Sea Level Change: We've got the "Best Available" Science, Now What?

February 28, 2019

APA Hazard Mitigation and Disaster Recovery Division

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RUTGERS Edward J. Bloustein School of Planning and Public Policy

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Rutgers University

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An introduction

Nicole Faghin, Washington Sea Grant

Where does SLR apply in planning?

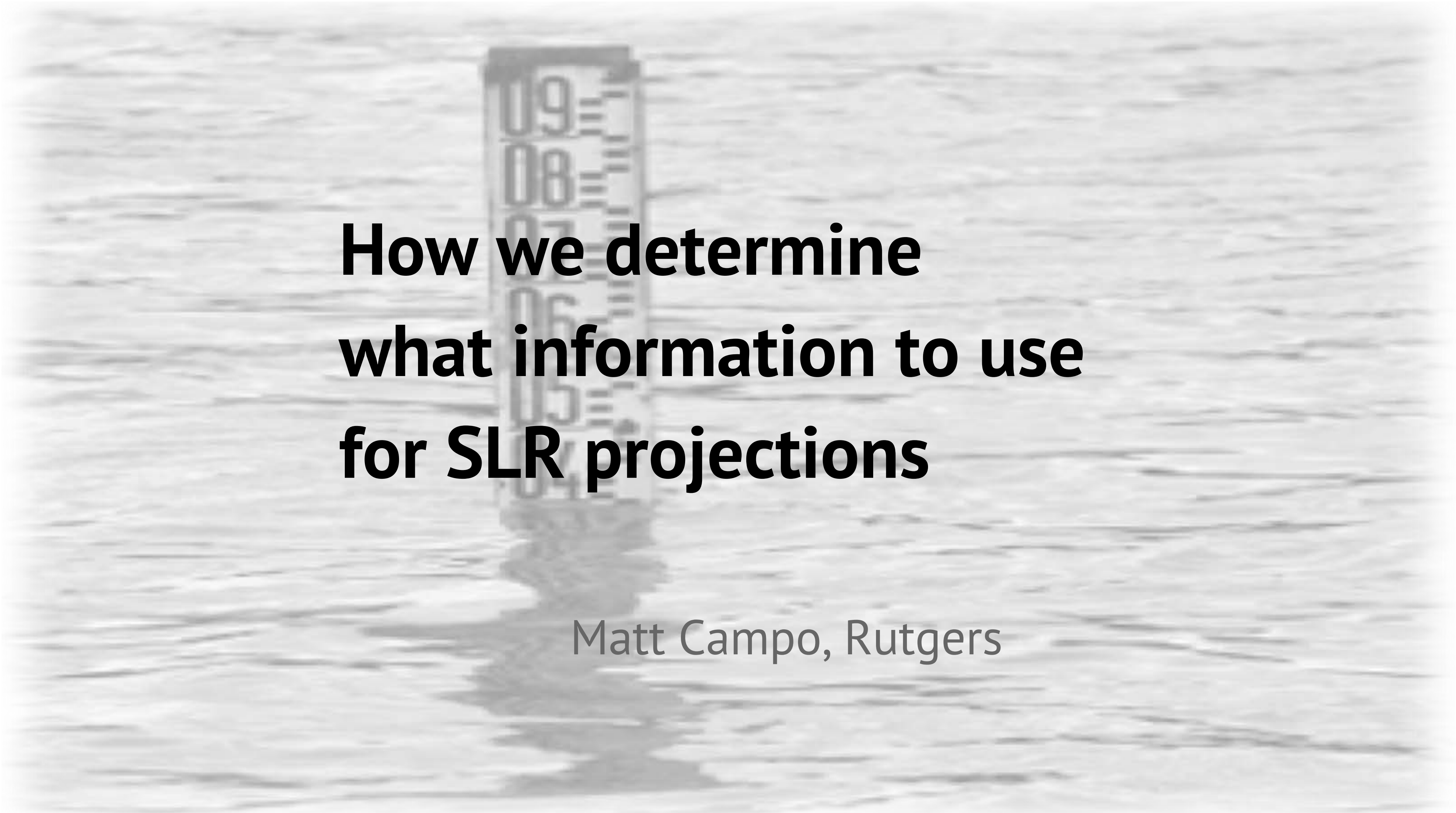
This series will help learn
how to use SLR information for different types of planning documents

#1: Overview of key concepts and current state

#2 Integrating SLR Projections into plans

#3 Creating Hazard Zones

#4 Capital Facilities or Capital Improvement Planning and SLR



How we determine what information to use for SLR projections

Matt Campo, Rutgers

Table TS.2 | Projected change in global mean surface air temperature and key ocean variables for the *near-term* (2031–2050) and *end-of-century* (2081–2100) relative to the *recent past* (1986–2005) reference period from CMIP5. Small differences in the projections given here compared with AR5 reflect differences in the number of models available now compared to at the time of the AR5 assessment (for more details see Cross-Chapter Box 1 in Chapter 1).

