Coastal Flood Risk in Connecticut

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NOAA Technical Report OAR CPO-1

GLOBAL SEA LEVEL RISE SCENARIOS FOR THE UNITED STATES NATIONAL CLIMATE ASSESSMENT

Climate Program Office (CPO)
Silver Spring, MD

Global Mean SLR Scenarios

We have very high confidence (>9 in 10 chance) that global mean sea level will rise at least 0.2 meters (8 inches) and no more than 2.0 meters (6.6 feet) by 2100.

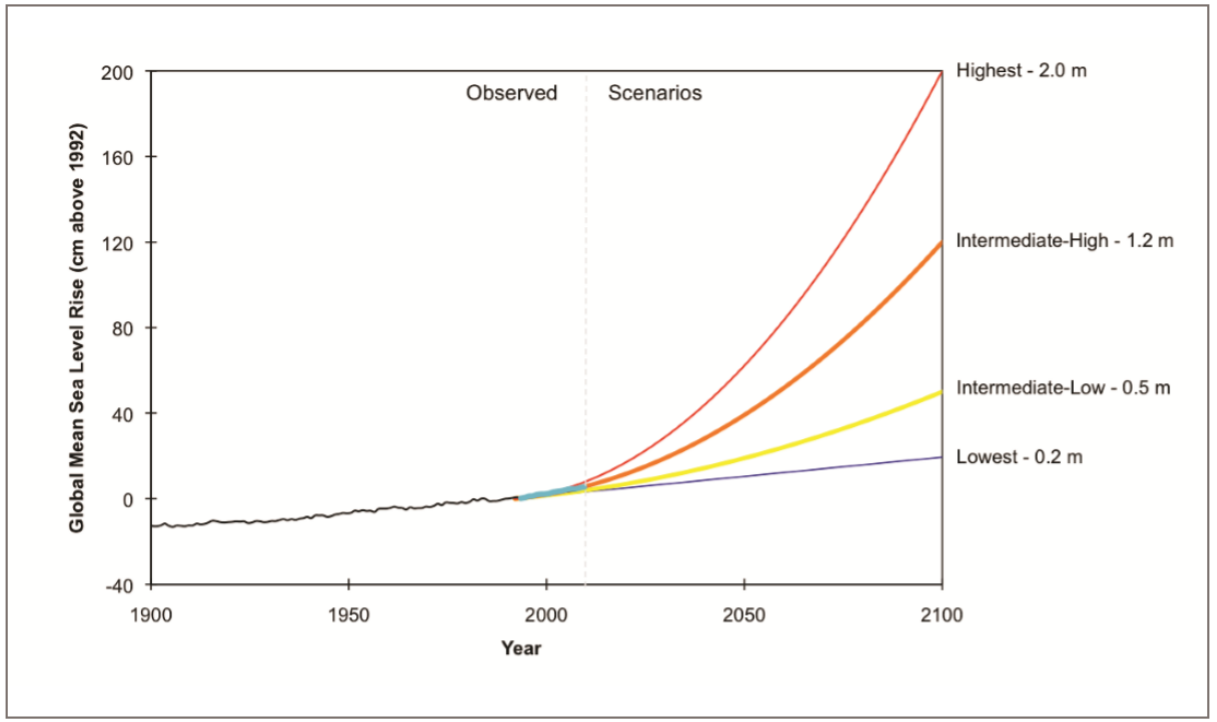


Figure ES 1. Global mean sea level rise scenarios. Present Mean Sea Level (MSL) for the US coasts is determined from the National Tidal Datum Epoch (NTDE) provided by NOAA. The NTDE is calculated using tide gauge observations from 1983 – 2001. Therefore, we use 1992, the mid-point of the NTDE, as a starting point for the projected curves. The Intermediate-High Scenario is an average of the high end of ranges of global mean SLR reported by several studies using semi-empirical approaches. The Intermediate Low Scenario is the global mean SLR projection from the IPCC AR4 at the 95% confidence interval.

Charge

In the Memorandum of Understanding between the Connecticut Department of Energy and Environmental Protection and the University of Connecticut establishing CIRCA included the direction that the institute should:

Develop a predictive tool(s) for municipalities that accounts for local conditions and establishes a mechanism for determining appropriate planning based on the sea level change scenarios published by the National Oceanic and Atmospheric Administration in Technical Report OAR CPO-1. Conduct at least one statewide workshop and provide online access to such tool(s).

