Sea level rise and coastal change: adapting to life in challenging times

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Quissett Harbor Preservation Trust
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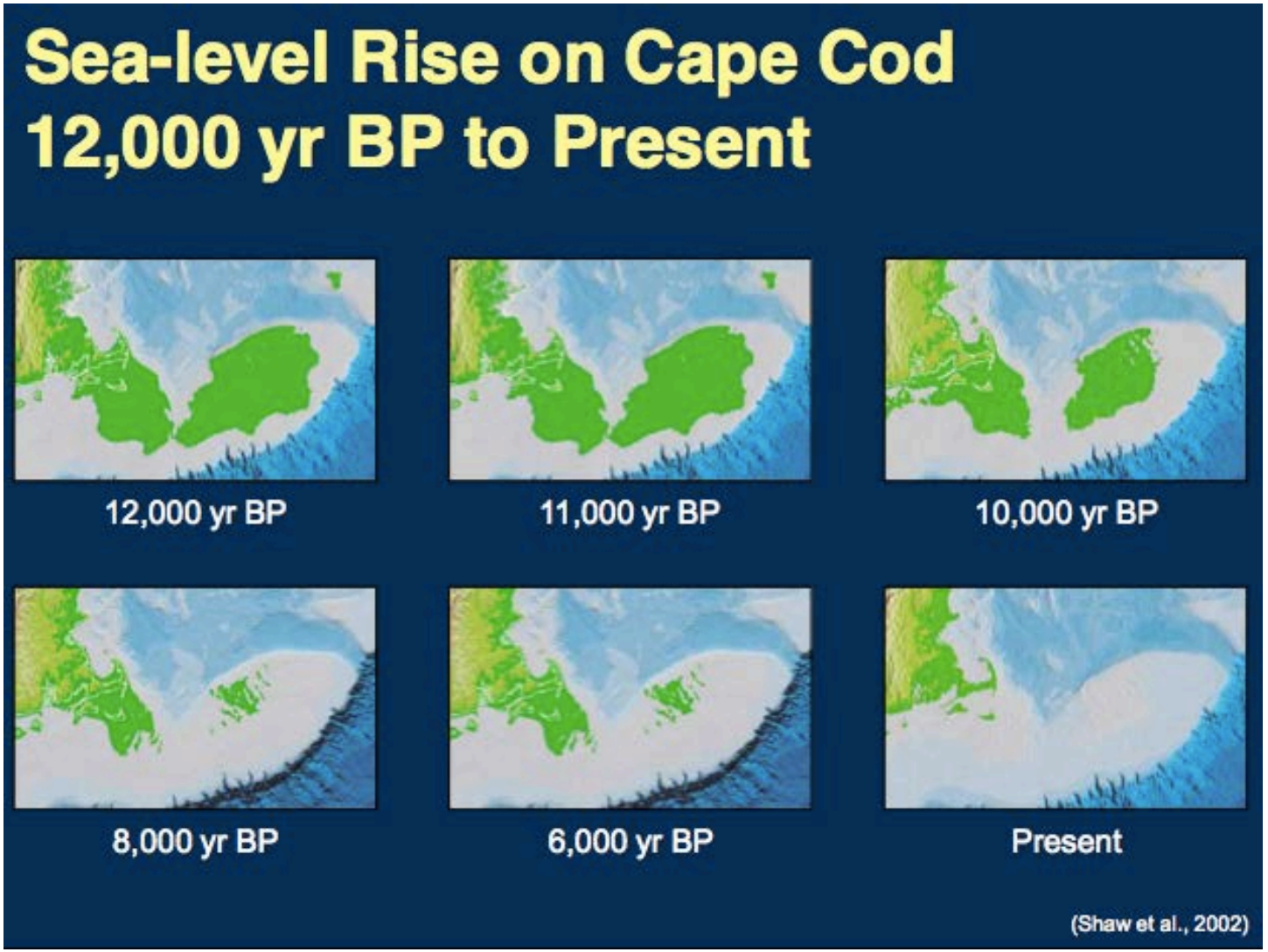
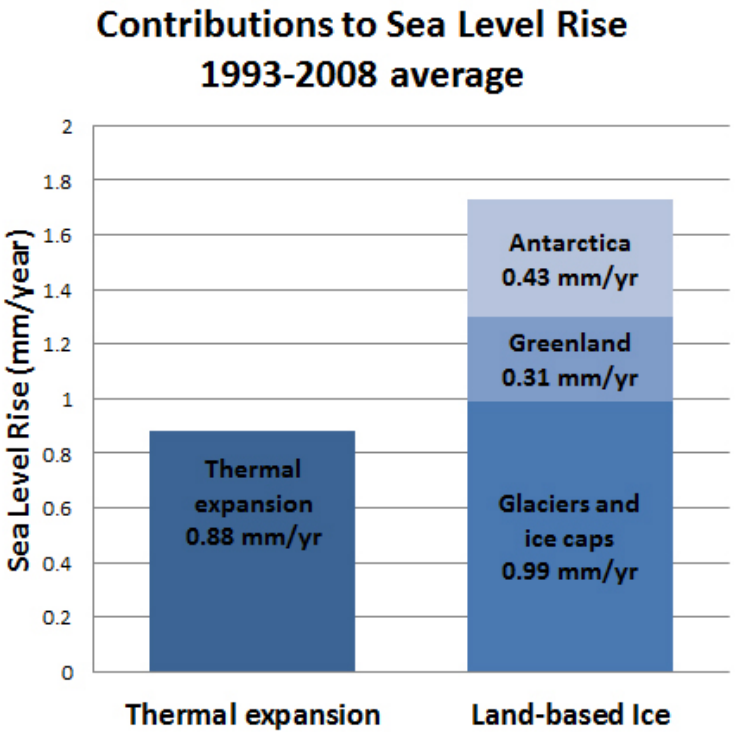
Geological context: sea level is always changing