		Near-term: 2031–2050		End-of-century: 2081–2100	
	Scenario	Mean	5–95% range	Mean	5–95% range
Global Mean Surface Air Temperature (ºC)[a]	RCP2.6	0.9	0.5–1.4	1.0	0.3–1.7
	RCP4.5	1.1	0.7–1.5	1.8	1.0–2.6
	RCP6.0	1.0	0.5–1.4	2.3	1.4–3.2
	RCP8.5	1.4	0.9–1.8	3.7	2.6–4.8
Global Mean Sea Surface Temperature (ºC)[b] (Section 5.2.5)	RCP2.6	0.64	0.33–0.96	0.73	0.20–1.27
	RCP8.5	0.95	0.60–1.29	2.58	1.64–3.51
Surface pH (units)[b] (Section 5.2.2.3)	RCP2.6	–0.072	–0.072 to –0.072	–0.065	–0.065 to –0.066
	RCP8.5	–0.108	–0.106 to –0.110	–0.315	–0.313 to –0.317
Dissolved Oxygen (100–600 m) (% change) (Section 5.2.2.4)[b]	RCP2.6	–0.9	–0.3 to –1.5	–0.6	0.0 to –1.2
	RCP8.5	–1.4	–1.0 to –1.8	–3.9	–2.9 to –5.0

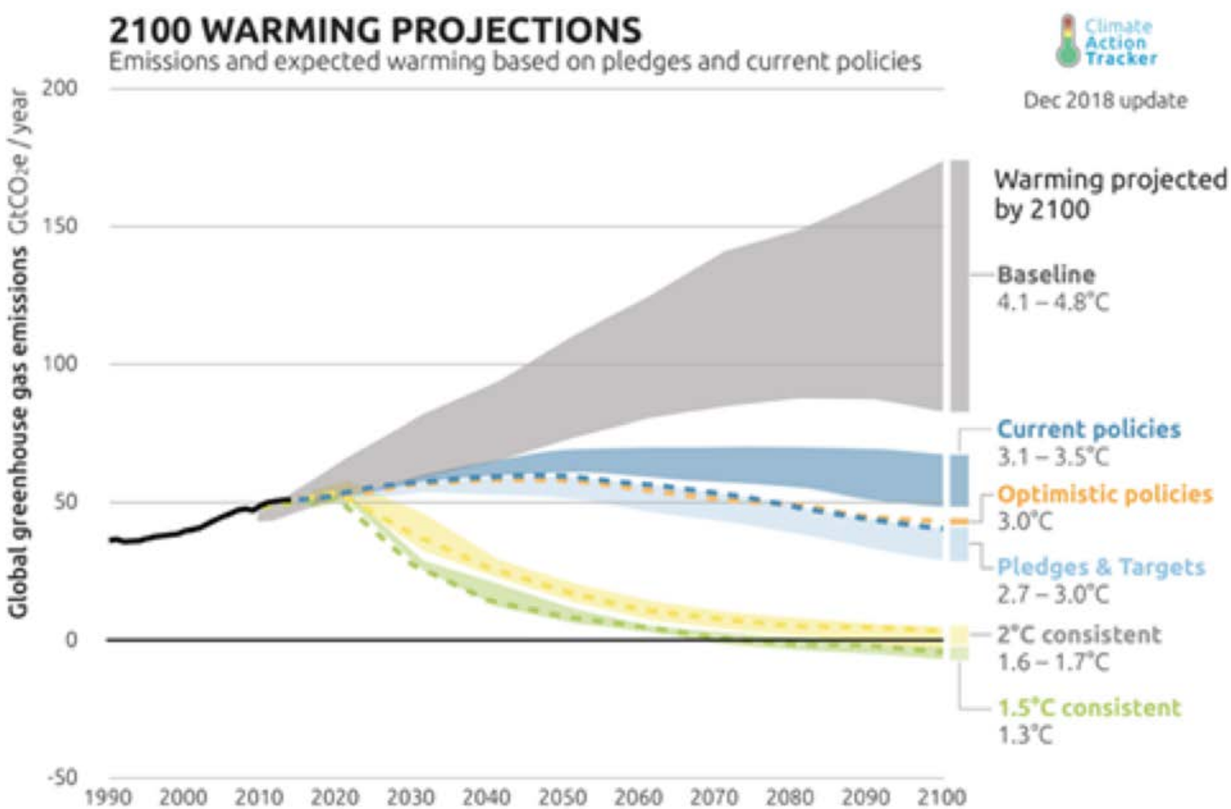
Notes:

[a] Calculated following the same procedure as the IPCC 5th Assessment Report (AR5). The 5–95% model range of global mean surface air temperature across CMIP5 projections was assessed in AR5 as the *likely* range, after accounting for additional uncertainties or different levels of confidence in models.

[b] The 5–95% model range for global mean sea surface temperature, surface pH and dissolved oxygen (100–600 m) as referred to in the SROCC assessment as the *very likely* range (see also Chapter 1, Section 1.9.2, Figure 1.4).

IPCC, 2019: Technical Summary [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, E. Poloczanska, K. Mintenbeck, M. Tignor, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.- O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. In press.

Emissions and ‘Pathways’



Comment

Falling costs for generating clean electricity have led to a proliferation of wind farms, such as this one near Palm Springs, California.