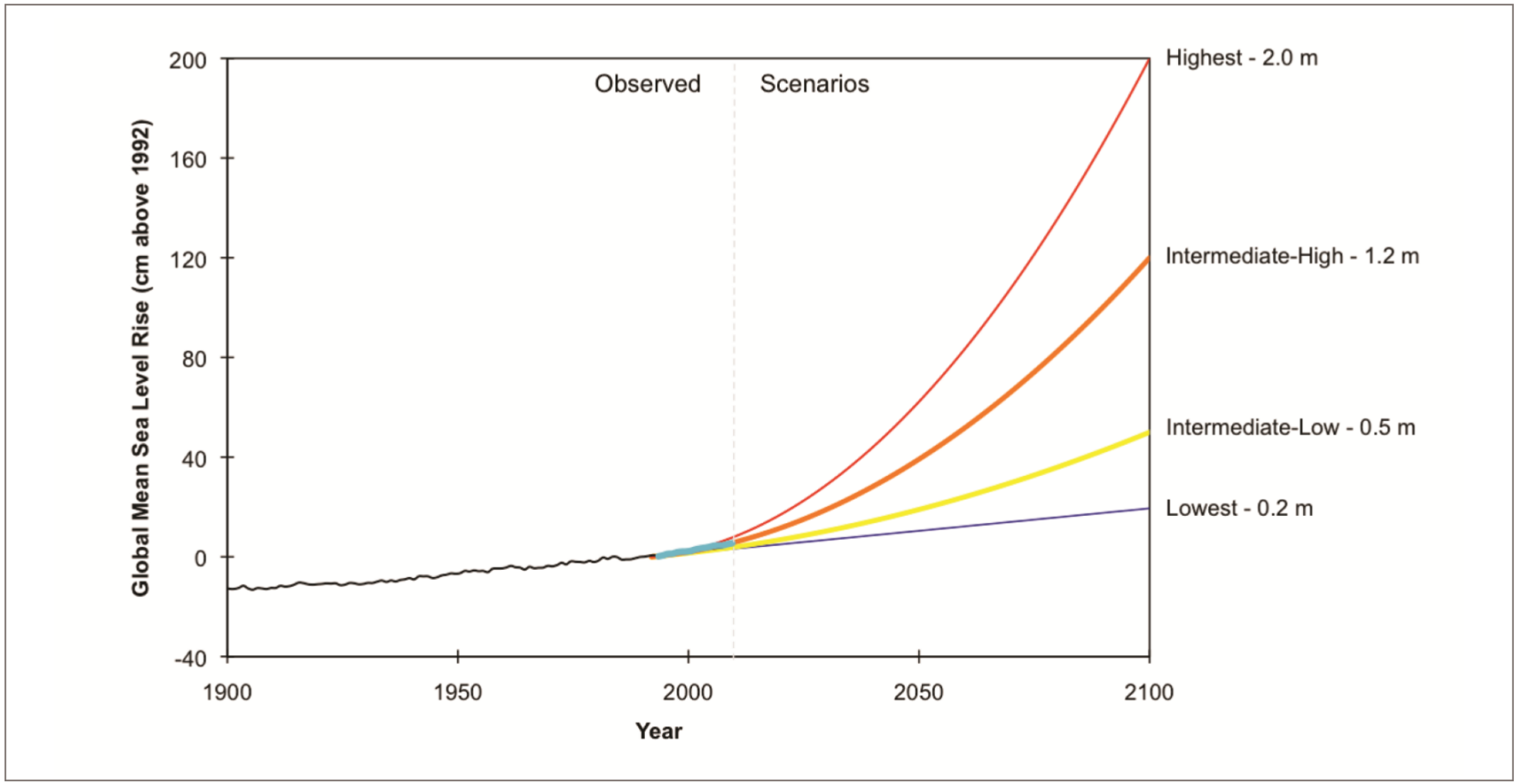


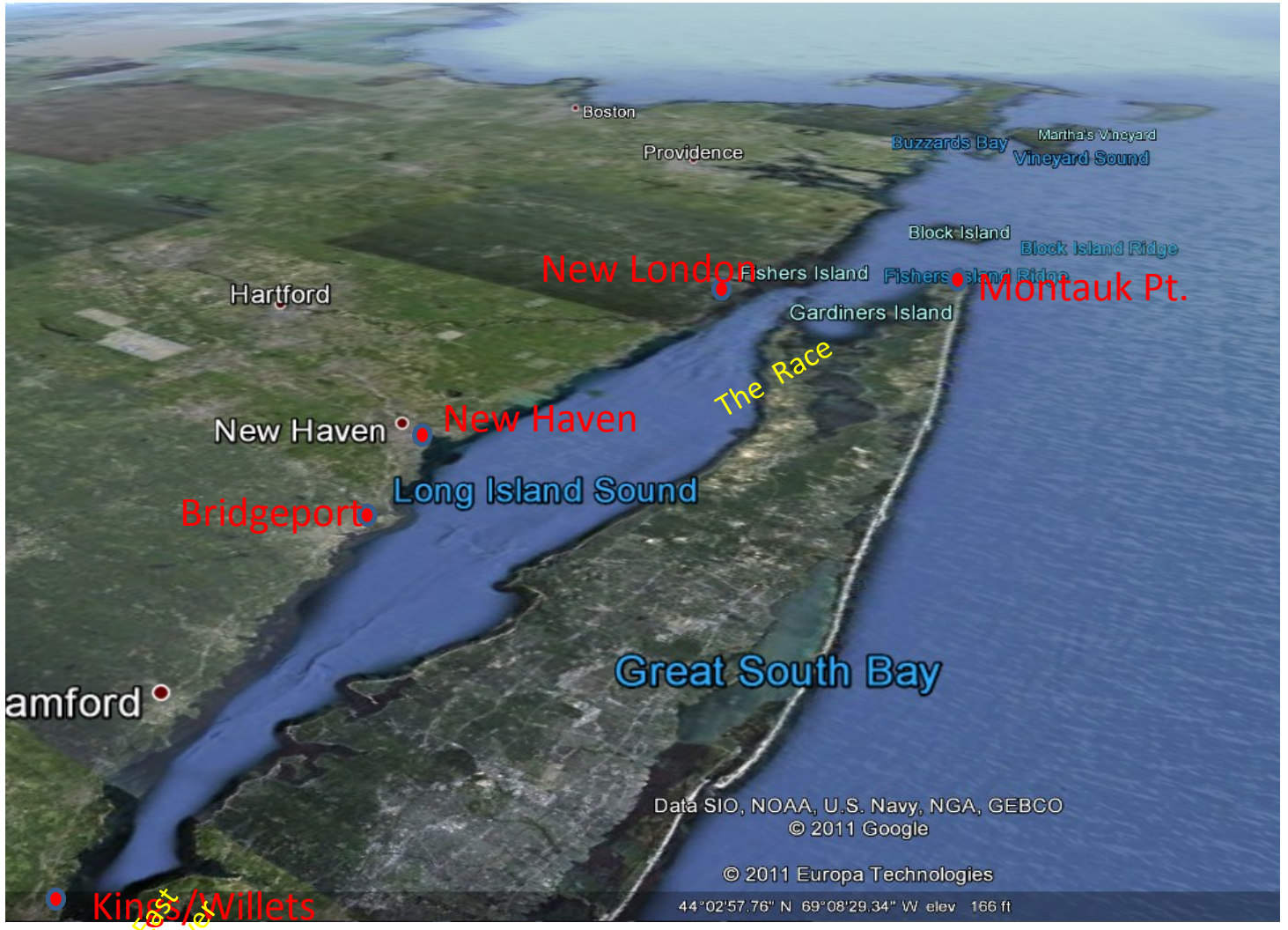
Figure 10. Global mean sea level rise scenarios. Present Mean Sea Level (MSL) for the US coasts is determined from the National Tidal Datum Epoch (NTDE) provided by NOAA. The NTDE is calculated using tide gauge observations from 1983 – 2001. Therefore, we use 1992, the mid-point of the NTDE, as a starting point for the projected curves. The Intermediate High Scenario is an average of the high end of ranges of global mean SLR reported by several studies using semi-empirical approaches. The Intermediate Low Scenario is the global mean SLR projection from the IPCC AR4 at 95% confidence interval.

