Climate Change in Connecticut:
and what to do about it.

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Darien Police.
https://media.necn.com/2021/07/E52vIumX0AI5wvX.jpeg?quality=85&strip=all&w=1024

Stamford Advocate
https://www.stamfordadvocate.com/local/article/Tropical-Storm-Elsa-causes-heavy-flooding-16303636.php#photo-21217276

Elias Loomis

Born	August 7, 1811 Willington, Connecticut, United States
Died	August 15, 1889 New Haven, Connecticut, United States
Citizenship	United States
Nationality	United States
Fields	Mathematics, Terrestrial Magnetism
Institutions	Western Reserve College, New York University, Yale College

H. A. Newton

Hubert Anson Newton, around 1879

Born	19 March 1830 Sherburne, New York
Died	12 August 1896 (aged 66) New Haven, Connecticut, USA
Nationality	American
Fields	Astronomer and mathematician
Institutions	Yale University
Alma mater	Yale University
Academic advisors	Michel Chasles
Doctoral students	E. H. Moore Josiah Willard Gibbs Charles Newton Little Arthur W. Wright
Known for	Science of meteors
Notable awards	Smith gold medal
	Signature

ART. V.—ON THE MEAN TEMPERATURE, AND ON THE FLUCTUATIONS OF TEMPERATURE, AT NEW HAVEN, CONN., Lat. 41° 18′ N., Long. 72° 55′ W. of Greenwich; BY PROFESSORS ELIAS LOOMIS AND H. A. NEWTON.

IN July, 1862, the Connecticut Academy of Arts and Sciences appointed a committee, consisting of Professors Elias Loomis and H. A. Newton, to reduce the meteorological observations which for a series of years had been made in the name of the Academy, and also to incorporate with them any other reliable observations made in New Haven. The committee have discharged the duty imposed upon them, so far as relates to the observations of temperature, and now present the results of their labors.*

Month.	Max.	Date. Year.	Day.	Observers.	Min.	Date. Year.	Day.	Observers.	Ran
	°				°				
Jan.,	64	1833	5	Dr. Alfred S. Monson.	−24	1835	5	Dr. Alfred S. Monson, Rodney Burton.	8
Feb.,	68	1810	26	Pres. Jeremiah Day.	−16	1855	7	Rodney Burton.	8
March,	76	1845	28	Col. Enos Cutler.	− 9	1835	2	Dr. Alfred S. Monson, Rodney Burton.	8
April,	85	1844	15	Col. Enos Cutler.	11	1847	1	Col. Enos Cutler.	7
May,	94	1845	12	Col. Enos Cutler.	27	1837	2	Edward C. Herrick.	6
June,	102	1864	26	Prof. Elias Loomis.	35	1787	2	Pres. Ezra Stiles,	6
						1816	7	Pres. Jeremiah Day.	
July,	101	[illegible]		[illegible]	44	1814	13	Pres. Jeremiah Day.	5
Aug.,	98	1780	6	Pres. Ezra Stiles,	39	1834	29	Dr. Alfred S. Monson.	5
Sept.,	92	1782	5	Pres. Ezra Stiles.	27	1834	30	Dr. Alfred S. Monson.	6
Oct.,	83	1809	1	Pres. Jeremiah Day,	19	1836	28	Dr. Alfred S. Monson.	6
		1858	4	Rev. David L. Ogden.					
Nov.,	74	1788	5	Pres. Ezra Stiles,	2	1786	29	Pres. Ezra Stiles.	7
		1805	2	Pres. Jeremiah Day.					
Dec.,	68	1809	26	Pres. Jeremiah Day.	−11	1831	16	Dr. Alfred S. Monson	7
Year,	102	1864		Prof. Elias Loomis.	−24	1835		Dr. Alfred S. Monson, Rodney Burton.	12

In order to determine whether the mean temperature of New Haven has changed since the time of the earliest recorded observations, we have divided the entire series of observations into two groups, the first embracing the observations down to 1820, forming a series of 41 years; the second embracing the observations since 1820, forming a series of 45 years. The mean temperature of each month according to the two series of observations is shown in the following table; the mean of the observations being reduced to the true mean temperature by applying the correction from the table on page 232.

Months.	First series.	Second series.	Difference.	Months.	First series.	Second series.	Difference.
	°	°	°		°	°	°
January,	26·31	26·73	+0·42	July,	71·70	71·62	−0·08
February,	28·08	28 16	+0·08	August,	70 80	69·88	−0·92
March,	35·80	36 36	+0·56	September,	62·84	62·20	−0·64
April,	47·17	46·53	−0·64	October,	51·28	50·93	−0·35
May,	57·26	57·30	+0·04	November,	40·04	40·59	+0·55
June,	67·47	66·51	−0·96	December,	30·56	30·29	−0·27

These differences are generally small, with repeated changes of sign; which seems to indicate that they are mainly due to those irregular causes which render the mean temperature of a given

Regional Climate Change: Connecticut

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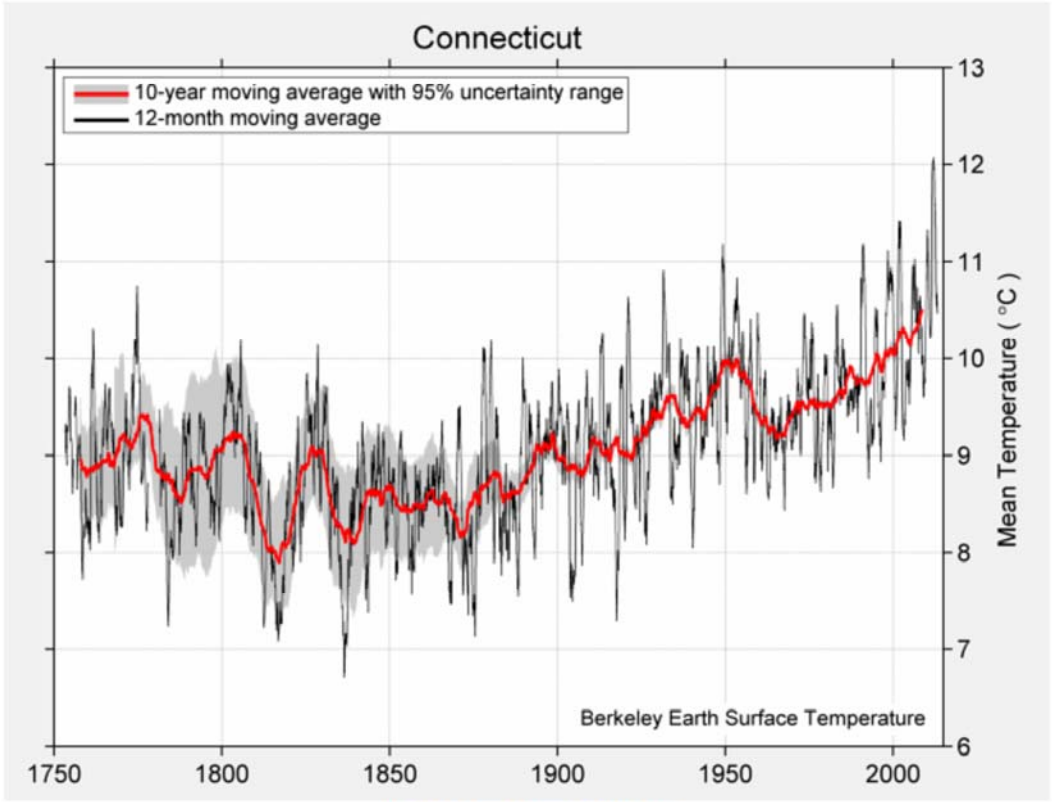
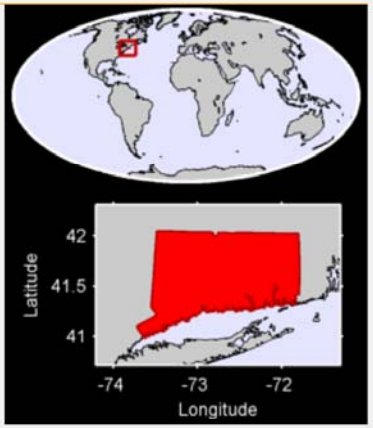