Emissions – the ‘business as usual’ story is misleading

Zeke Hausfather & Glen P. Peters

Stop using the worst-case scenario for climate warming as the most likely outcome – more-realistic baselines make for better policy.

More than a decade ago, climate scientists and energy modellers made a choice about how to describe the effects of emissions on Earth's future climate. That choice has had unintended consequences which today are hotly debated. With the Sixth Assessment Report (AR6) from the Intergovernmental Panel on Climate Change (IPCC) moving into its final stages in 2020, there is now a rare opportunity to reboot.

In the lead-up to the 2014 IPCC Fifth Assessment Report (AR5), researchers developed four scenarios for what might happen to greenhouse-gas emissions and climate warming by 2100. They gave these scenarios a catchy title: Representative Concentration Pathways (RCPs)[1]. One describes a world in which global warming is kept well below 2 °C relative to pre-industrial temperatures (as nations later pledged to do under the Paris climate agreement in 2015); it is called RCP2.6. Another paints a dystopian future that is fossil-fuel intensive and excludes any climate mitigation policies, leading to nearly 5 °C of warming by the end of the century[2,3]. That one is named RCP8.5.

RCP8.5 was intended to explore an unlikely

618 | Nature | Vol 577 | 30 January 2020

Earth processes that influence local relative sea-level

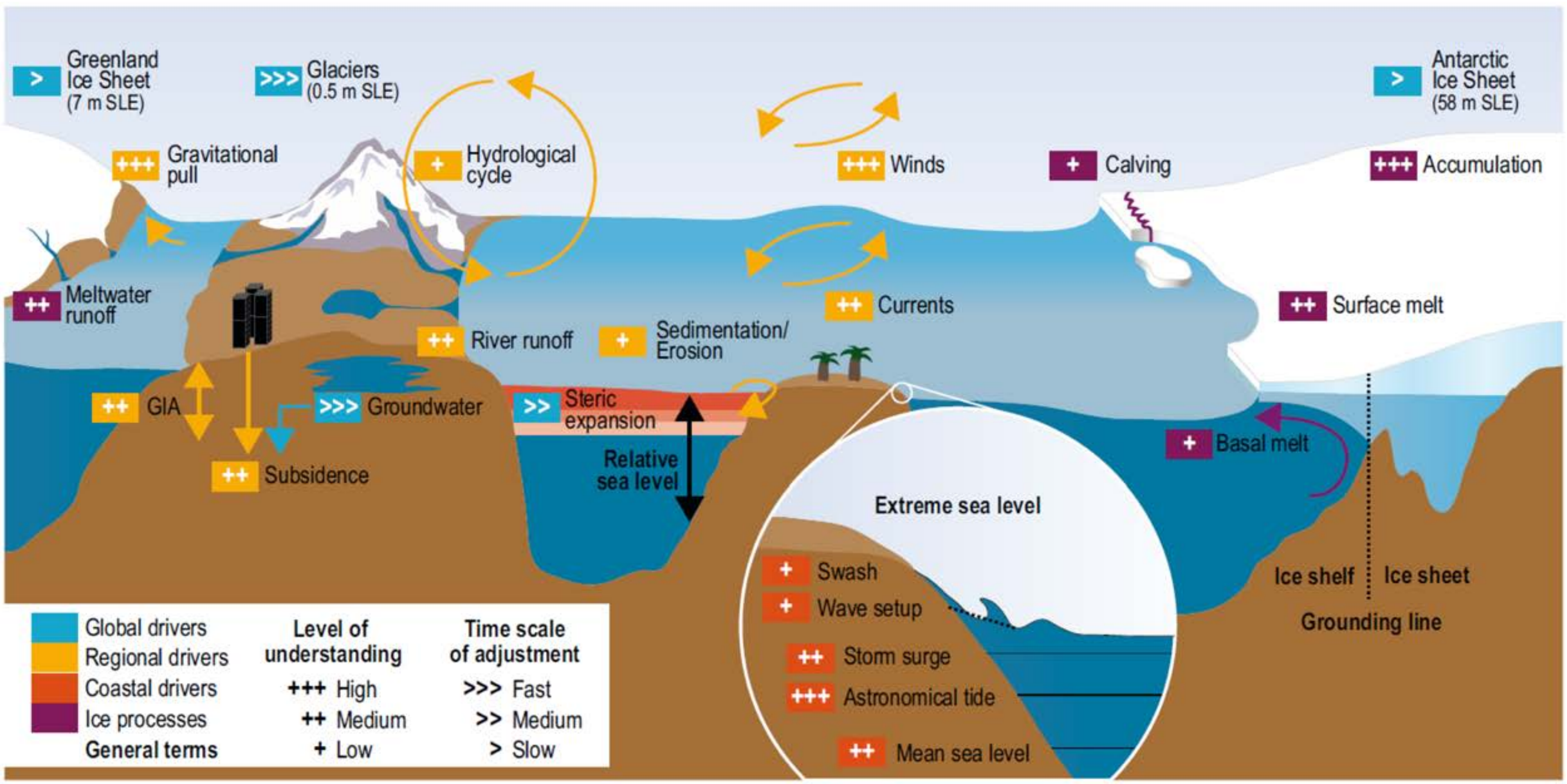
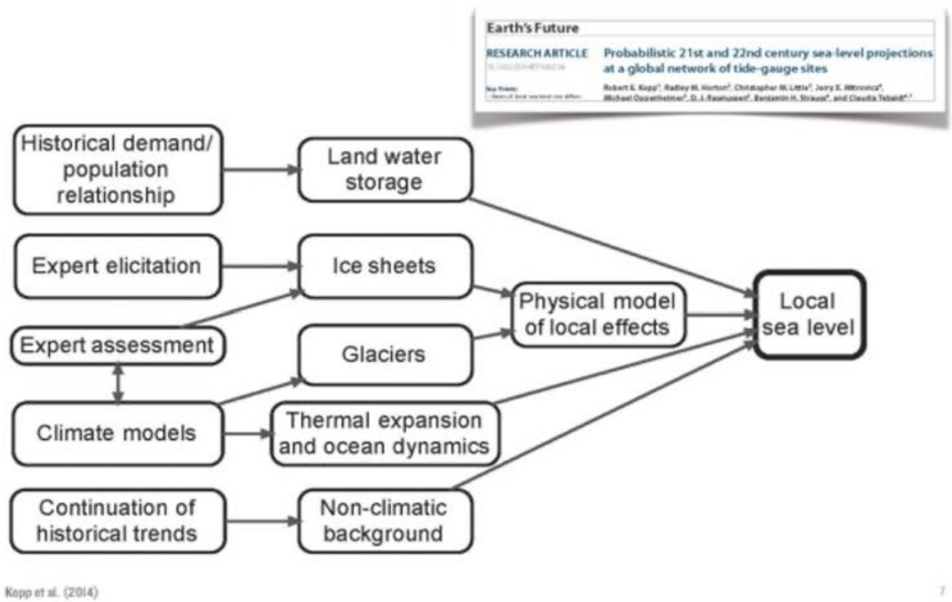