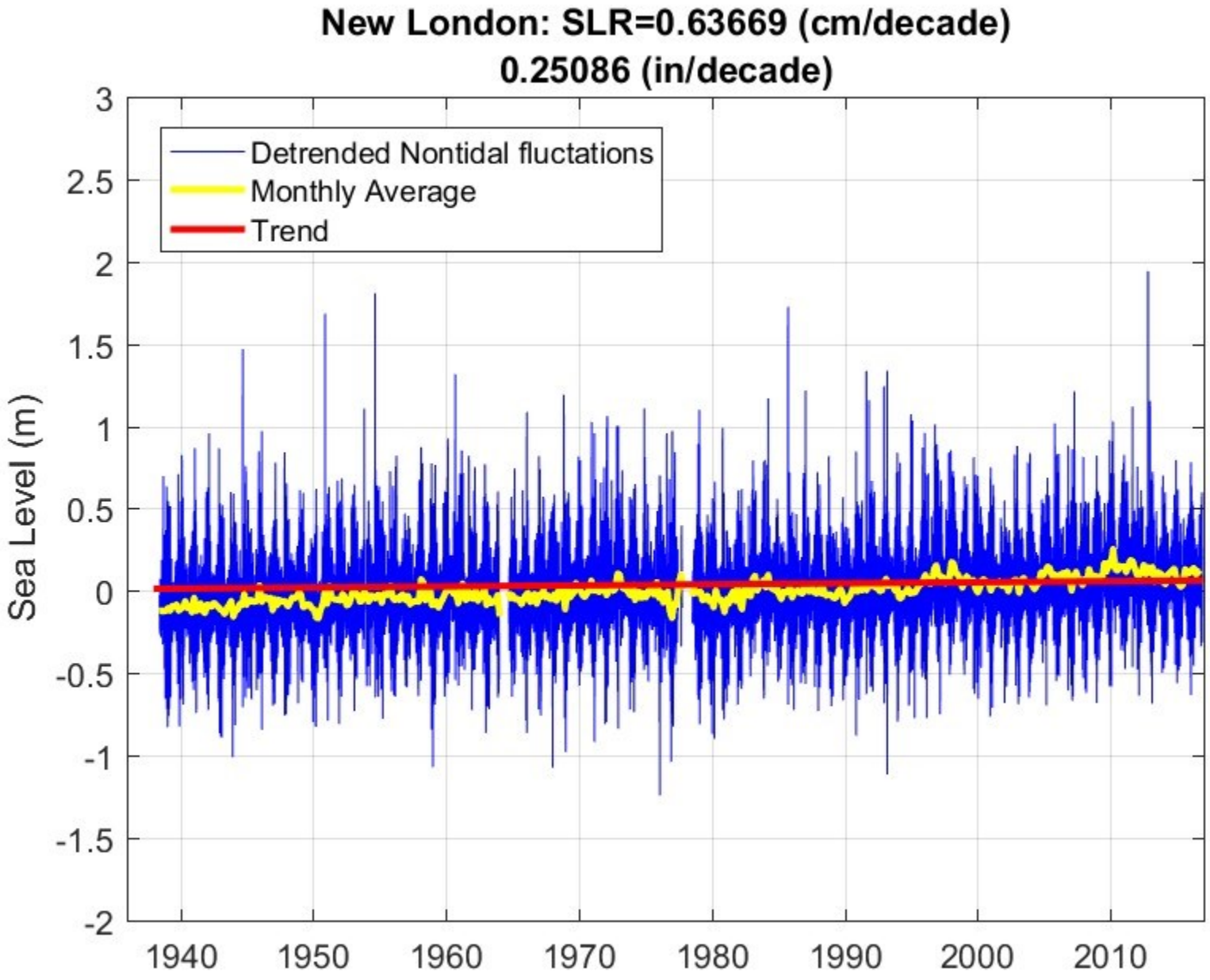
Intermediate Low

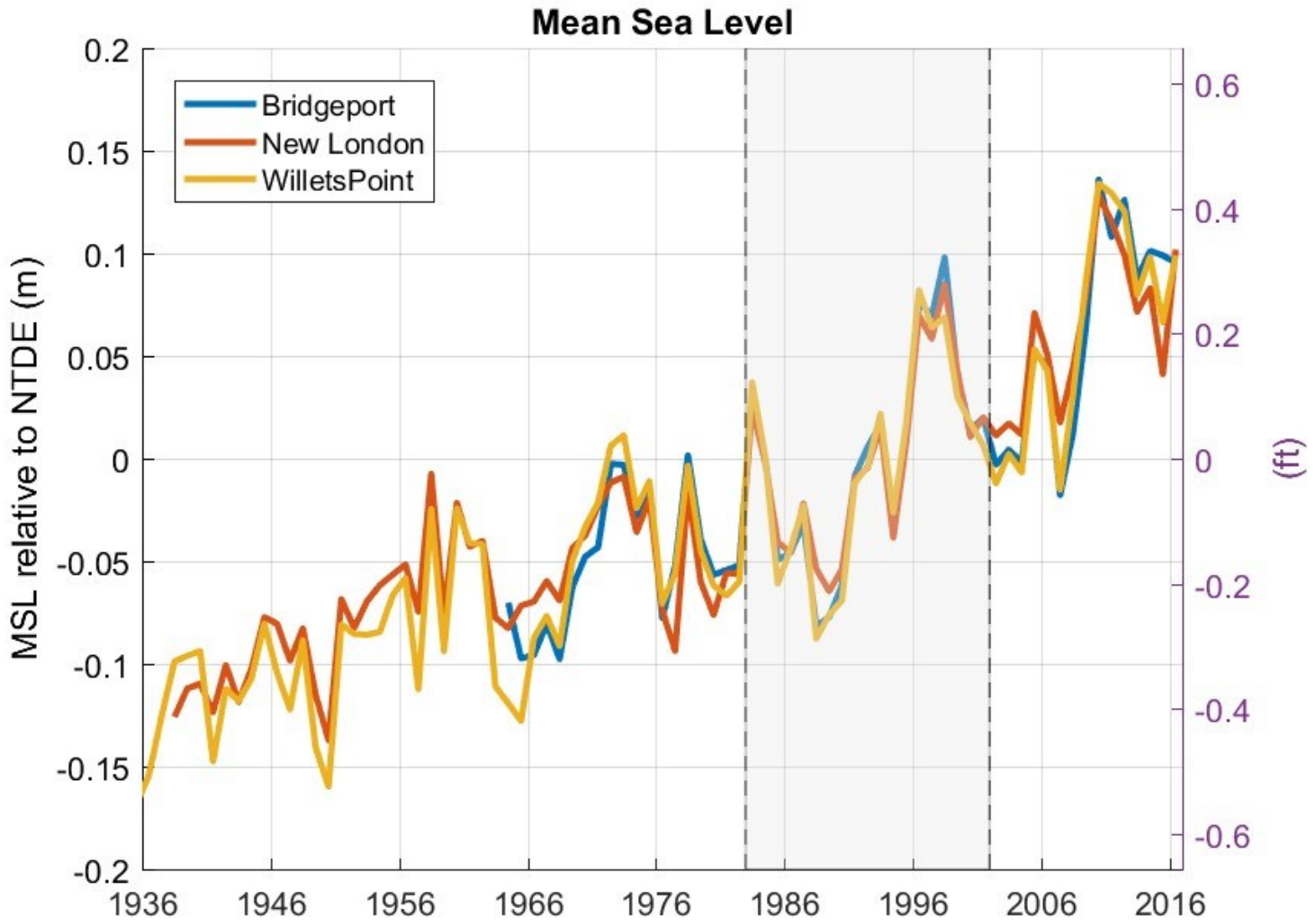
In IPCC AR4 scenario A2 the continued emission of GHGs was expected to lead to a concentration of 870 PPM by 2100 (more than twice the 2016 level) and a warming of the global average surface air temperature of 3.5 C between 2000 and 2100 (IPCC, 2007). The 5-95% range of the predicted rise in global mean sea level between the decades 1980 to 1999 and 2090 to 2099 was 0.23 to 0.51 m (or 0.75 to 1.67 ft).

Updates

- Review of Observations in CT up to 2016
- Review of IPCC (2013) Model Predictions near CT
- Model of Mean Sea Level variations in LIS
- Summary


Boston
Providence
Buzzards Bay
Martha's Vineyard
Vineyard Sound
Block Island
Block Island Ridge
New London
Fishers Island
Fishers Island Ridge
Montauk Pt.
Hartford
Gardiners Island
The Race
New Haven
New Haven
Long Island Sound
Bridgeport
Great South Bay
amford
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2011 Google
© 2011 Europa Technologies
44°02'57.76" N 69°08'29.34" W elev 166 ft
Kings/Willets Pt.
East River


New London: SLR=0.63669 (cm/decade)
0.25086 (in/decade)
Detrended Nontidal fluctations
Monthly Average
Trend
Sea Level (m)
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
1940
1950
1960
1970
1980
1990
2000
2010