High Resolution Version | Data Table



Connecticut Region Statistics

Land Area:	12,000 km^2
Percent of Global Land Area:	0.01%

Temperature Stations in Region

Active Stations:	29
Former Stations:	37

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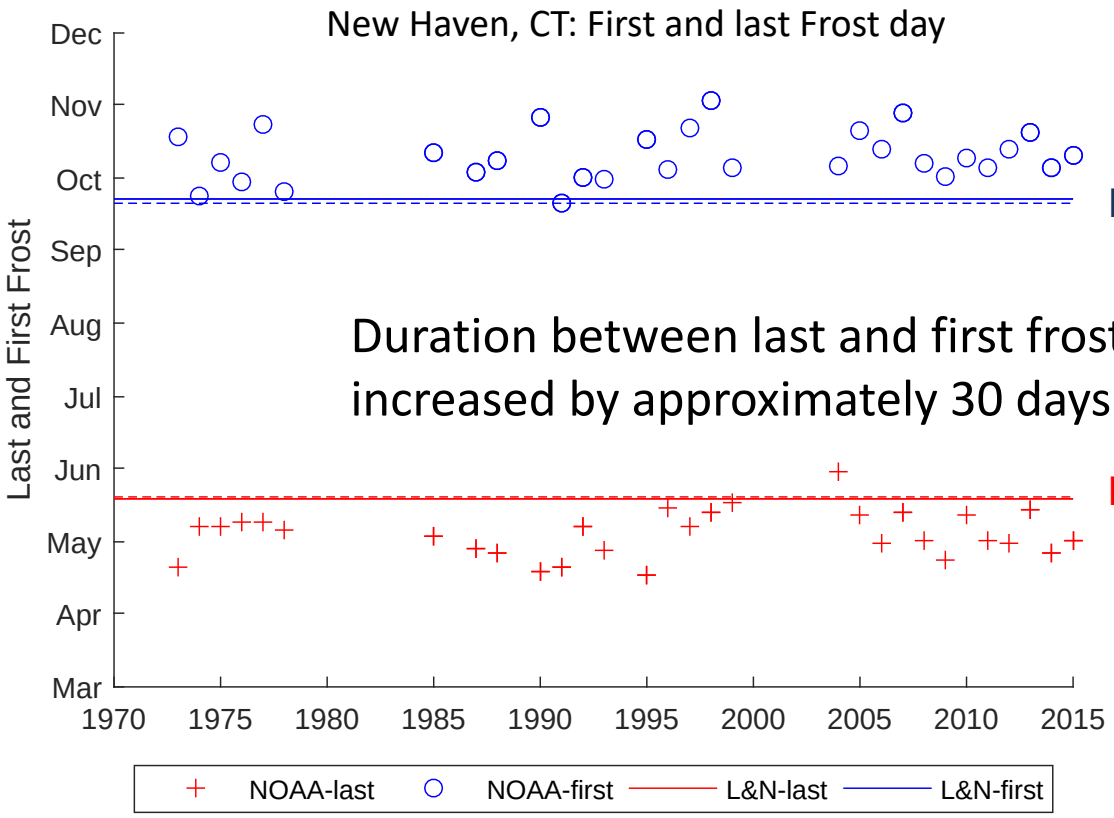
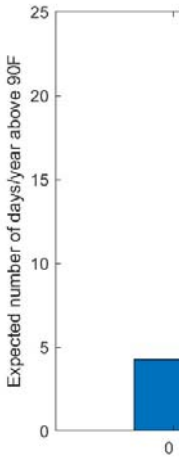


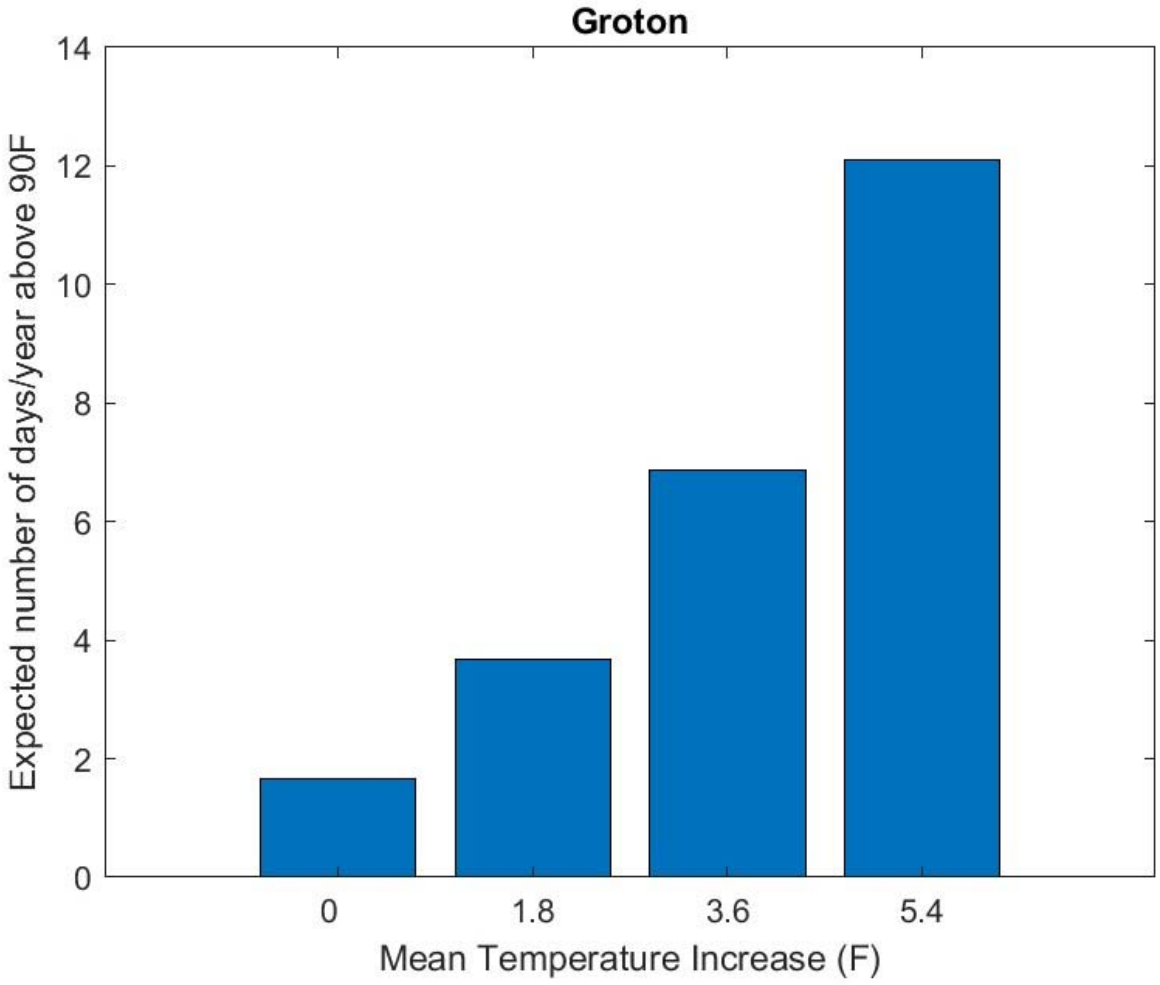
First frost 1779-1820 & 1820-8165

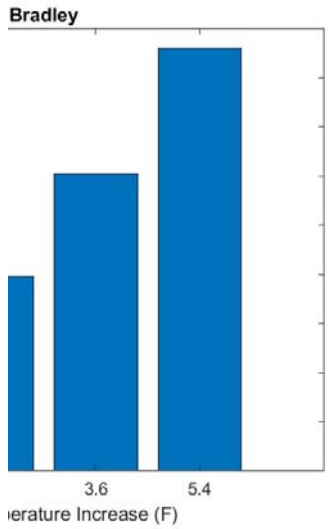
Duration between last and first frost increased by approximately 30 days

Last frost 1779-1820 & 1820-8165

The day of the year when the last temperature value below 4.4 °C (40°F) was observed in the data from Tweed-New Haven airport is shown in by the red '+' symbols. The first day in the fall when the temperature falls below 4.4 °C is shown by the blue circles. This threshold was chosen to represent condition suitable for frost. The red and blue lines show the mean date of these thresholds were crossed in the data records from 1779-1820 (red and blue solid lines) and 1820-8165 (red and blue dashed lines).