Image Source: IPCC SROCC (2019) - Chapter 4

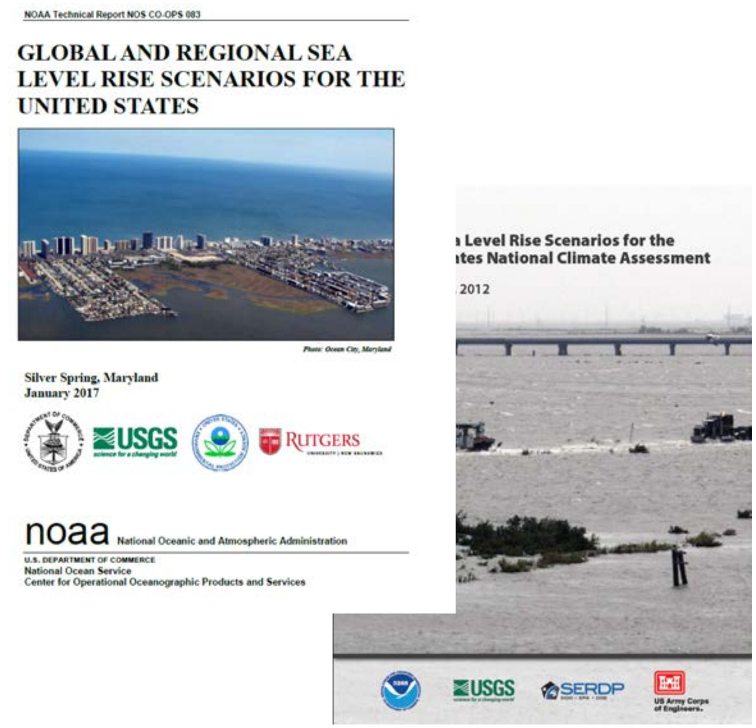
Figure 4.4 | A schematic illustration of the climate and non-climate driven processes that can influence global, regional (green colours), relative and extreme sea level (ESL) events (red colours) along coasts. Major ice processes are shown in purple and general terms in black. SLE stands for Sea Level Equivalent and reflects the increase in GMSL if the mentioned ice mass is melted completely and added to the ocean.

Science supporting planning in the US

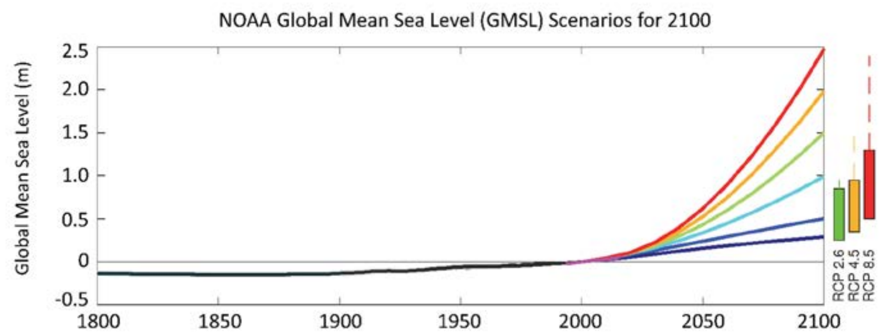
"Probabilistic" Approach (e.g., Kopp et al., 2014)