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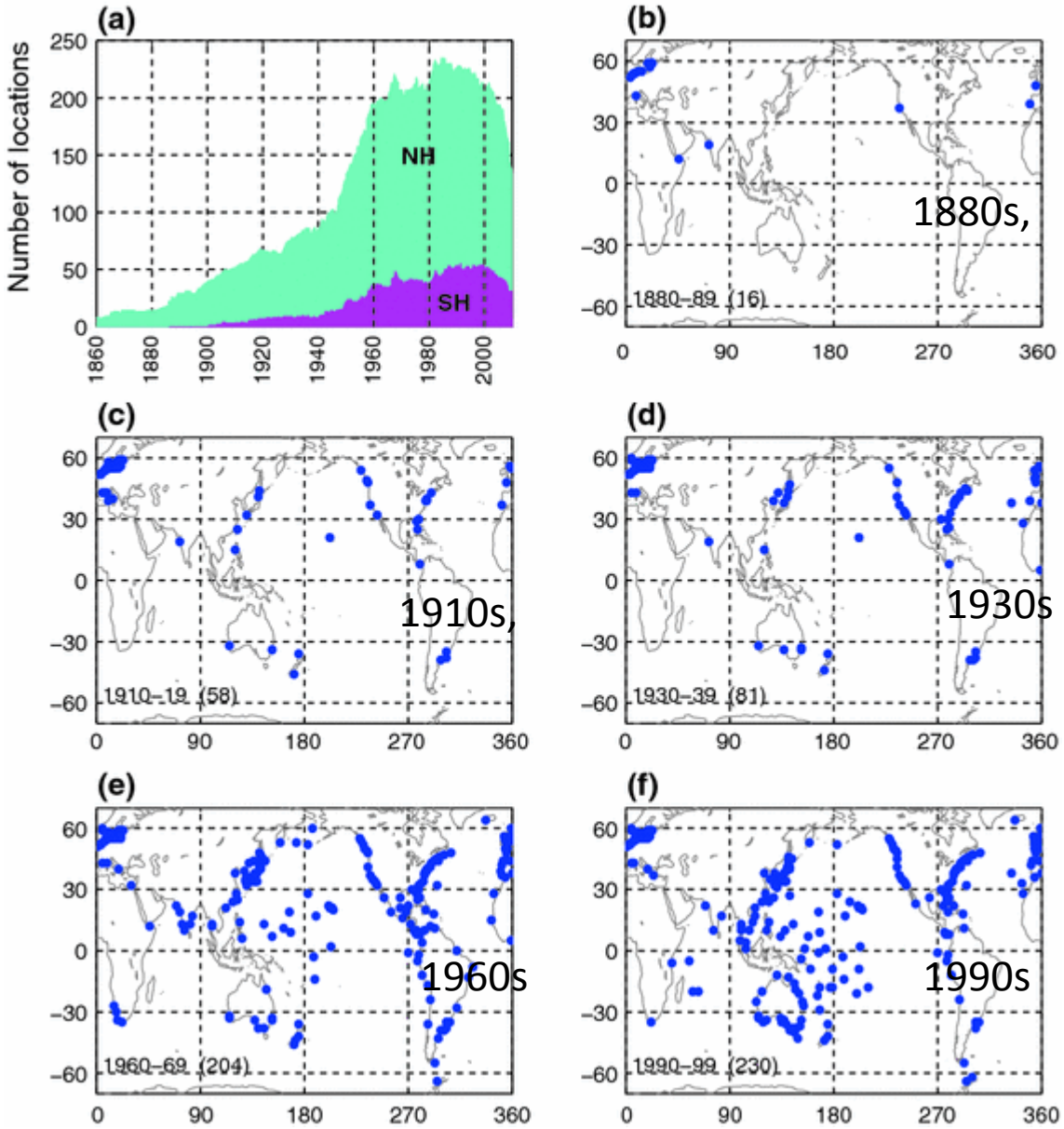
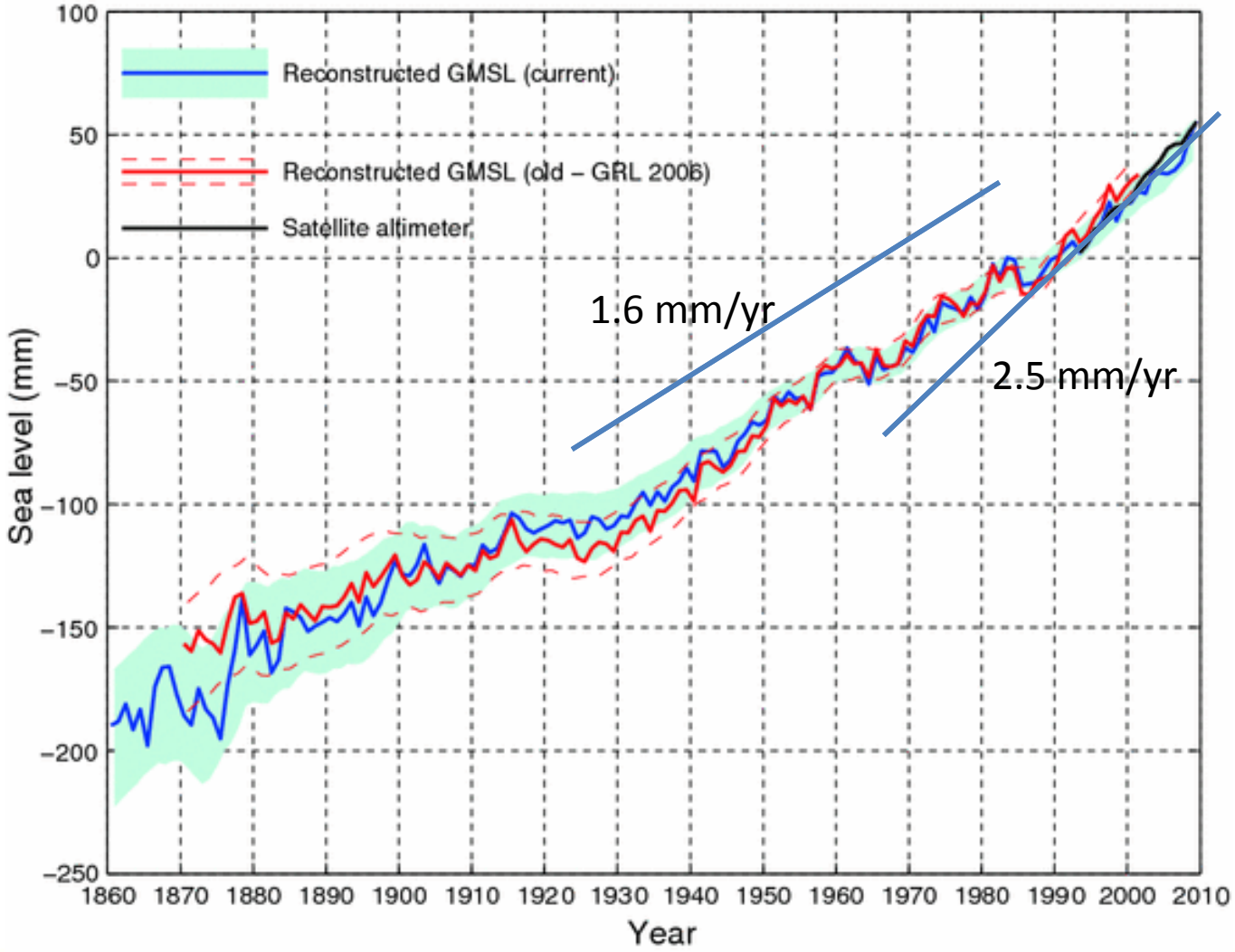
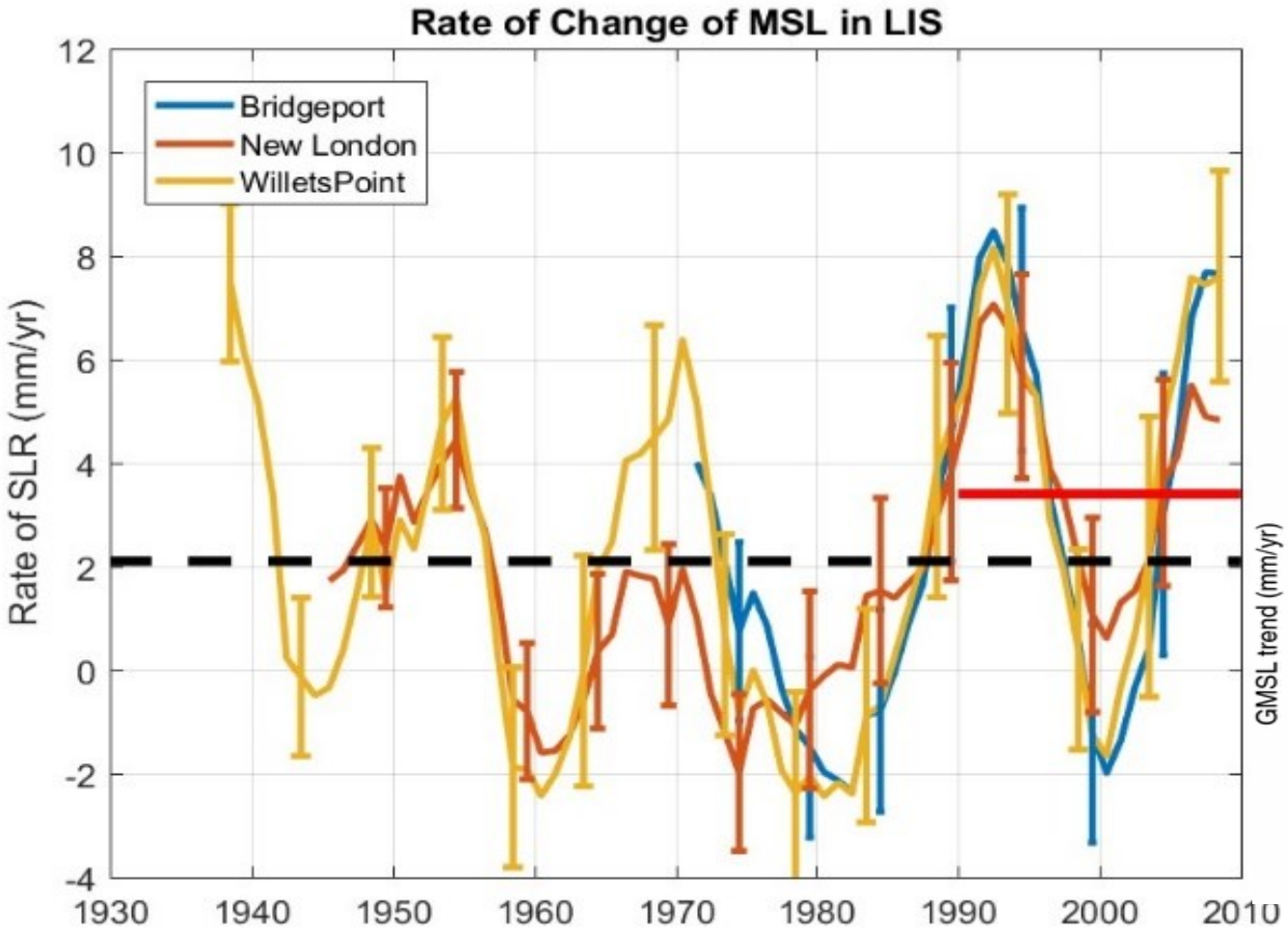


Church and White, 2011

- The number and distribution of sea-level records available for the reconstruction. **a** The number of locations for the globe and the northern and southern hemispheres. **b**–**f** indicate the distribution of gauges in the 1880s, 1910s, 1930s, 1960s and 1990s. The locations indicated have at least 60 months of data in the decade and the number of records are indicated in *brackets*

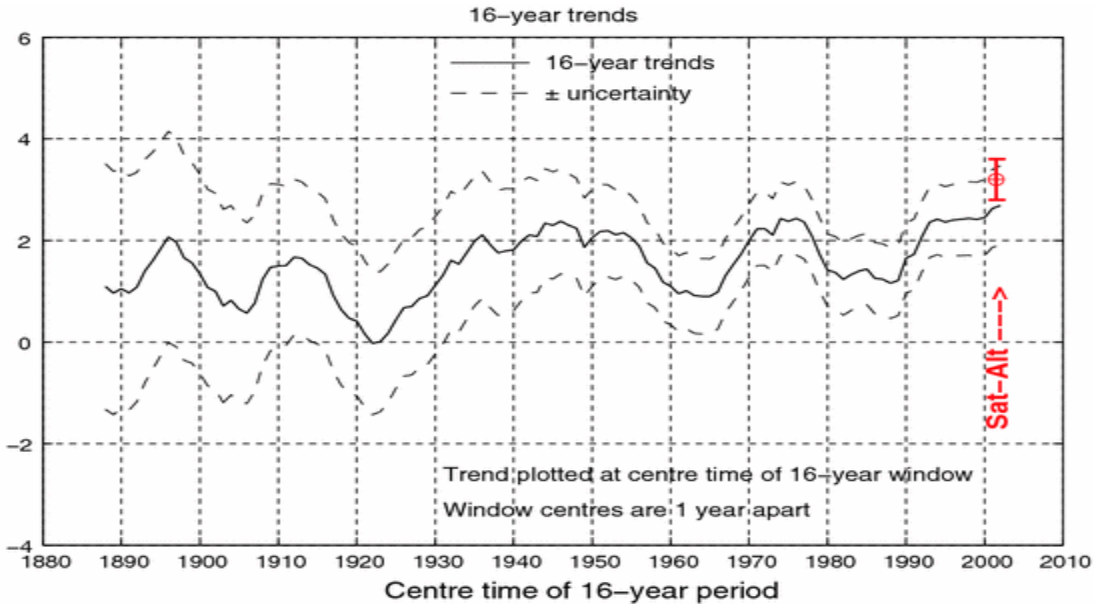
Church and White (2011) estimated the rate of sea level increase between 1900 and 2009 as 1.7 ± 0.2 mm/yr and 1.9 ± 0.4 mm/yr from 1961 to 2009





LIS Sea Level trends are in-line with the estimates of GMSL Rise when VLM (0.7mm/yr) is taken into account.

