simpson category 3 @ high tide	13.8	ft	NOAA SLOSH
	(4.2)	(m)	
Saffir-simpson category 4 @ high tide	17.2	ft	NOAA SLOSH
	(5.2)	(m)	

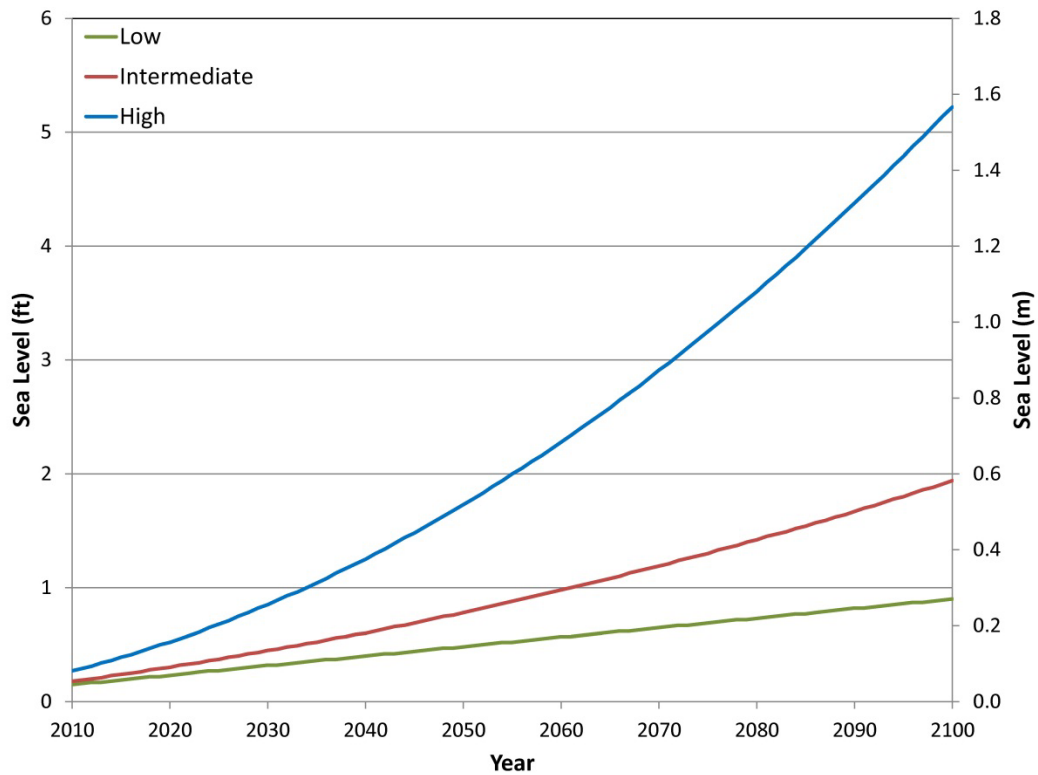


Figure 1: Projected rate of sea level rise for Boston, MA (USACE 2014)