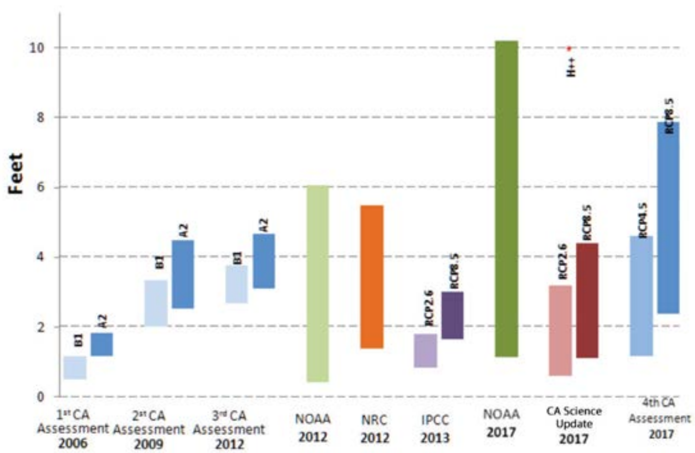


Scenario-based Approach (Sweet et al., 2017)

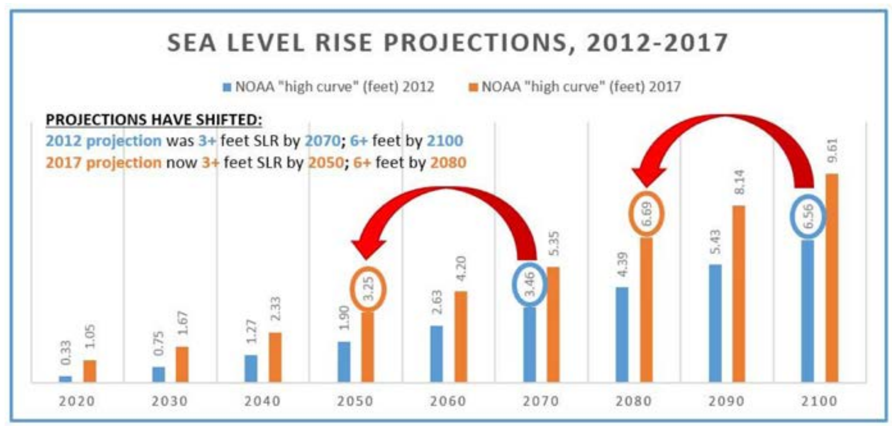


Users act on both probabilistic and scenario-based science



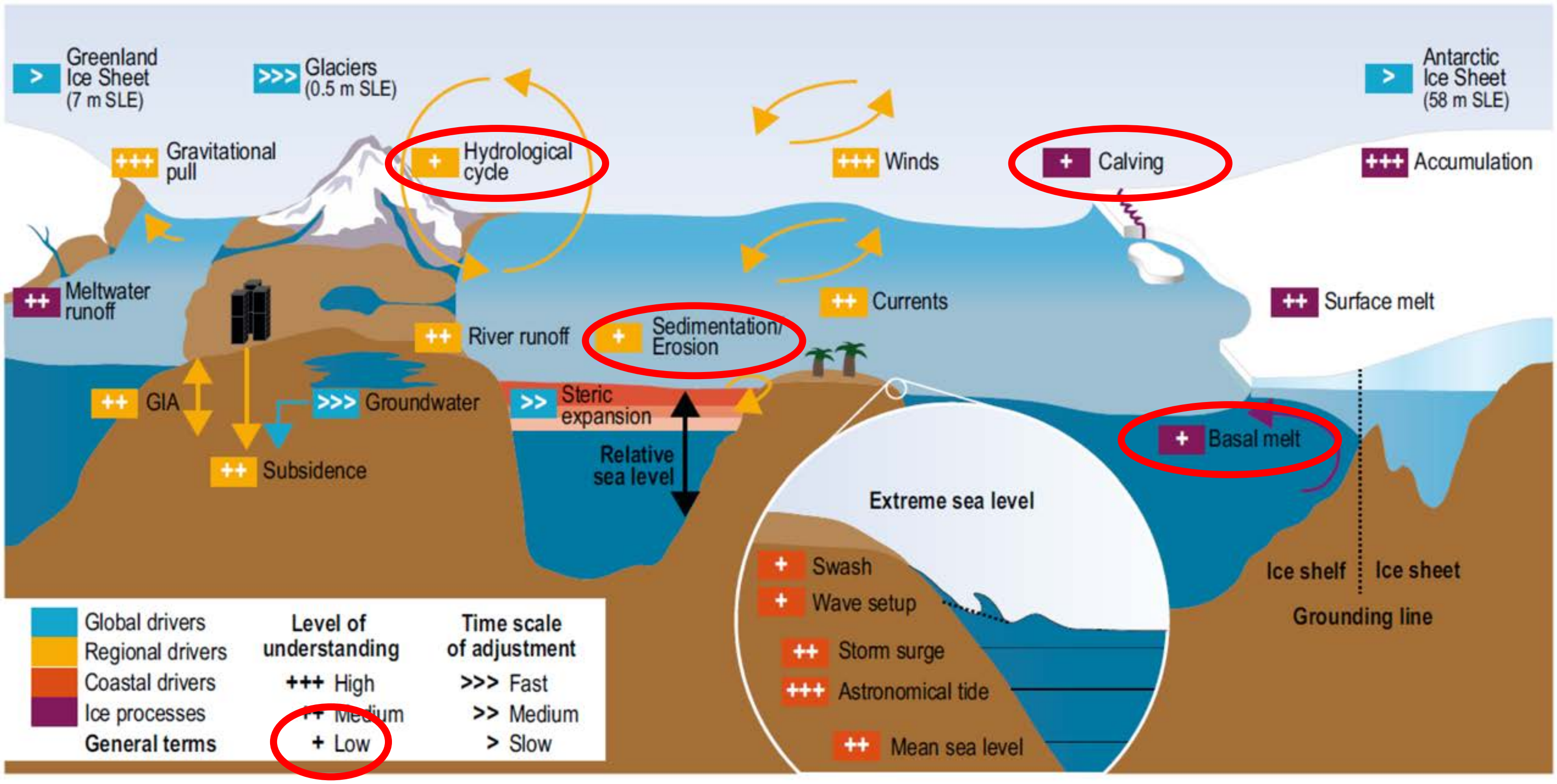


Griggs, G, Árvai, J, Cayan, D, DeConto, R, Fox, J, Fricker, HA, Kopp, RE, Tebaldi, C, Whiteman, EA (California Ocean Protection Council Science Advisory Team Working