The most recent 15 years has been above the long term mean. The rate is equivalent to 4 mm/yr in LIS.



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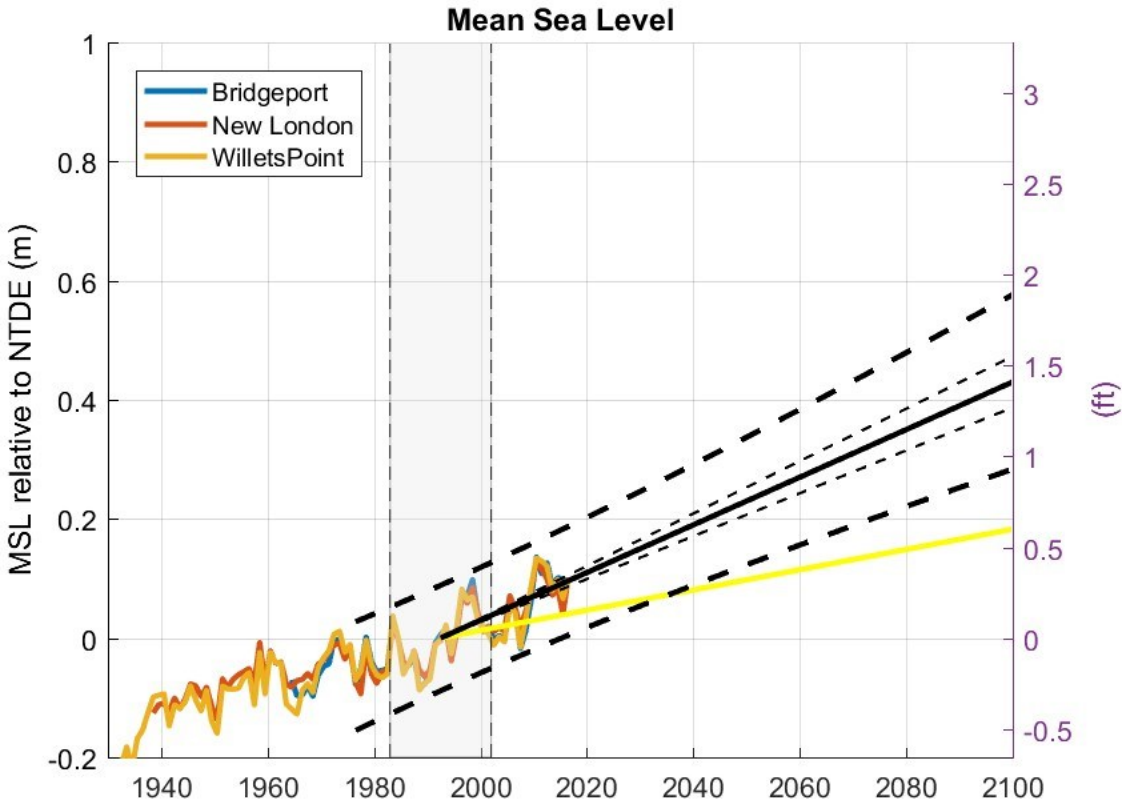
Summary of Results



Year	Mean (m)	Upper 95% (m)	NOAA (m)	Mean (ft)	Upper 95% (ft)	NOAA (ft)
2020	0.15	0.25	0.06	0.5	0.81	0.21
2030	0.19	0.29	0.08	0.63	0.96	0.27
2040	0.23	0.34	0.10	0.76	1.11	0.32
2050	0.27	0.39	0.12	0.89	1.27	0.38
2070	0.31	0.43	0.13	1.02	1.42	0.43
2080	0.35	0.48	0.15	1.15	1.58	0.49
2090	0.39	0.53	0.17	1.29	1.74	0.55
2100	0.43	0.58	0.18	1.42	1.9	0.60

http://cses.washington.edu/db/pdf/snoveretalsok2013sec3.pdf

Table 2 Overview of representative concentration pathways (RCPs)

	Description[a]	Publication—IA Model
RCP8.5	Rising radiative forcing pathway leading to 8.5 W/m^2 (~1370 ppm CO_2 eq) by 2100.	(Riahi et al. 2007)—MESSAGE
RCP6	Stabilization without overshoot pathway to 6 W/m^2 (~850 ppm CO_2 eq) at stabilization after 2100	(Fujino et al. 2006; Hijioka et al. 2008)—AIM
RCP4.5	Stabilization without overshoot pathway to 4.5 W/m^2 (~650 ppm CO_2 eq) at stabilization after 2100	(Clarke et al. 2007; Smith and Wigley 2006; Wise et al. 2009)—GCAM
RCP2.6	Peak in radiative forcing at ~3 W/m^2 (~490 ppm CO_2 eq) before 2100 and then decline (the selected pathway declines to 2.6 W/m^2 by 2100).	(Van Vuuren et al., 2007a; van Vuuren et al. 2006)—IMAGE

[a] Approximate radiative forcing levels were defined as ±5% of the stated level in W/m^2 relative to pre-industrial levels. Radiative forcing values include the net effect of all anthropogenic GHGs and other forcing agents

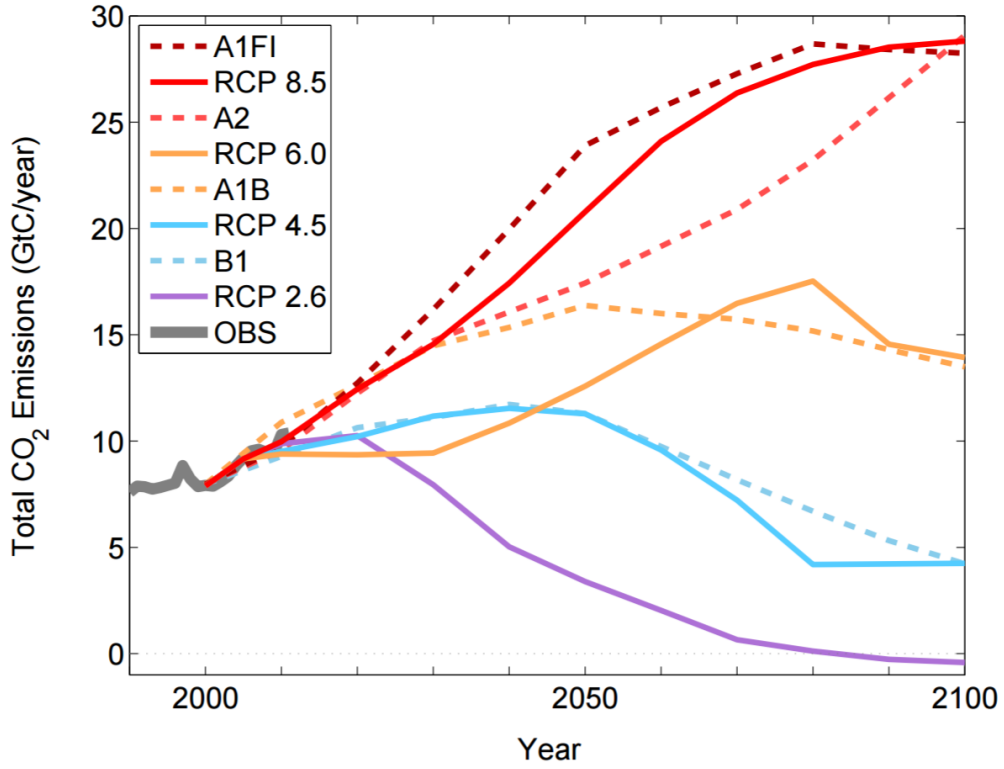
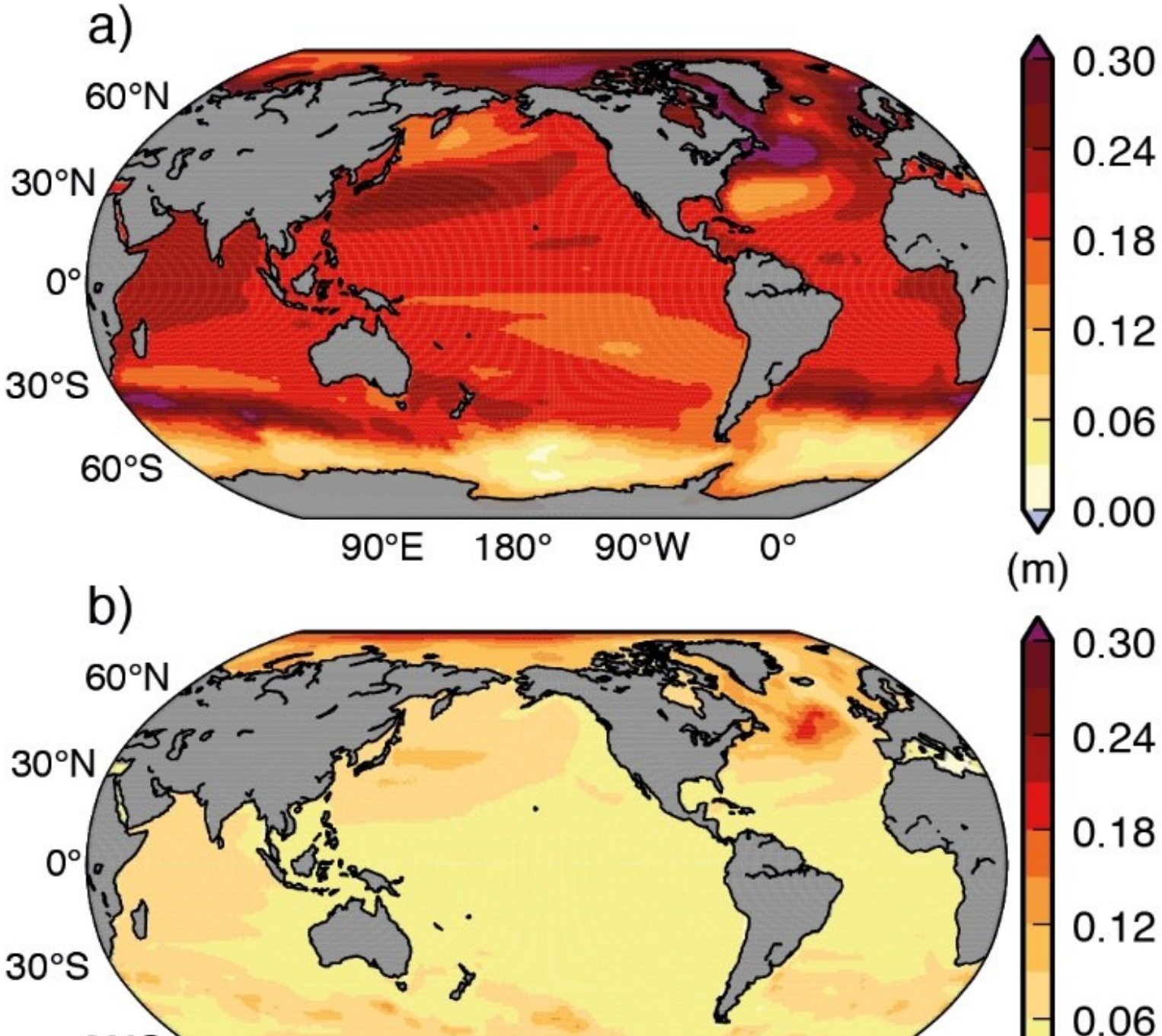