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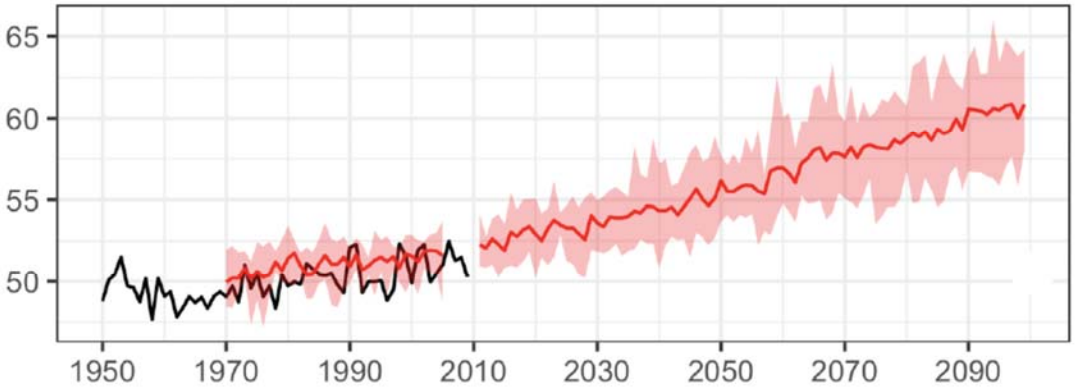
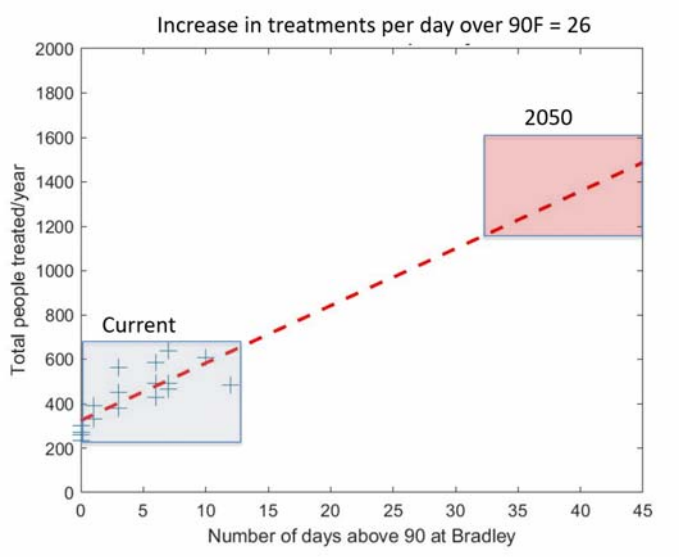
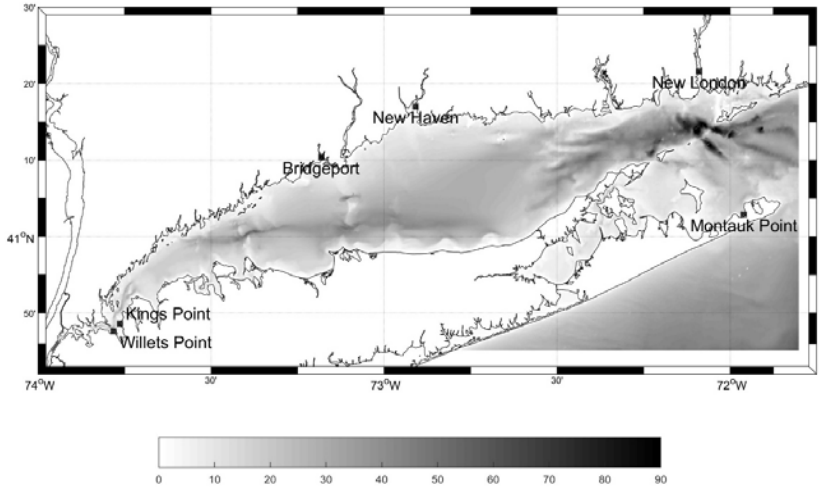
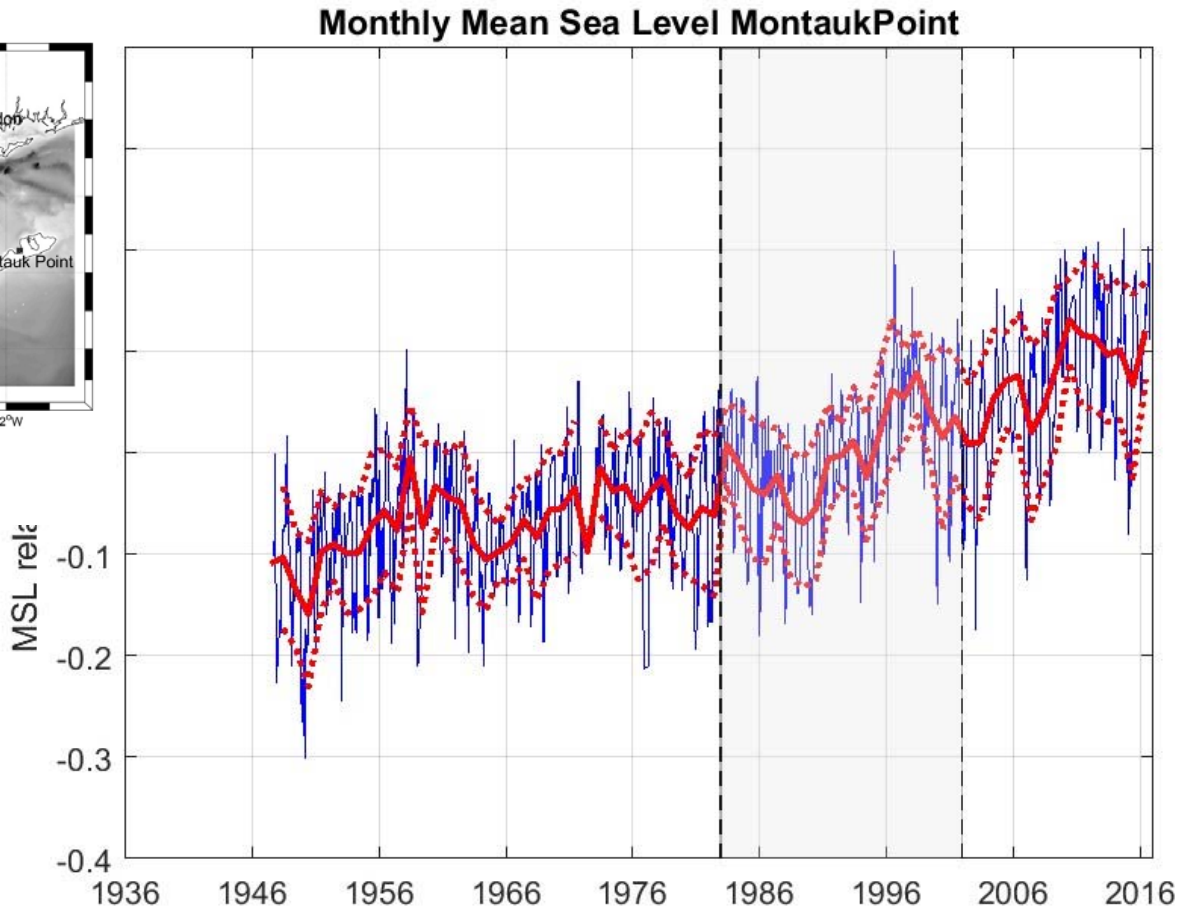
Measurements and model projections (with no CO2 reductions) of annual mean temperature in CT – CIRCA's PSCAR report (Seth et al, 2019)





Plan for: **Sea level rise UP TO 20 inches (50 cm) by 2050**
Warming of UP TO 5°F (°C) by 2050





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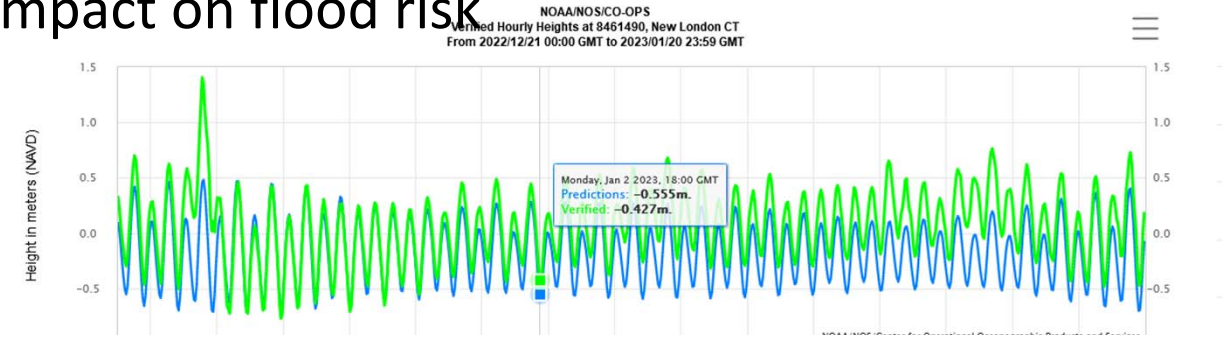
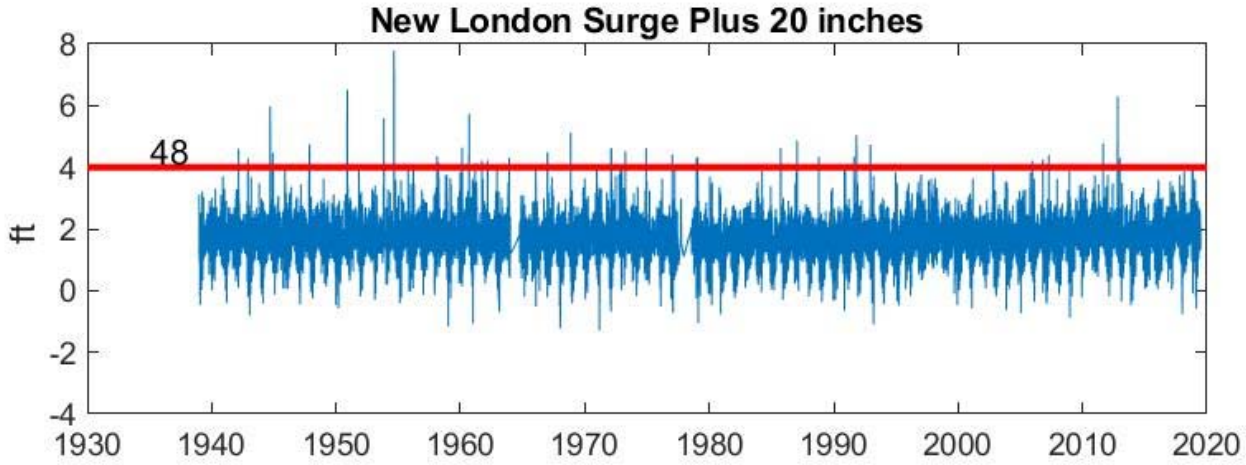
Modest changes in mean sea level have a big impact on flood risk

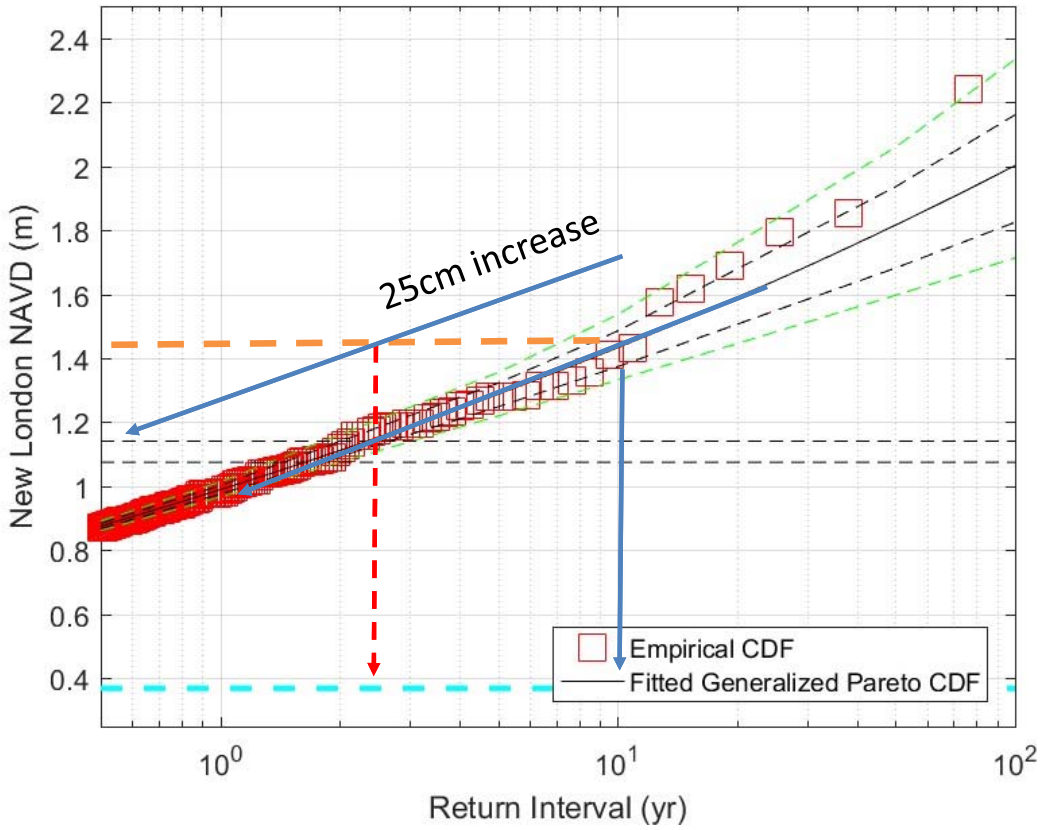




NOAA's New London Tide Gage

- Places that flood now when the surge is 4 ft have a 5/80 risk per year.
- With a 20 inch mean SLR, that risk increases to 48/80.
- The details are important here but the point is the change in risk is large.