Group). Rising Seas in California: An Update on Sea-Level Rise Science. California Ocean Science Trust, April 2017.



Rhode Island Coastal Resources Management Council Shoreline Change SAMP Volume I (2018)

‘Best Available’ based on what we know at a point in time...



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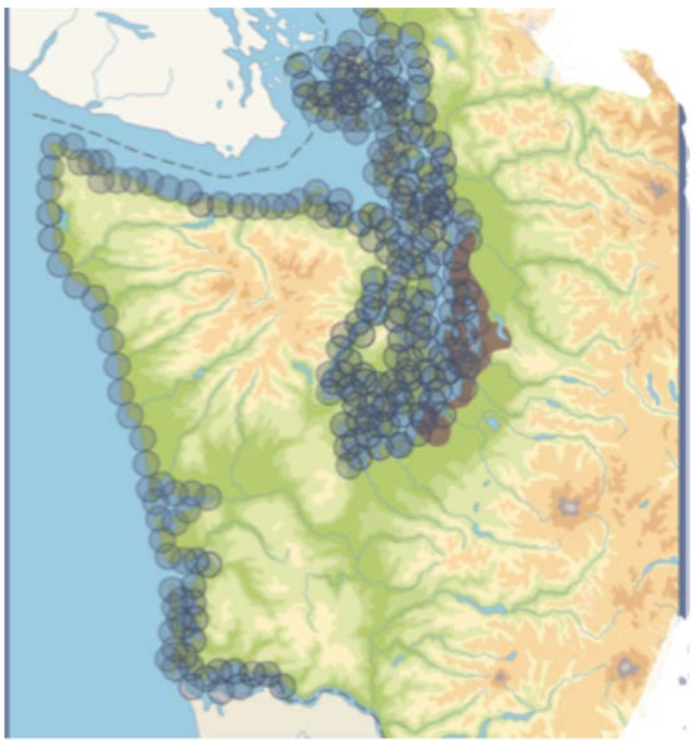
How close is close enough?