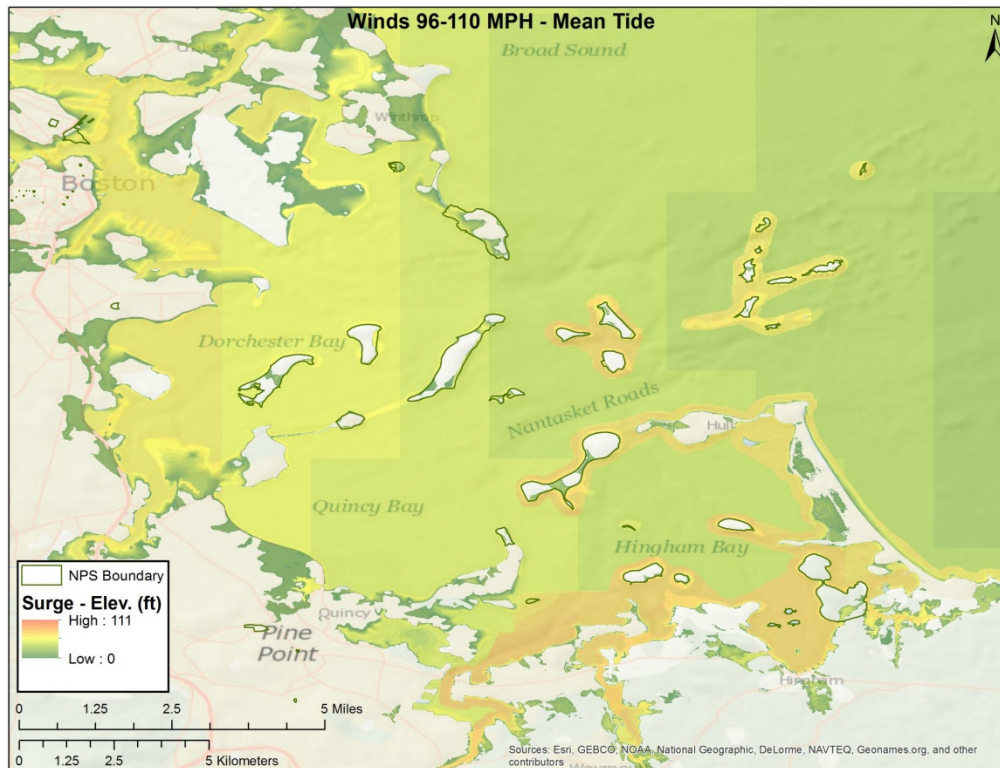


Figure 2: Storm surge (ft.) for a category 2 storm at mean tide (prepared using NOAA SLOSH).

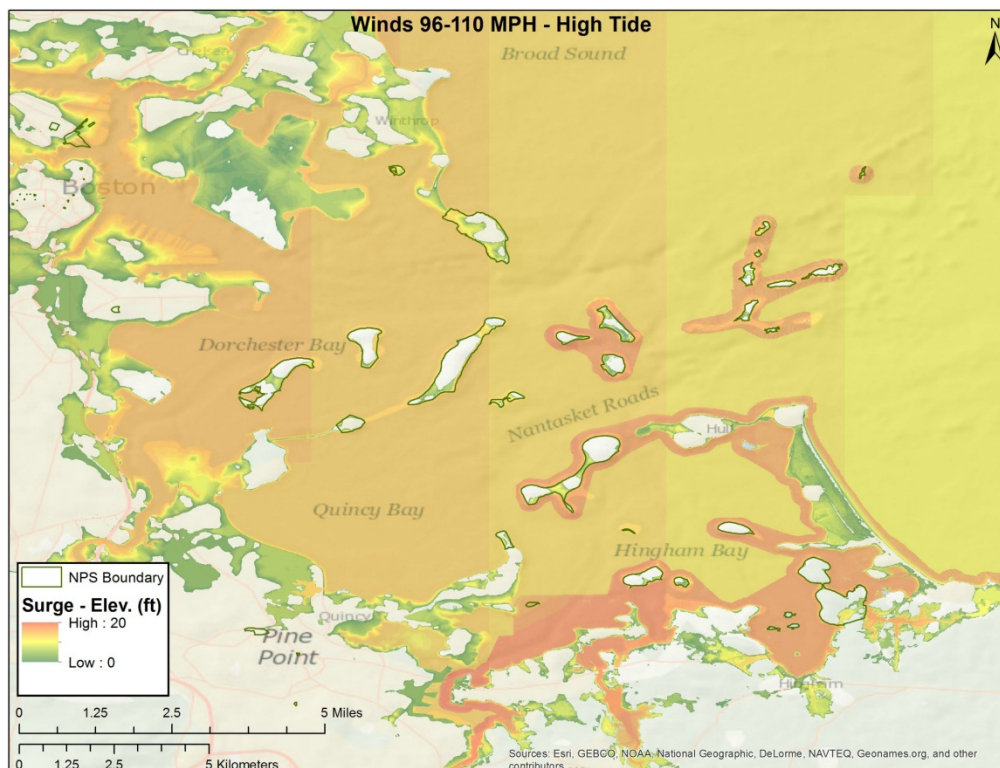


Figure 3: Storm surge (ft.) for a category 2 storm at high tide (prepared using NOAA SLOSH).