New London Total Water Level Return Interval

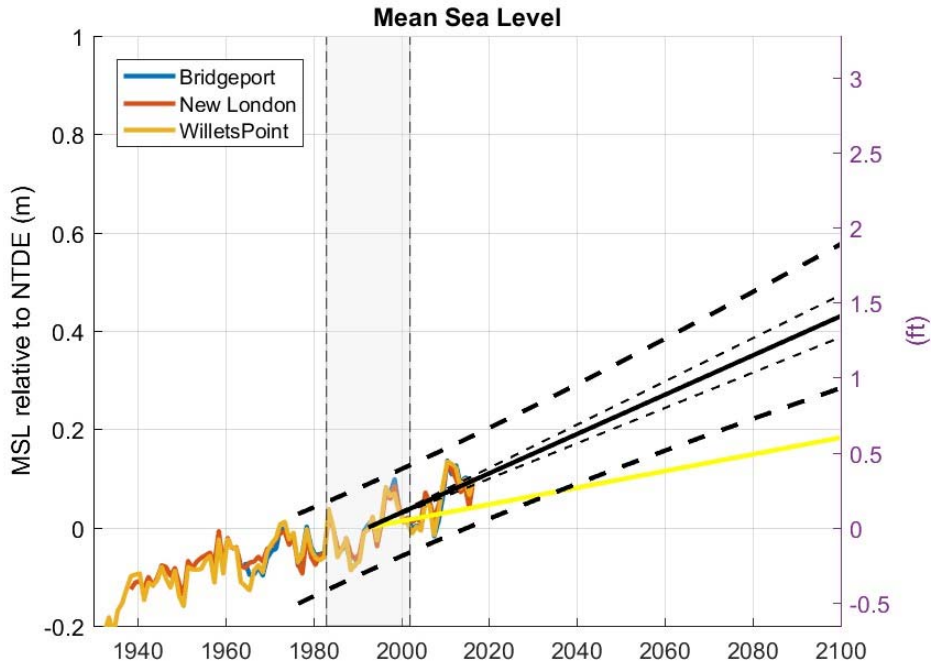


Currently the 10 yr return is ~1.45 m

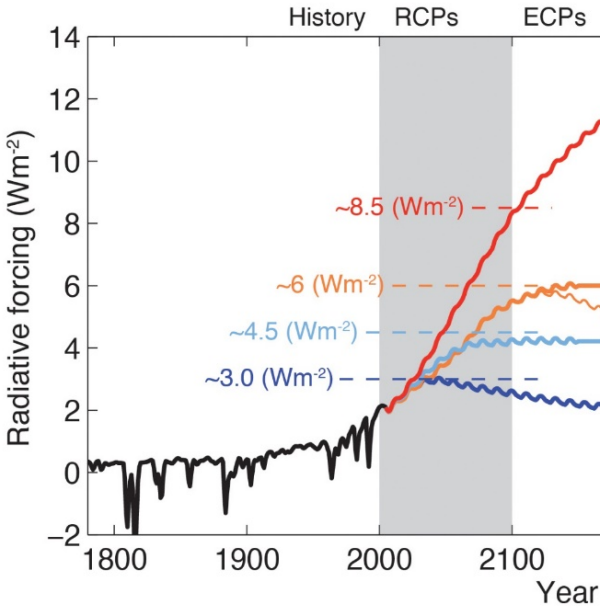
If sea level increased by 0.25 m then storms would cause that every 2.5 yrs.

Note that is a 4 fold increase in flooding risk or frequency


Boston
Providence
Buzzards Bay
Martha's Vineyard
Vineyard Sound
Block Island
Block Island Ridge
Fishers Island
Fishers Island Ridge
Gardiners Island
Hartford
New London
Montauk Pt.
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.


Mean Sea Level
Bridgeport
New London
WilletsPoint
MSL relative to NTDE (m)
(ft)
1
0.8
0.6
0.4
0.2
0
-0.2
3
2.5
2
1.5
1
0.5
0
-0.5
1940
1960
1980
2000
2020
2040
2060
2080
2100

Net Change in “radiative forcing”



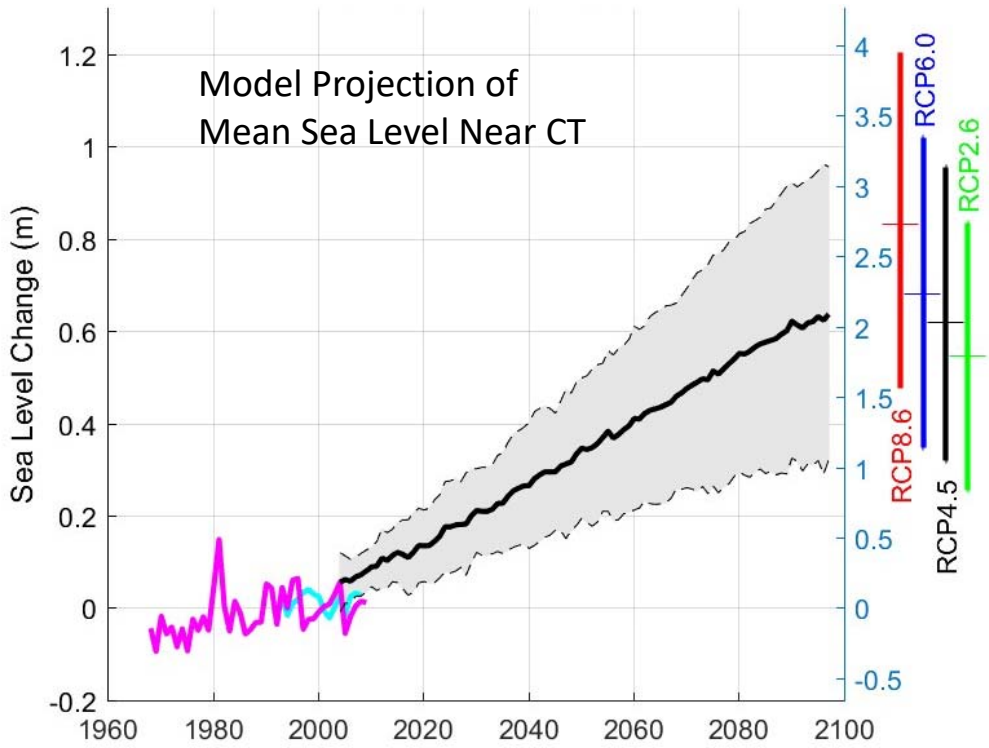
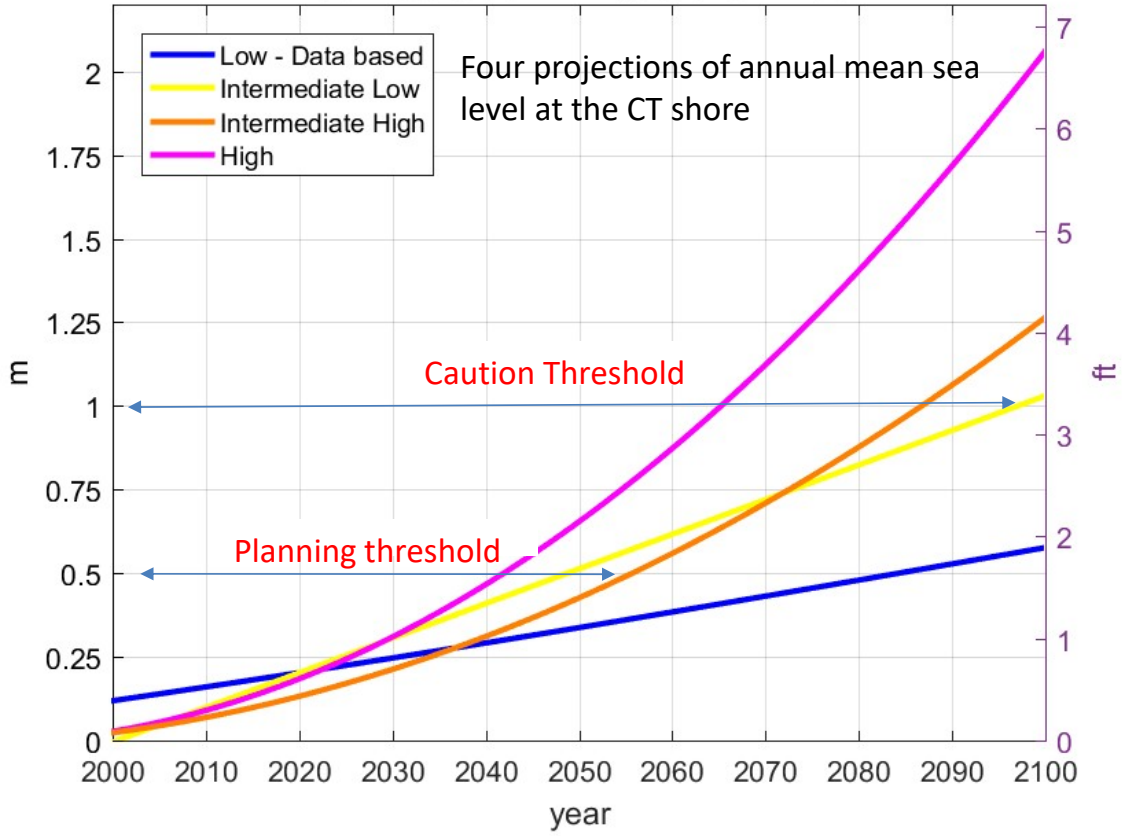


Figure 1. Sea level rise projections for Connecticut based on local tide gage observations (blue), the IPCC (2013) RPC 4.5 model simulations near Long Island Sound (yellow line), the semi-empirical model predictions are in orange and the magenta shows the ice mass balance projections.