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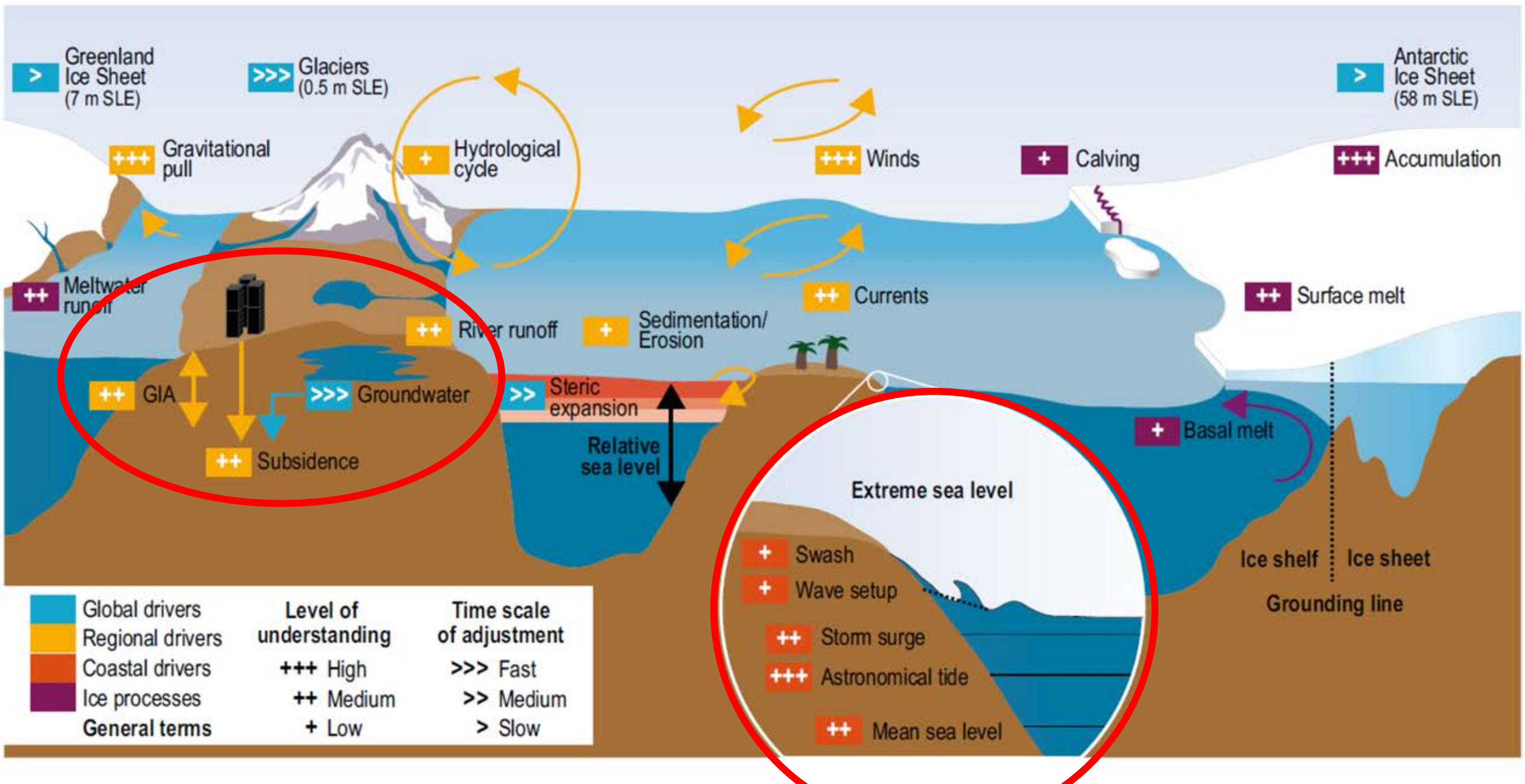

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Creating sea level change projections in Washington (and uncertainty)

Nicole Faghin, Washington Sea Grant

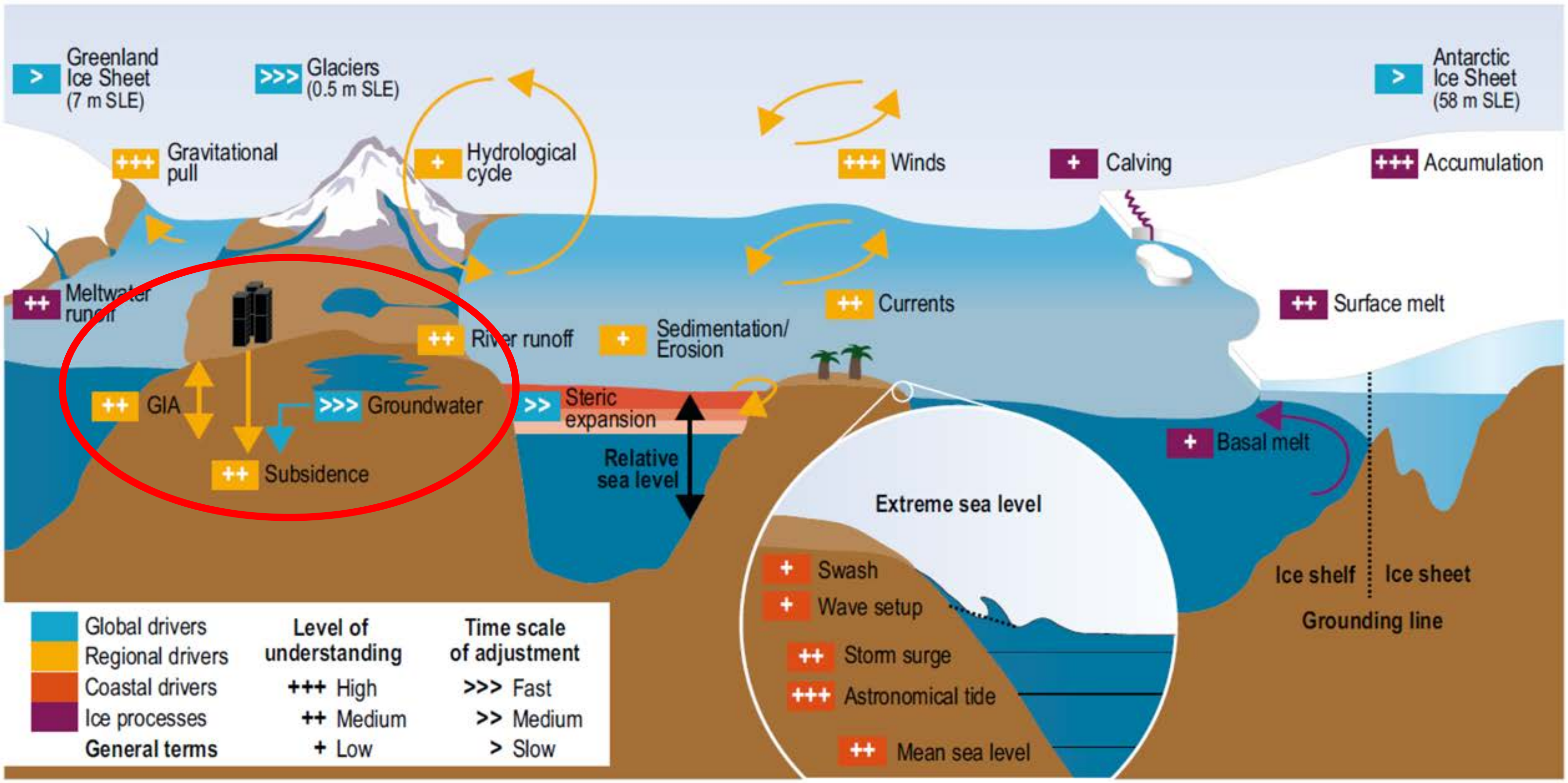
1, 2 or 3 feet?