Figure 3-1. Future greenhouse gas scenarios range from aggressive reductions to large increases in greenhouse gas emissions. The figure shows annual total CO_2 emissions in Gigatons of Carbon (GtC). Though not the only greenhouse gas, CO_2 emissions are the dominant driver of global warming. The old greenhouse gas scenarios (dashed lines) have close analogs in the new scenarios (solid lines) – similar scenarios are plotted using similar colors. Actual emissions for 1990-2010 are shown in grey. Year-to-year emissions of greenhouse gases, shown in this graph, accumulate in the atmosphere, causing CO_2 concentrations to rise, as shown in Figure 3-2. Scenarios with higher emissions cause atmospheric concentrations to rise rapidly, while lower scenarios cause concentrations to rise more slowly or decline. *Figure source: Climate Impacts Group, based on data used in IPCC 2007 and IPCC 2013 (http://tntcat.iiasa.ac.at:8787/RcpDb[3] and http://sedac.ciesin.columbia.edu/ddc/sres/[4]).*



Sea Level change by 2100 in RCP4.5; from IPCC (2013)

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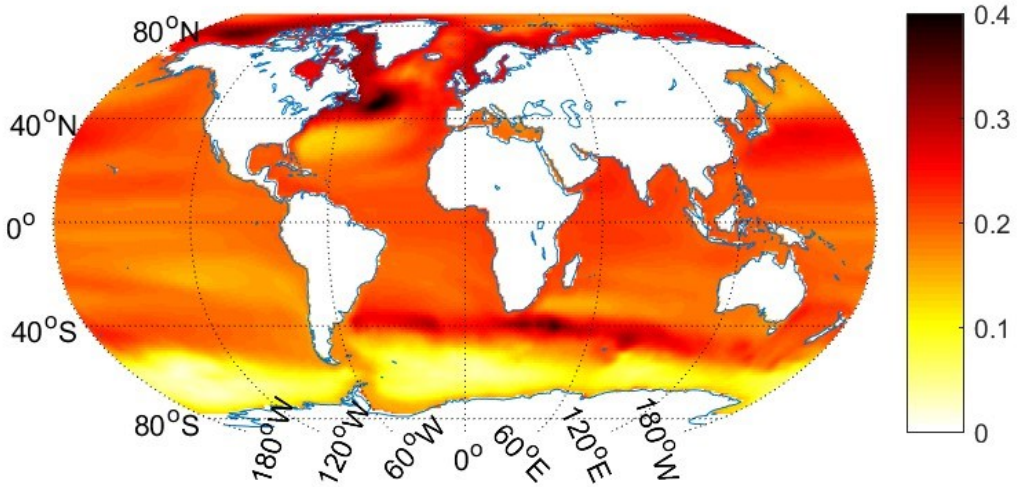
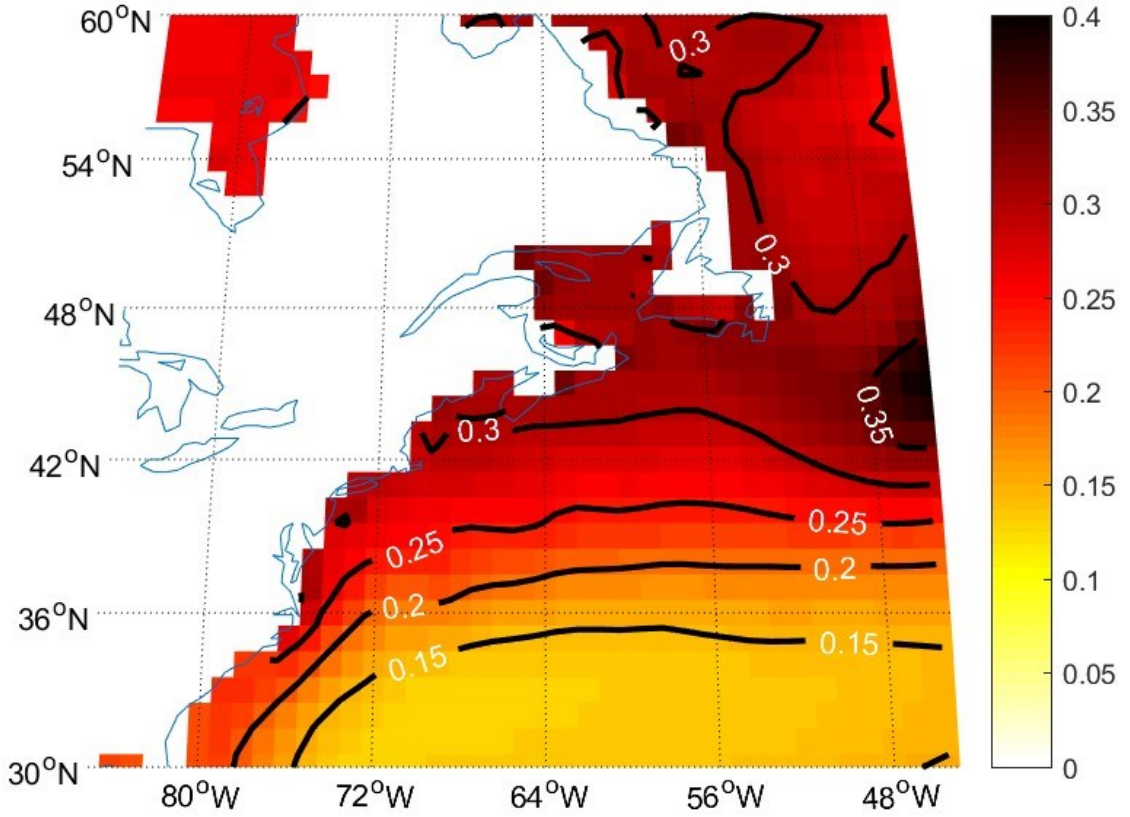
Change in mean MSL at 2100 in RCP 4.5