Current causes of sea level rise:

- Melting glaciers (Greenland, Antarctica)
- Thermal expansion of oceans
- Land subsidence

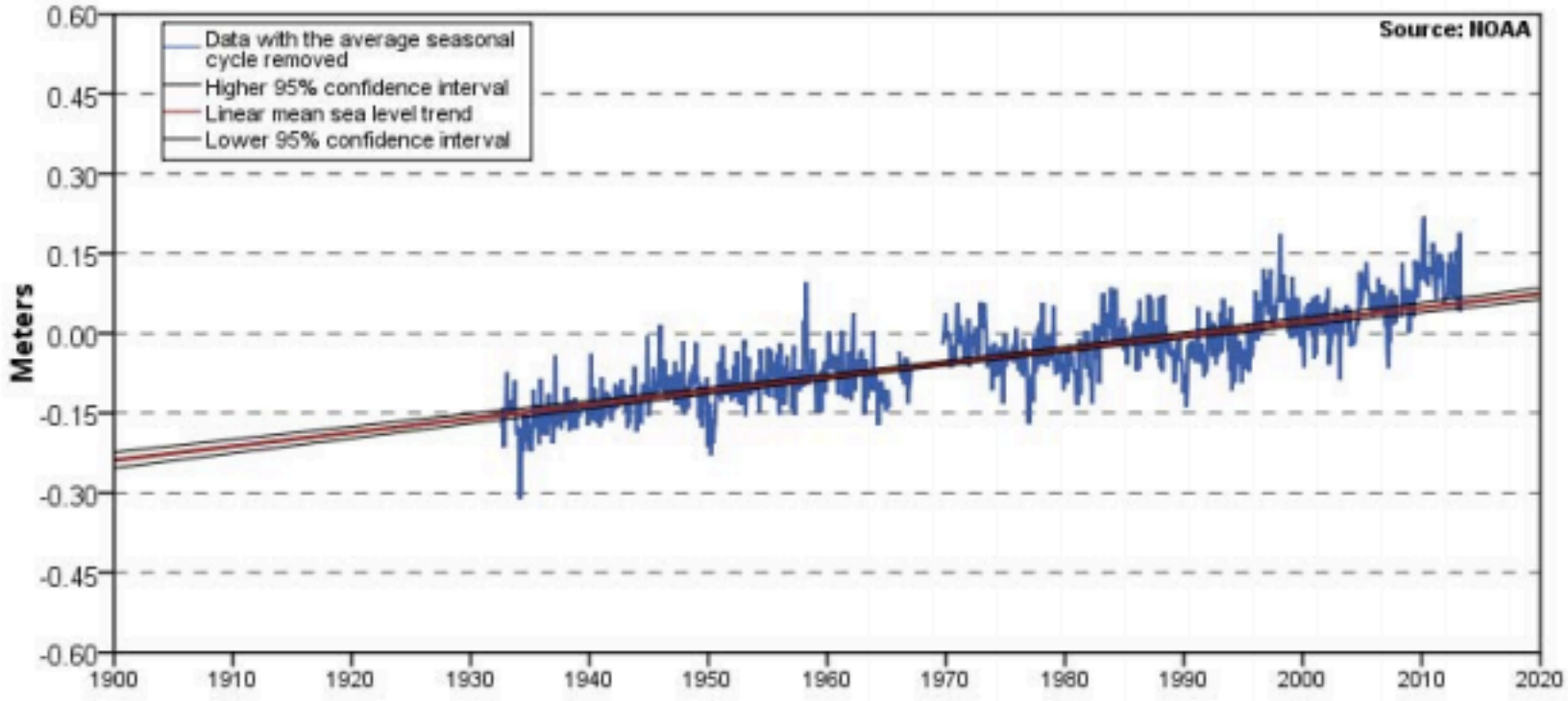


UCS, after Church et al. 2011

Table 1: Mean sea level trends for NOAA's Massachusetts tide gauge stations.

Station	Mean sea level trend and 95% confidence interval (millimeter/year)	(inch/year)	Period	Century rate (feet/100 years)
Boston, MA	2.79 ± 0.17	0.11 ± 0.007	1921-2012	0.92
Woods Hole, MA	2.81 ± 0.19	0.11 ± 0.007	1932-2012	0.92
Nantucket, MA	3.52 ± 0.42	0.14 ± 0.017	1965-2012	1.15

WOODS HOLE



(a) Sea level data for NOAA Woods Hole tide gauge station with linear trend and 95% confidence interval.

CZM 2013, SLR planning guidance document

****There is substantial uncertainty in SLR predictions****

- How much heat is the ocean absorbing?
- How quickly are/will Greenland and Antarctic ice sheets melt?
- Are there tipping points, feedback loops?

Table 3. Relative sea level rise estimates for Boston, MA. Global scenarios were adjusted to account for local vertical land movement with 2003 as the beginning year of analysis.

Scenario	2025		2038		2050		2063		2075		2088		2100	
	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m
Highest	0.49	0.15	1.08	0.33	1.81	0.55	2.80	0.85	3.92	1.19	5.33	1.63	6.83	2.08
Intermediate High	0.36	0.11	0.73	0.22	1.19	0.36	1.80	0.55	2.47	0.75	3.32	1.01	4.20	1.28
Intermediate Low	0.24	0.07	0.43	0.13	0.65	0.20	0.92	0.28	1.21	0.37	1.55	0.47	1.91	0.58
Lowest (Historic Trend)	0.18	0.06	0.29	0.09	0.39	0.12	0.50	0.15	0.60	0.18	0.71	0.22	0.81	0.25
Range	0.31	0.09	0.79	0.24	1.42	0.43	2.30	0.70	3.32	1.01	4.62	1.41	6.02	1.83

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Other climate changes include increases in heavy precipitation, increasing flooding, runoff and erosion