20in/50cm at 2050

Decadal Review

Alert people about the prospect of 100cm by 2100

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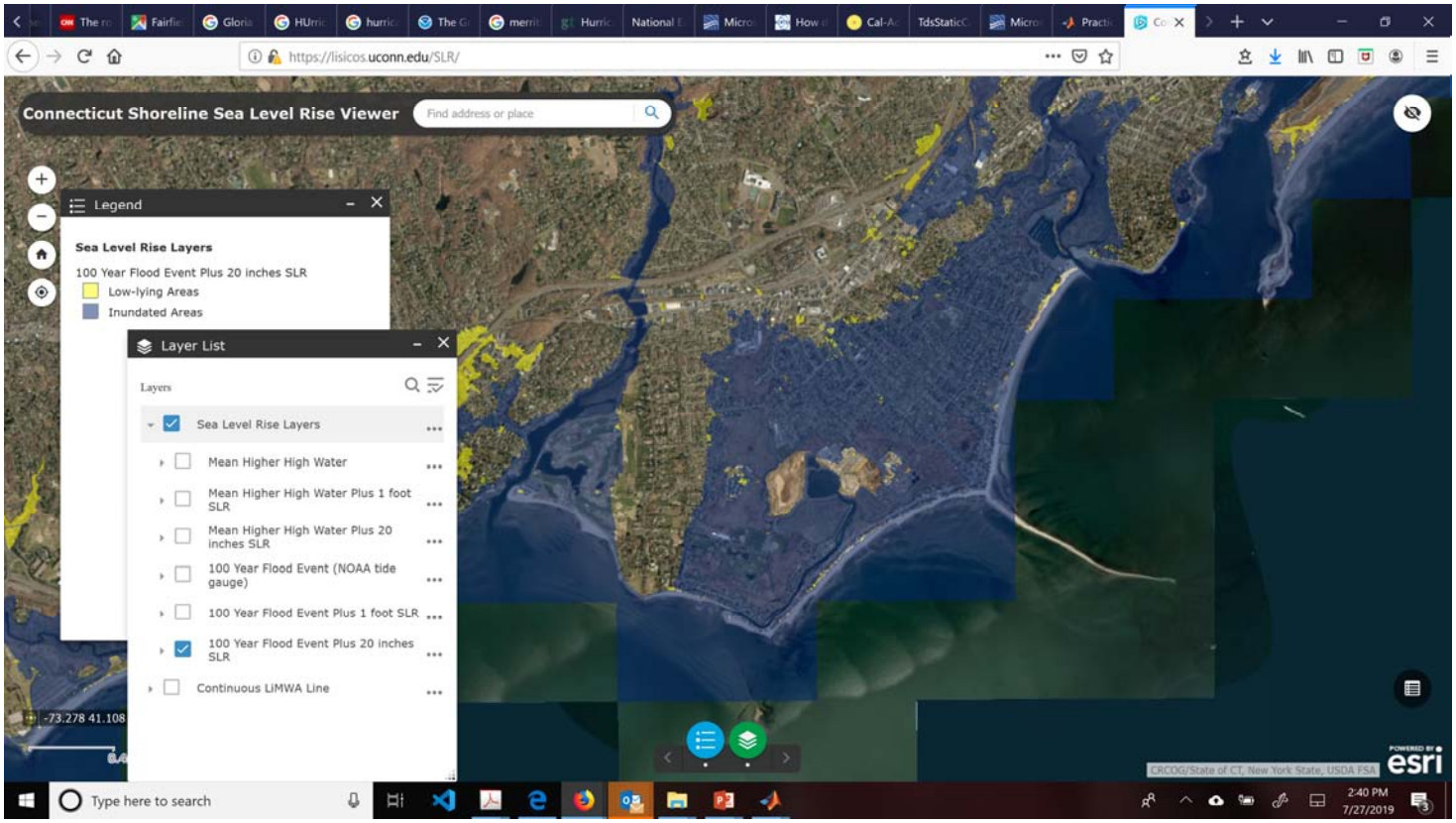
IMPACTS



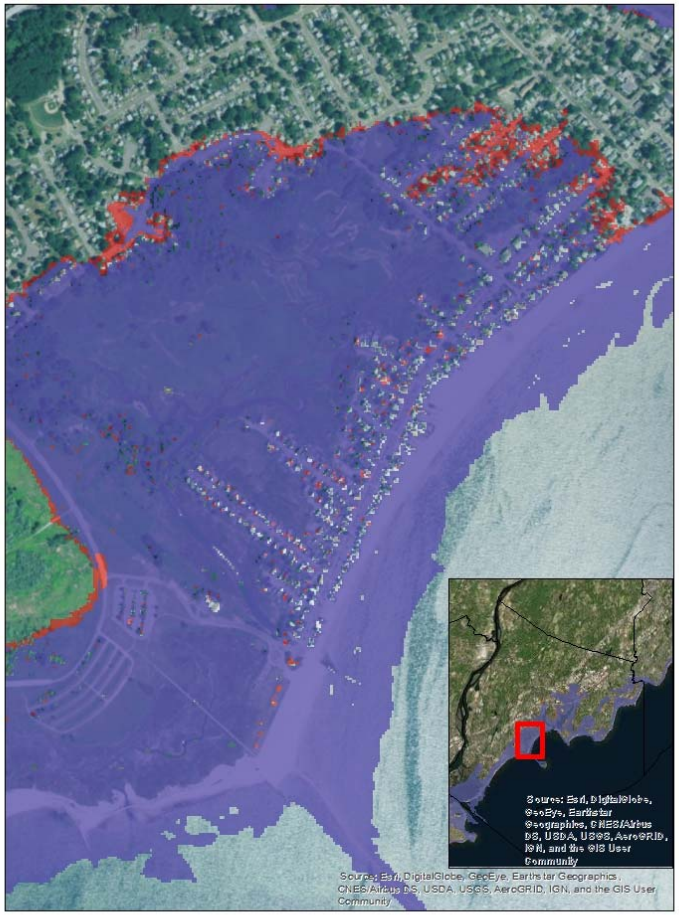
- Hurricanes are potential devastating and costly, but infrequent.
- $675 billion in assets insured and at risk of hurricane damage on the CT coast as of 2017

The 100 yr flood zones will not expand very much because of the geology of CT

The water levels that lead to flooding will occur more frequently.

In 2050 the risk of the flooding like occurred in Sandy could be 5-10 time higher depending upon local geography. Generally, increases will be higher in the east.

https://lisicos.uconn.edu/SLR/


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

https://coastfieldguides.com/2015/07/21/glacial-lake-connecticut-map/

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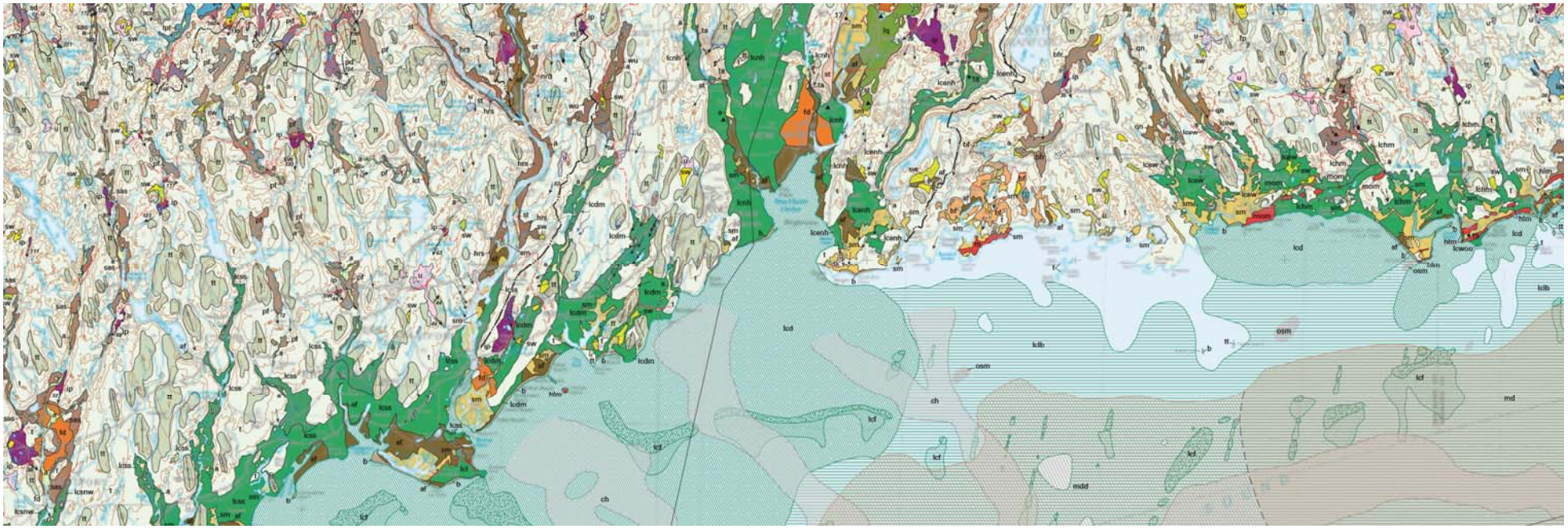

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- Sea Level Rise Means that flooding in coastal CT that is expected once in 10 years should be expected every 2 or 3 years in 2050.