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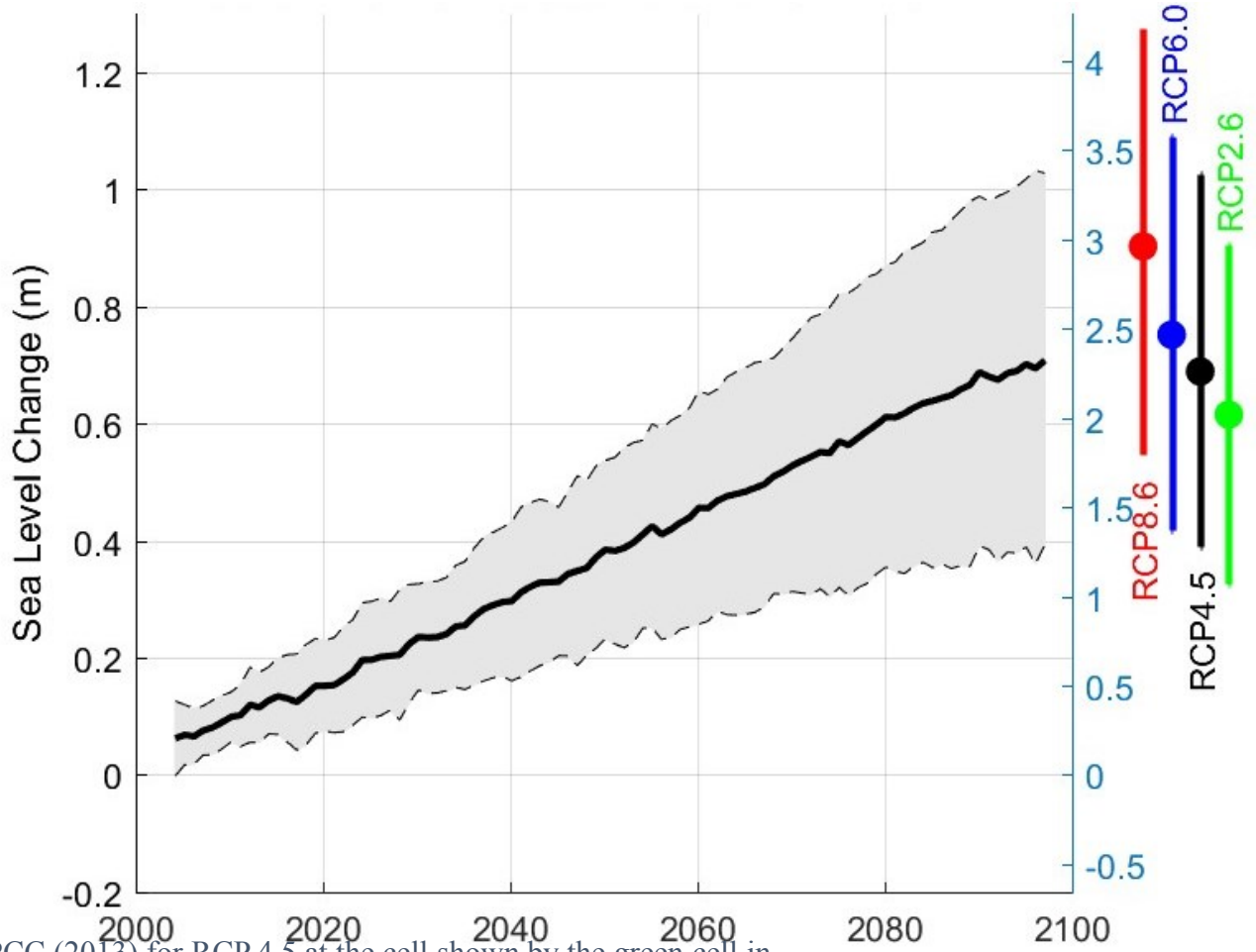


Figure 12. Sea level projection from IPCC (2013) for RCP 4.5 at the cell shown by the green cell in Figure 11 with the rate of vertical land motion added are shown by the solid black line. The 5 to 95% confidence interval is represented by the grey stripe. On the right of the figure the average sea level, and 5 to 95% range, for the interval 2090 and 2100 is shown for the 4 RCPs in IPCC (2013).

- SNE is on High side of all intervals
- SNE has larger variance than the global mean

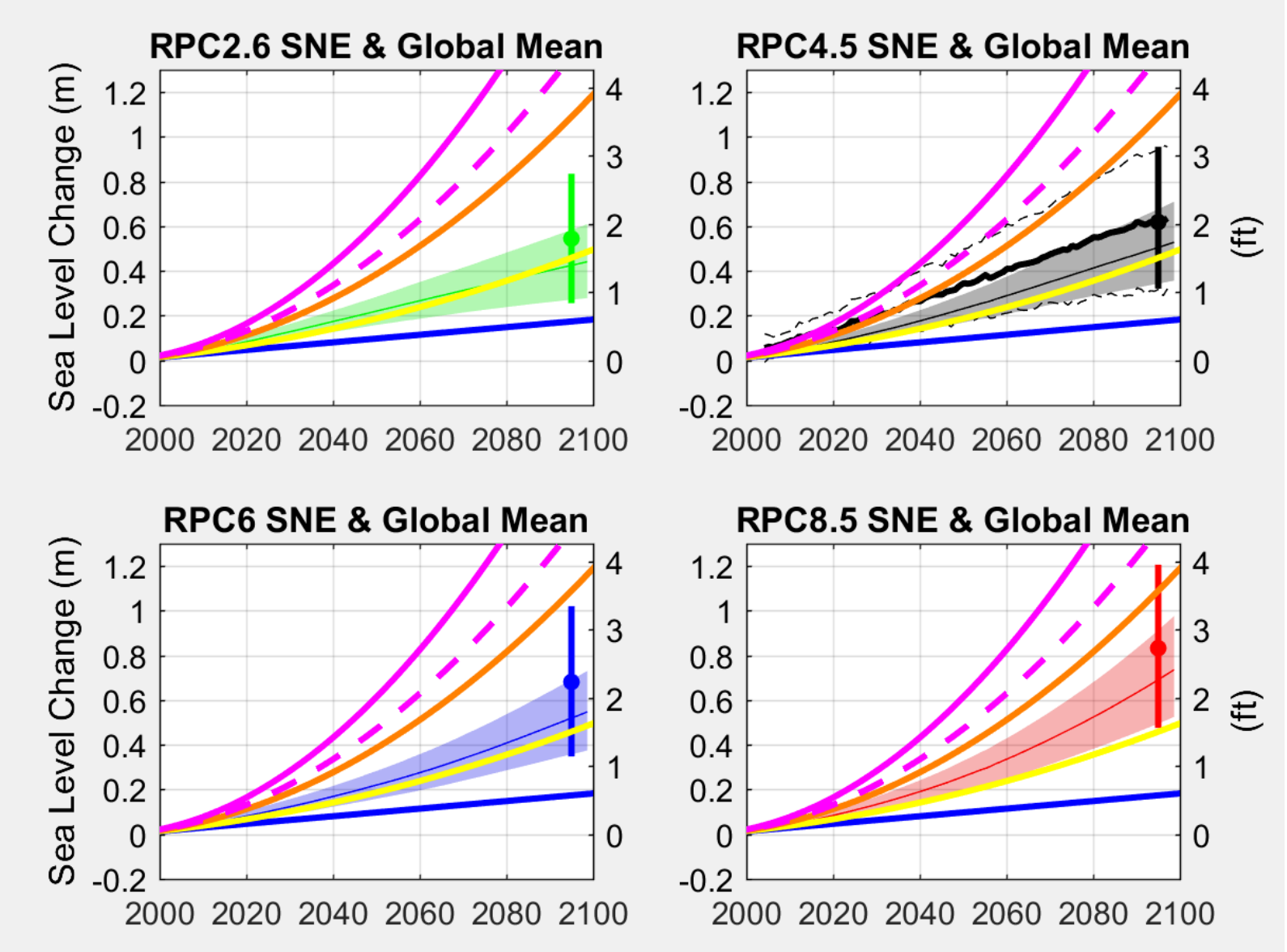
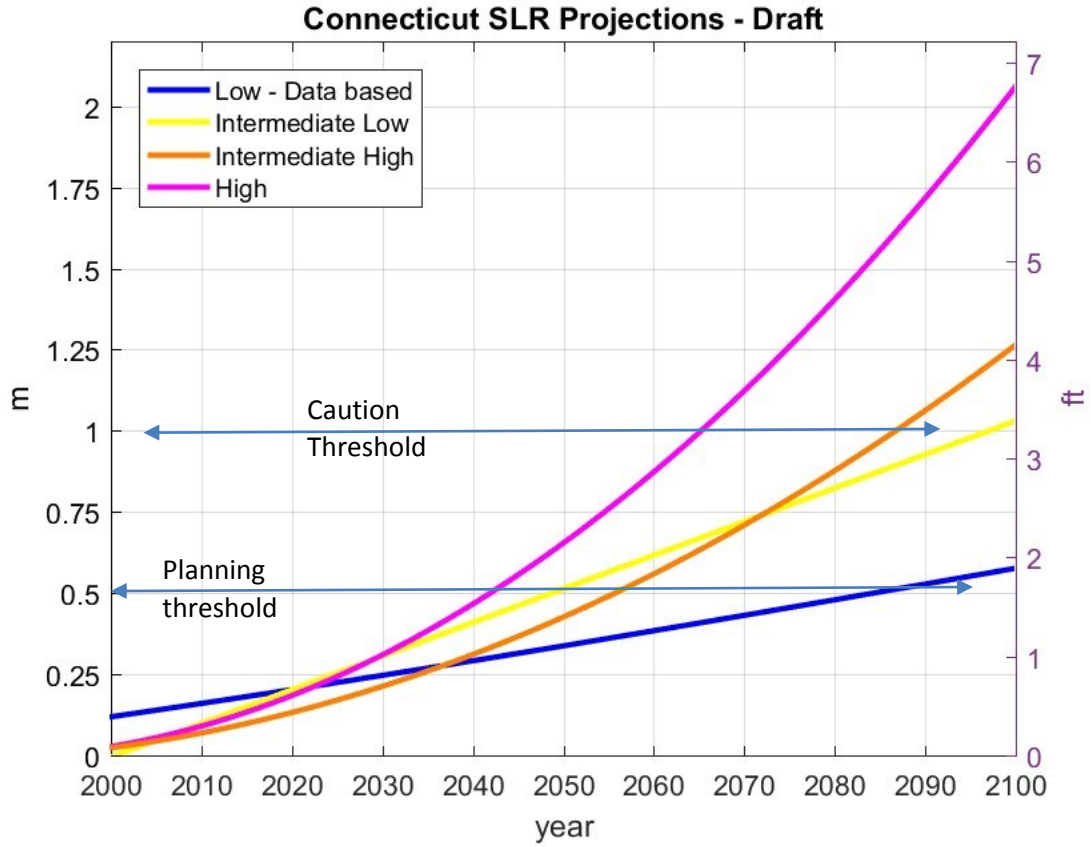
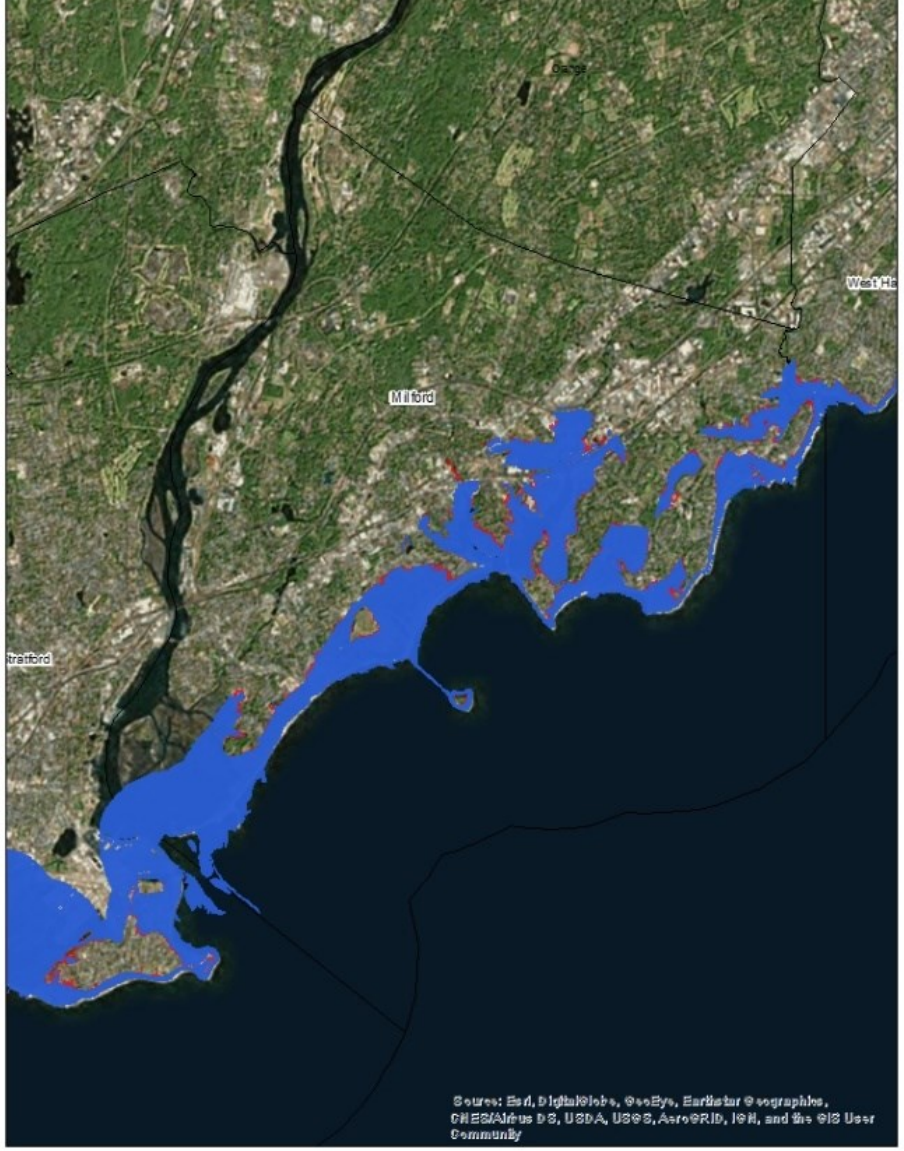