Percentage Change in Very Heavy Precipitation

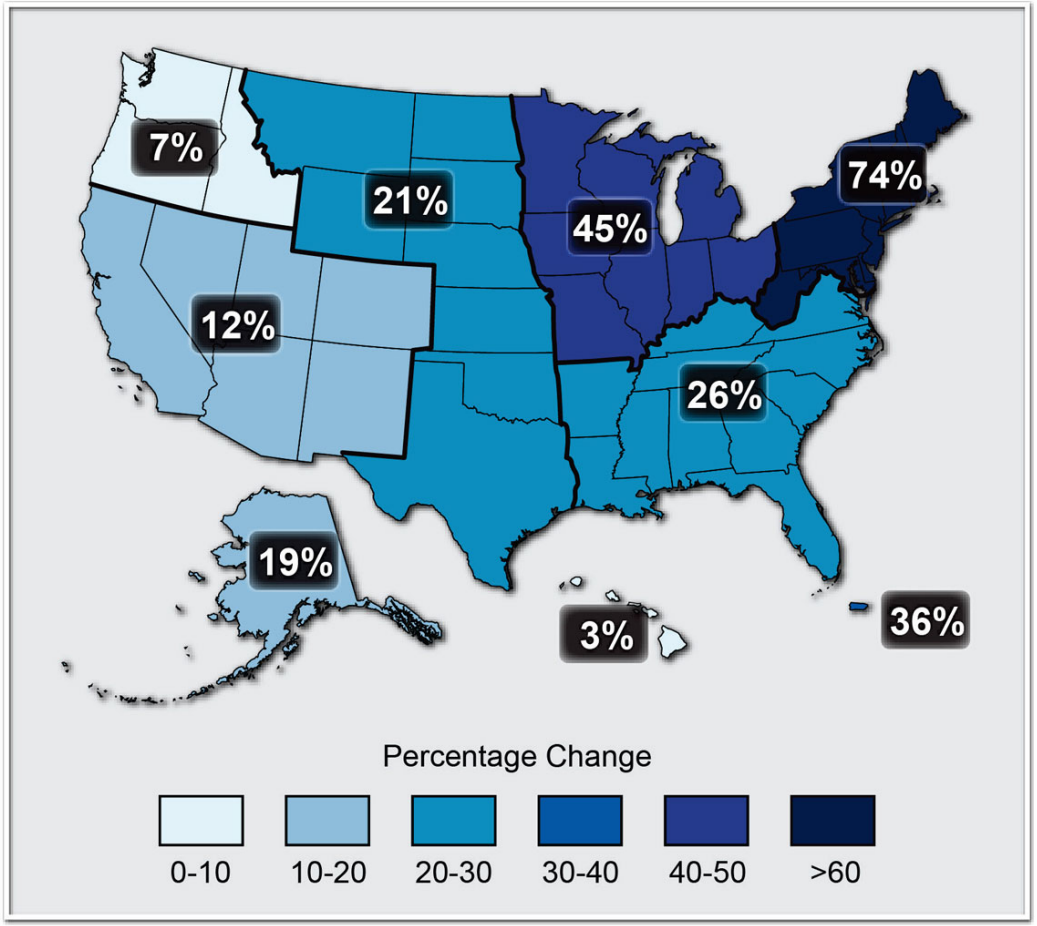

Figure 2.16: Percentage Change in Very Heavy Precipitation
Caption: The map shows percent increases in the amount of precipitation falling in very heavy events (defined as the heaviest 1% of all daily events) from 1958 to 2011 for each region. There are clear trends toward a greater amount of very heavy precipitation for the nation as a whole, and particularly in the Northeast and Midwest.
(Figure source: updated from (Karl et al. 2009) with data from NCDC)

Source: National Climate Assessment Draft January 2013; http://ncadac.globalchange.gov/download/NCAJan11-2013-publicreviewdraft-chap2-climate.pdf

Damage from the 1991 Halloween nor'easter (Image: NOAA)

Erosion on Plum Island, MA, after winter storm Nemo, Feb. 2013. Image: Mike Seidel

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- Managed retreat
- Reduce overland runoff
  - pervious pavers, grass/gravel driveways and parking lots
  - rain gardens
  - protect open space

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It takes a village.

After Hurricane Ike, Gilchrist Texas 2008

Photo credit: Robert Mihovil

For more information:

Dealing with coastal erosion: the spectrum of erosion control methods (WHOI Sea Grant)
http://web.whoi.edu/seagrant/new-document-released-on-dealing-with-coastal-erosion-through-the-spectrum-of-control-methods/

StormSmart Properties (Mass. Office of Coastal Zone Management StormSmart Coasts program)
http://www.mass.gov/eea/agencies/czm/program-areas/stormsmart-coasts/stormsmart-properties/

Sea Level Rise: understanding and applying trends and future scenarios for analysis and planning (Mass. Office of Coastal Zone Management)
http://www.mass.gov/eea/docs/czm/stormsmart/slr-guidance-2013.pdf

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