- This will raise the cost of living bay the shore and likely impact property values in flood prone area.

- This is happing in Virginia and Florida

Norfolk, Virginia: Floods in the Norfolk and Hampton Roads area threaten to make the largest naval base in the world inaccessible.

Courtesy Steven McAlpine/First Street Foundation

https://www.businessinsider.com

Sunny day flooding in Miami

Environmental Research Letters

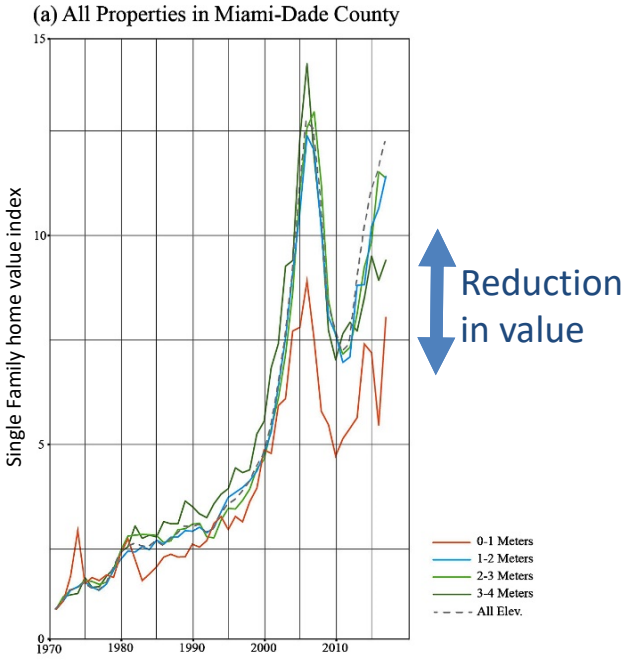
LETTER • OPEN ACCESS • FEATURED ARTICLE

Climate gentrification: from theory to empiricism in Miami-Dade County, Florida

Jesse M Keenan[1,3], Thomas Hill[1] and Anurag Gumber[2]

Published 23 April 2018 • © 2018 The Author(s). Published by IOP Publishing Ltd

Environmental Research Letters, Volume 13, Number 5



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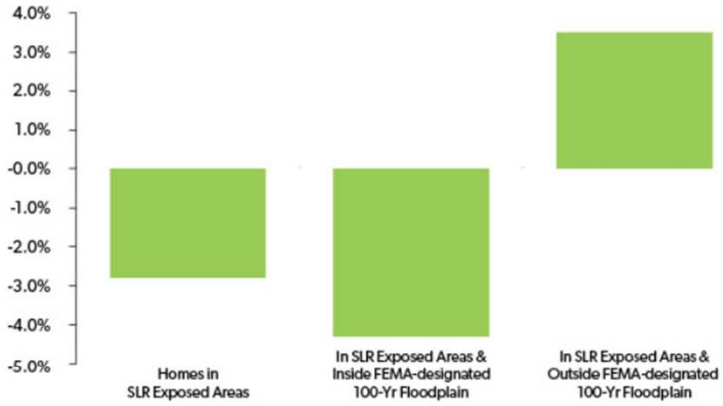
https://www.freddiemac.com/research/insight/20220316-sea-level-rise-and-impact-home-prices-coastal-florida

Home price discount/premium*

Homes in SLR exposed areas sold for less than homes outside of SLR exposed areas, but the price discount was limited to homes also located in FEMA-designated 100-year floodplains.



*Compared to homes located outside of SLR exposed areas, all else equal.

Note: The price discounts and premiums in the chart are based on two separate OLS regressions. In regression 1, sale price is regressed on location within SLR exposed areas, and in regression 2, sale price is regressed on the location within SLR exposed areas in and out of FEMA-designated 100-year floodplains. In both models, we accounted for observable characteristics, such as distance to coastline, views of the coast and other amenities, number of beds and baths, and distance to highways, that could also influence home prices.

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PLANET

Every Coastal Home Is Now a Stick of Dynamite

Wealthy homeowners will escape flooding. The middle class can't.

By Jake Bittle

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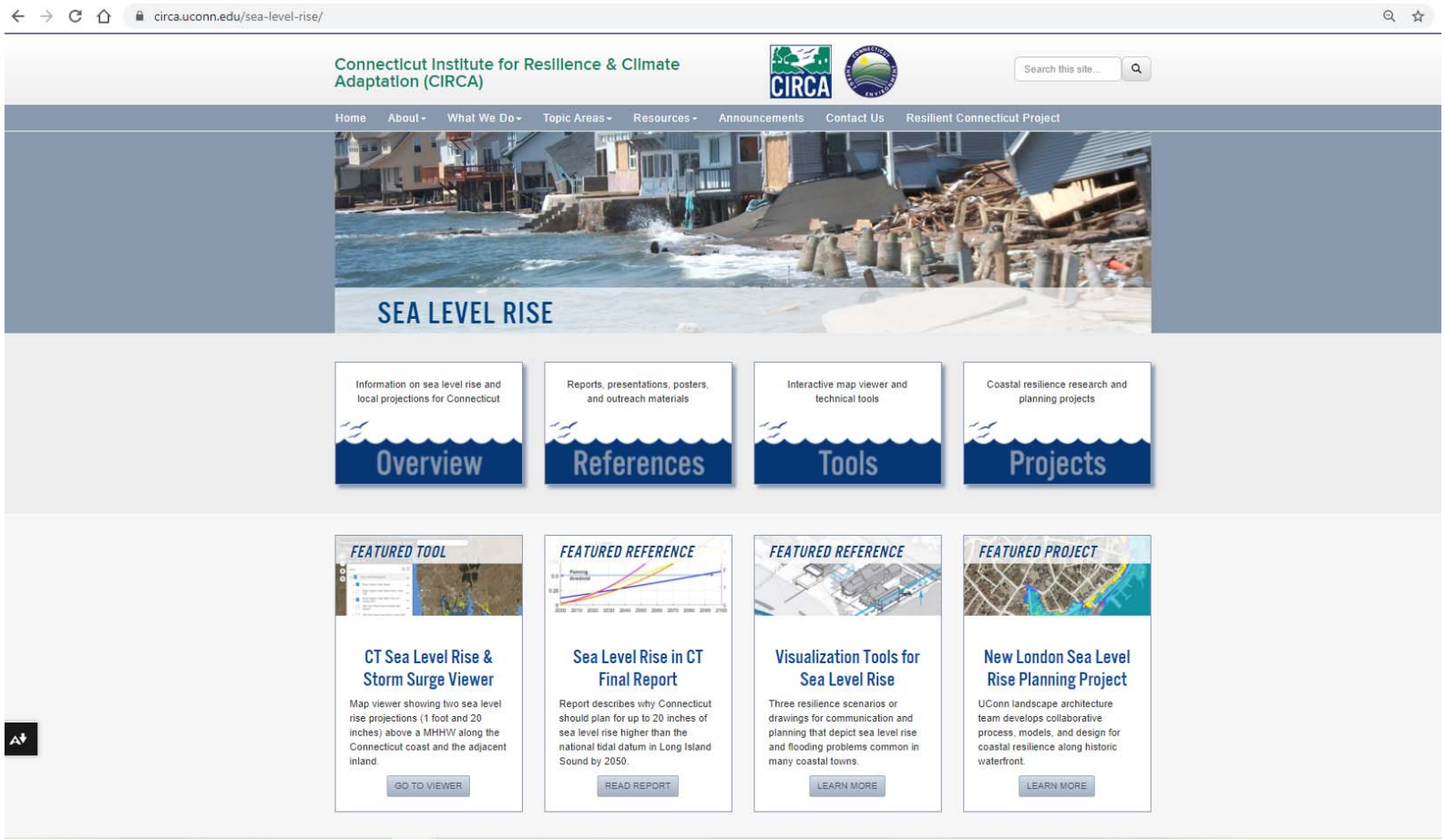
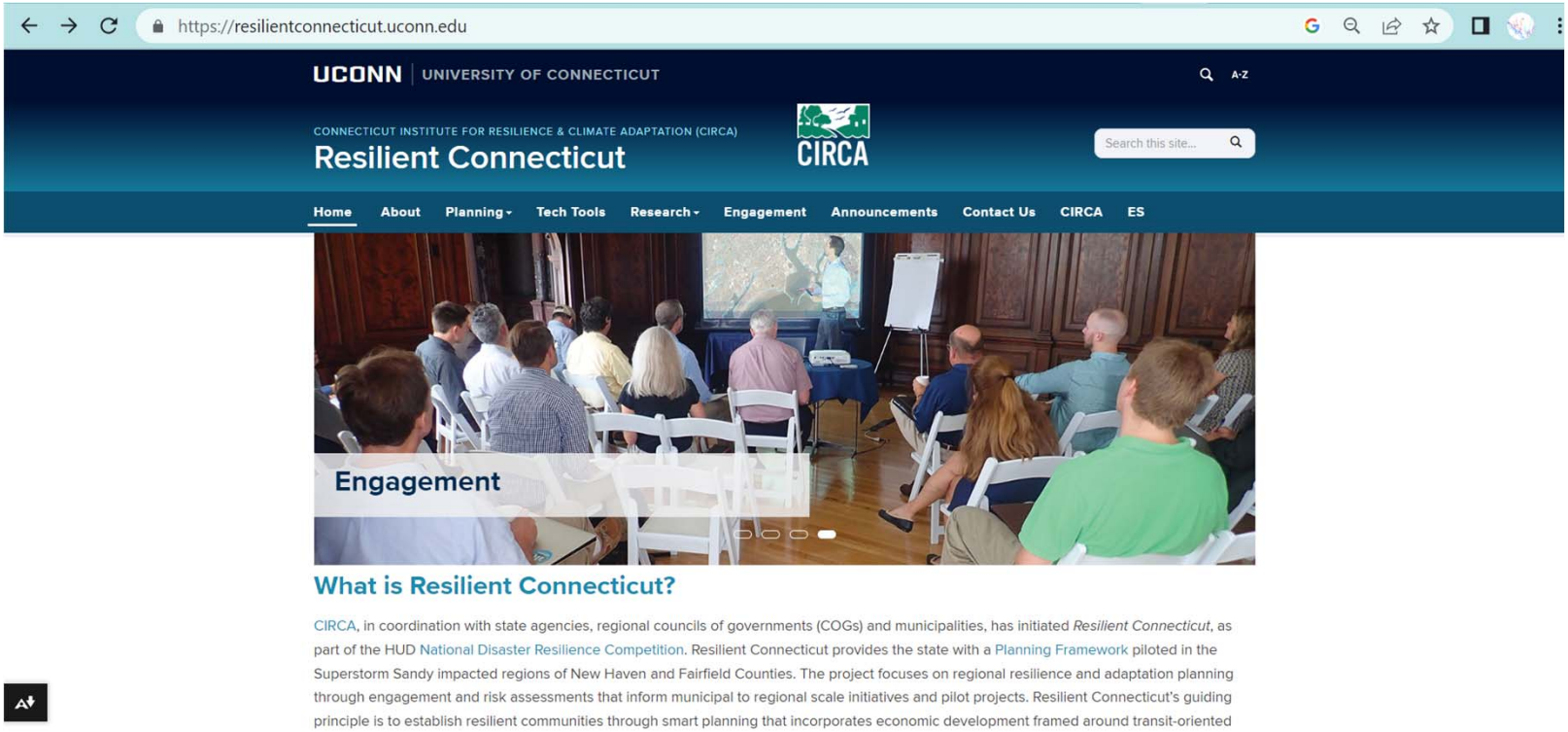
https://circa.uconn.edu