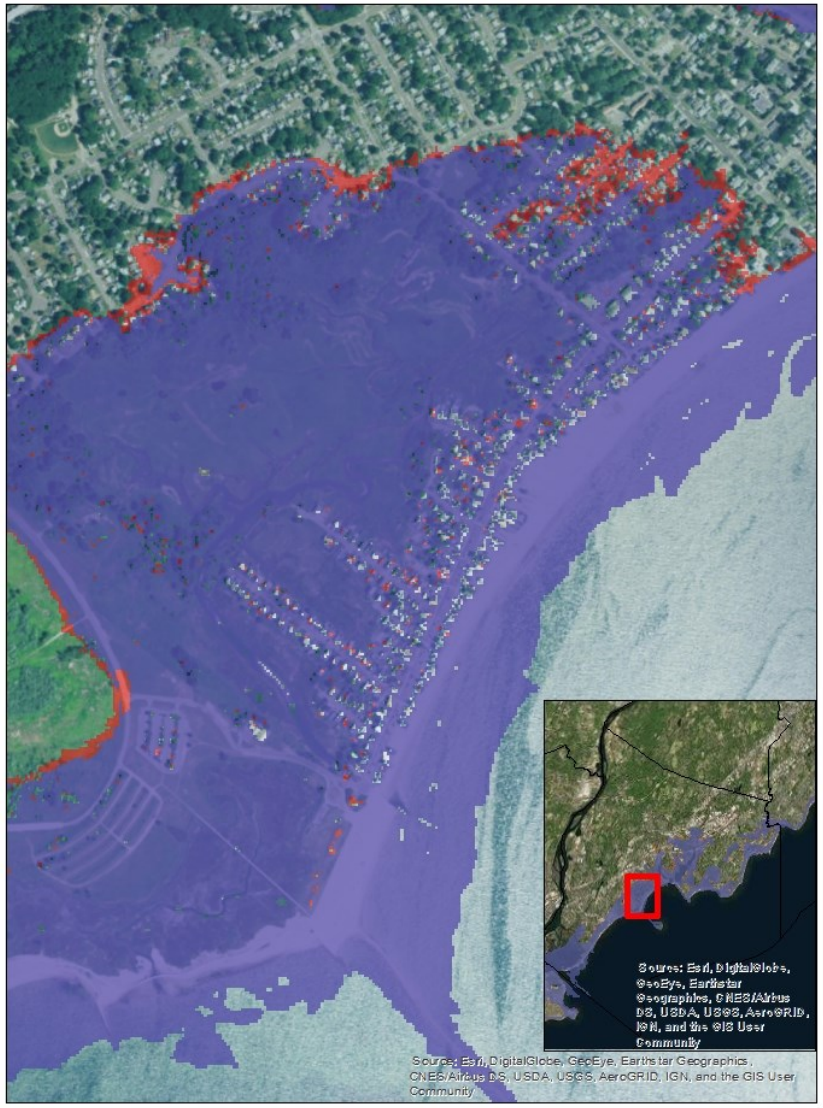
Figure 1. Sea level rise projections for Connecticut based on local tide gage observations (blue), the IPCC (2013) RPC 4.5 model simulations near Long Island Sound (yellow line), the semi-empirical model predictions are in orange and the magenta shows the ice mass balance projections.



Summary

- CT is special (location and oceanography, weather, geology). Consequently,
- We will get more SLR than other areas, and the predictions have prediction intervals.
- We should plan for 50 cm (almost 2 ft) increase by 2050 and alert people that in the future higher thresholds may be required.
- The increase in the area impacted will not be very large because of the geology of CT.
- We should institute a decadal review and update to ensure new science is incorporated in the planning to minimize costs and maximize safety.
- Since the coastal areas are flat small increases in MSL will cause a large increase in flood risk. The geometry and orientation of the Sound causes tides and surge to be larger in the west of CT so the impact of SLR on the flood risk is higher in the east.





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