https://resilientconnecticut.uconn.edu/



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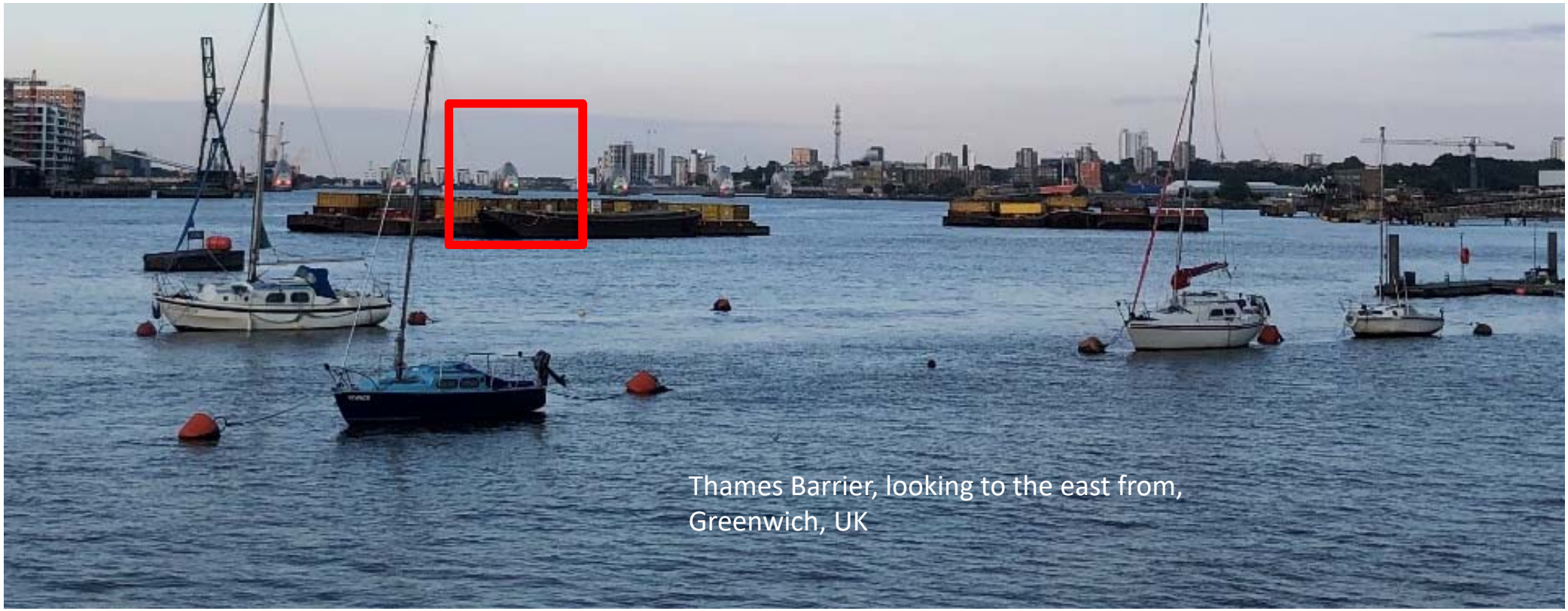
https://www.nae.usace.army.mil/Missions/Civil-Works/Flood-Risk-Management/Connecticut/Stamford-Hurricane-Barrier/

Stamford Surge Barrier and gate,
Million $15 in 1969
Roughly Million $150 in 2022

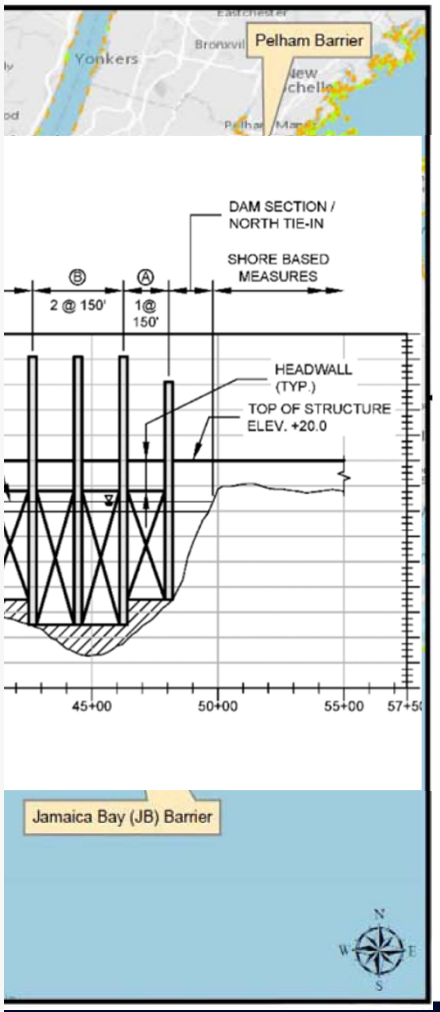
https://www.theguardian.com/cities/2015/feb/19/thames-barrier-how-safe-london-major-flood-at-risk

Thames River Barrier, London, UK
Milliion £ 534 in 1884
Roughly Billiion $ 3 in 2022



Thames Barrier, looking to the east from, Greenwich, UK

Inner Harbor Navigation Canal Lake Borgne Surge Barrier also called The Great Wall of Louisiana,



CIRCA's Ten Steps to Municipal Resilience

1. Avoid development on floodplain

Ensure/require that development is outside of the 2020 floodplain.

This will reduce risk to people, property and the town's tax base to severe weather and changes to FEMA rules.

Expand participation in the FEMA Community Rating System

It will likely effect bond ratings in the future.

2. Integrate adaptation to infrastructure planning and investment.

- Repairs and replacement should recognize future risks. This can yield a high return on investment.

3. Define your accepted risk level

- Recognize Hurricanes and Climate Change/Sea Level Rise risks are different.
- We need to plan for both, but the strategies and costs are different

4. Develop a resilience project pipeline

- Use locally applicable science-based risk assessments for 2050 to identify and prioritize projects.
- Employ zones of shared risk planning to maximize co-benefits.
- Use community engagement to develop conceptual plans and align resilience investments with advancement of the town's long-term development vision.

5. Prioritize equity in planning and action

- Recognize and prioritize the voices of those that will have the most difficult time adapting to change due to socioeconomic challenges and historical inequalities.

6. Assess the cost of doing nothing.

- Higher maintenance costs, more frequent repairs, higher insurance rates, more and longer business interruptions, lower bond ratings.

7. Leverage resources from existing State and Federal programs

- i.e., CIRCA, CTDEEP, DECD, NOAA, EPA, FEMA, USACE

8. Organize to win federal resilience and adaptation funds.

- This will take decades and a lot of money. Anticipate many proposals/grant applications and develop an office to coordinate and prepare them.

9. Plan for the costs.

- Assess how to distribute costs equitably.
- Use HB6441 and invent other ways of sharing the burdens.
- Consider creating a climate change resiliency reserve fund and develop a long-term investment strategy to match funding to long term liabilities associated with sea level rise.
- Public Act No. 19-77 allows towns to create a resiliency reserve fund and invest a portion in equities like many already do for employee pensions and other financial obligations.

10. Act NOW!

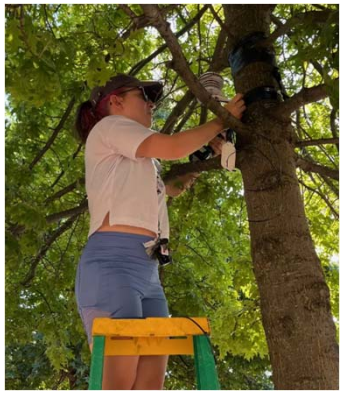
- Change is inevitable. It comes down to whether we want to manage that change or wait until escalating disasters gives us no other option. Figure out what the problems are and produce a plan to address them.
- CT has significant technical and financial capacity within the state. We can do this if we work together.
- Support GHG emission reductions. Ignoring the problem puts lives and dollars at risk.

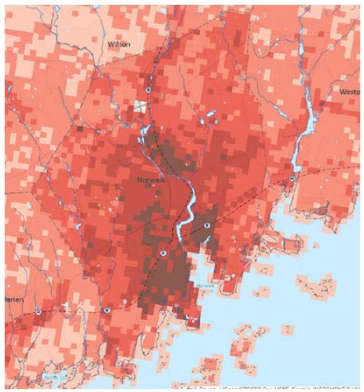
What else do we need to do?

- **Identify impediments to Action**
  - Consensus Decision-making (what do we do and who pays?)
  - Prioritization (lists of projects is not enough)
  - Funding/Cost sharing formulae
- **Institutionalize the Response**
  - Coordination of planning and action among agencies and towns
    - to address big problems and maximize value and avoid wrong turns
    - develop and share successful approaches
  - Develop Standards, Regulations, Incentives
  - Be ready to win in all federal competitions for funds
  - Sustained attention of public and leaders

RESILIENT CONNECTICUT AND OTHER PROGRAMS

- CIRCA initiated Resilient Connecticut in Fairfield and New Haven Counties 2018 – 2023.
- Program expanded to New London, Middlesex, Hartford, and Tolland Counties in 2021-2024.
- Goals are to support development of a statewide resilience project pipeline, increase coordination across municipal, regional, and state planning.
- Data and mapping tools to support project development include Climate Change Vulnerability Index (CCVI) for flooding and heat, zones of shared risk, resilience opportunity areas.
- EJ projects include creation of a statewide EJ Screen mapping tool in partnership with DEEP/DPH and EJ community organizations, and Climate & Equity Grants program w/ DEEP.





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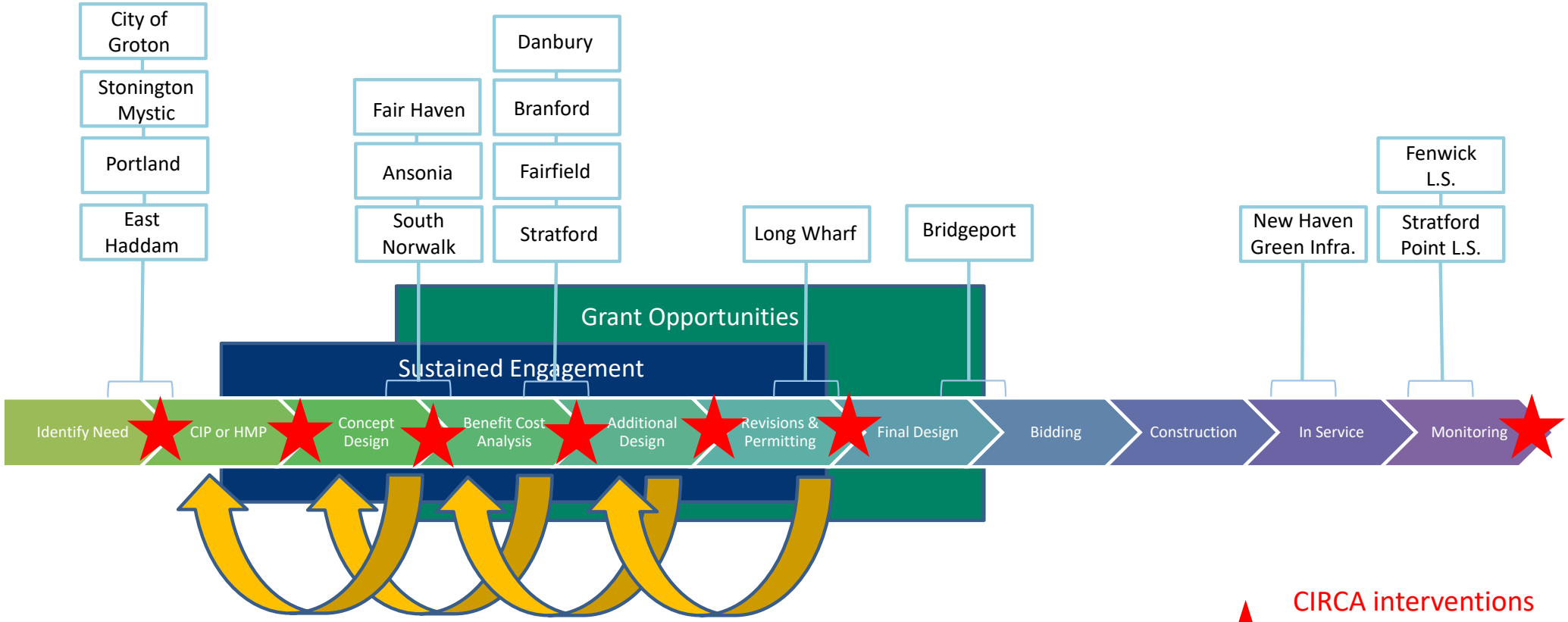
CONNECTICUT ENERGY ENVIRONMENT

RESILIENT CONNECTICUT AND THE PROJECT PIPELINE



CIRCA interventions and value added possible

Taking a step backward is possible and often will occur, in practice, along a project pipeline

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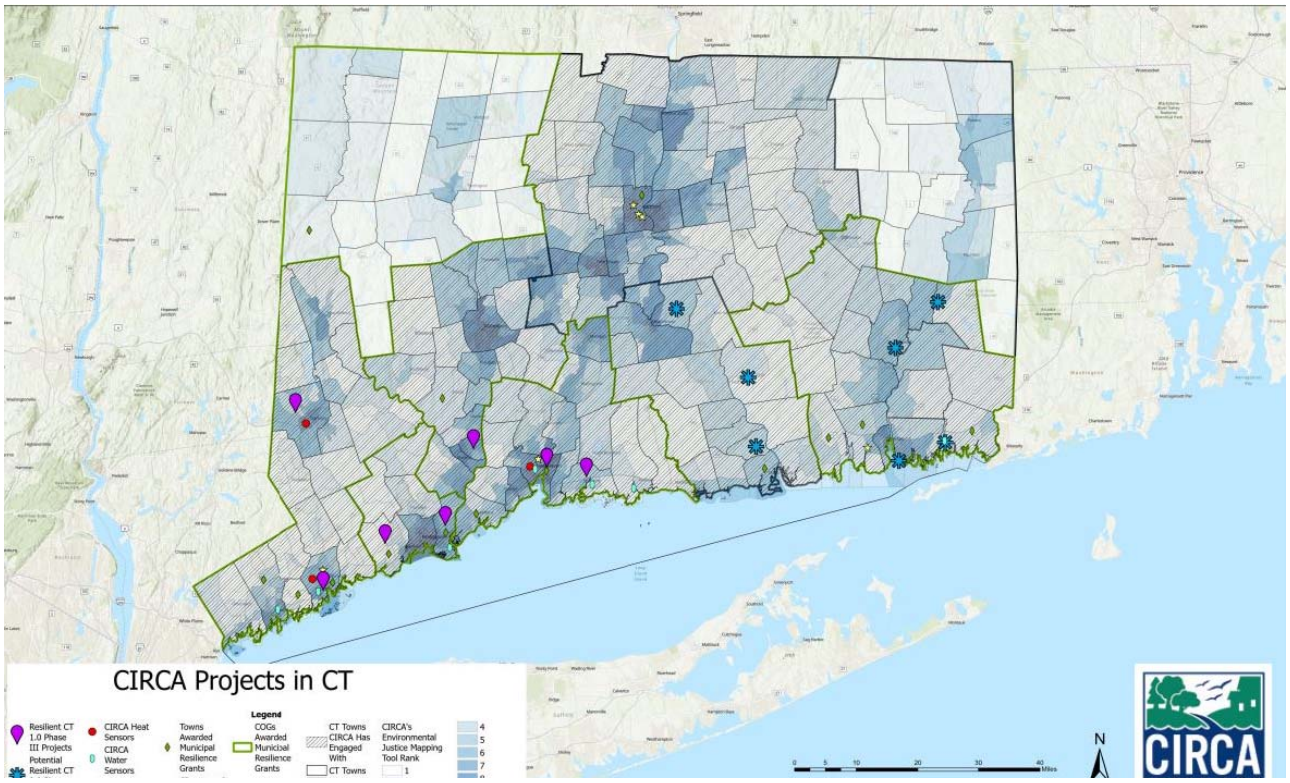
AREAS OF WORK STATEWIDE

- The seven pilot projects (“Phase III”) are the purple icons in southwest Connecticut
- The upcoming projects under Resilient Connecticut 2.0 Phase III are the blue icons in the RiverCOG and SCCOG regions



Summary

- Sea level is going up … Plan for up to 20 inches by 2050 and maybe 40 in by 2100
- The frequency of coastal flooding will increase… by a factor of 5-10 by 2050.
- There are many predictable consequences… increased insurance cost, property value losses, increased repair costs.
- In much of CT the flood plain will not expand (very much), flooding will be more frequent and deeper.
- Temperature is going to increase… maybe up to 5F by 2050.
- We are going to get a lot more days above 90F

- The number of storms (extra-tropical cyclones) per years in the northeast has declined since 1979.
- Rainfall has been steady, but delivered in more intense events
- Climate models predict reduced number, but more intense storms with a 50% increase high rainfall events.

- Data suggest more Category 3 hurricanes in the North Atlantic, but no evidence of trends on effects on NE

- Wind speeds in the Northeast are likely to increase in winter and reduce in summer but not by much (~5% RCP8.5)
- Designs based on hurricanes are likely to be adequate. But building standards enforcement is key.
- Adaptation planning and projects takes time …. 10-30 years
- Innovative approaches are needed
- Coordination with economic activity and housing needs is required
- We need to imbed adaptation into the administrative structures and procedures of the State

Save the Date

Resilient Connecticut Summit

Friday, December 1, 2023

UConn School of Law

Starr Reading Room

55 Elizabeth St, Hartford, CT 06105

Details and agenda to follow

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