Making it Local

Neah Bay, WA

Seattle, WA

Factors influencing sea level change



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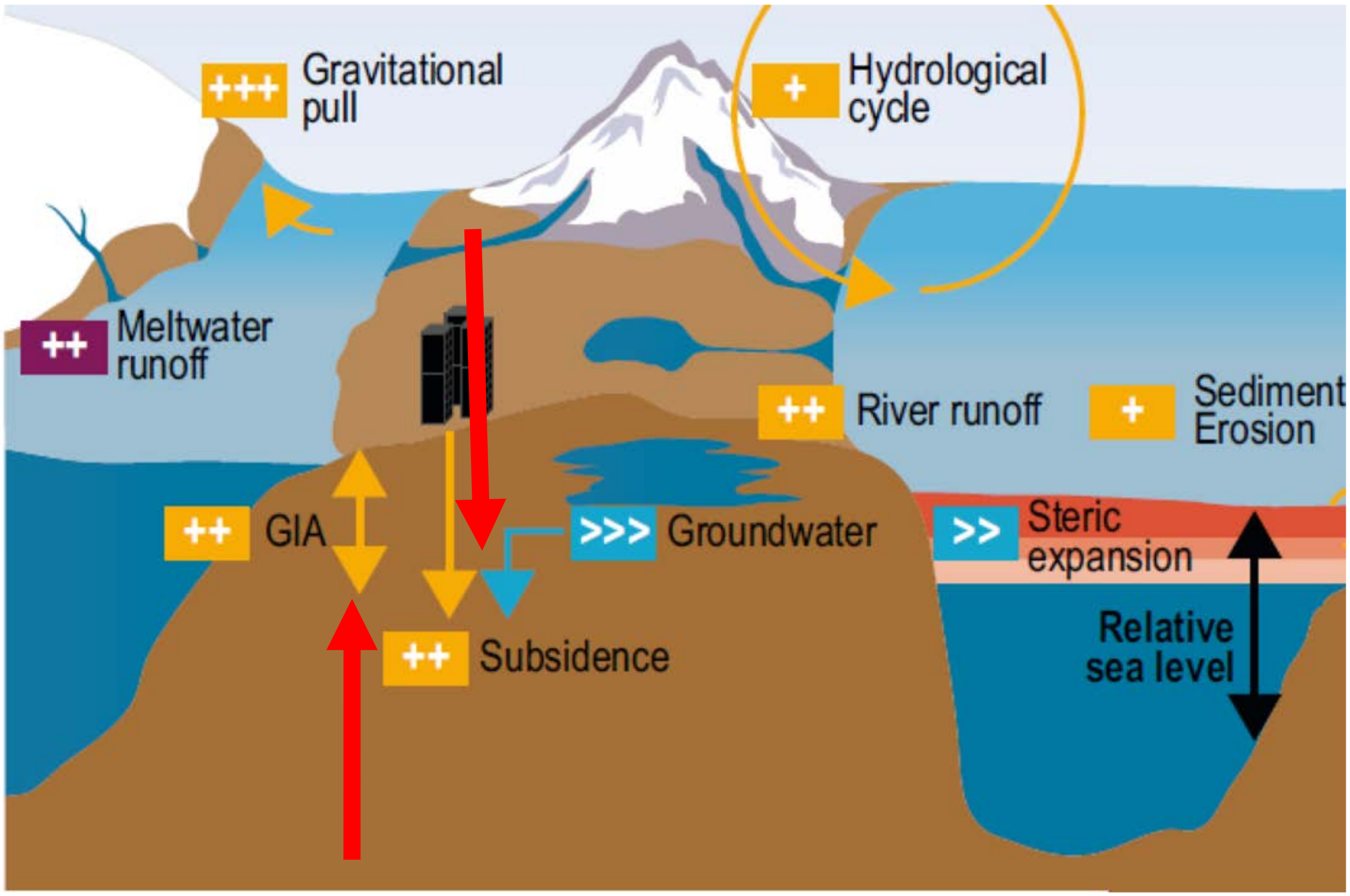
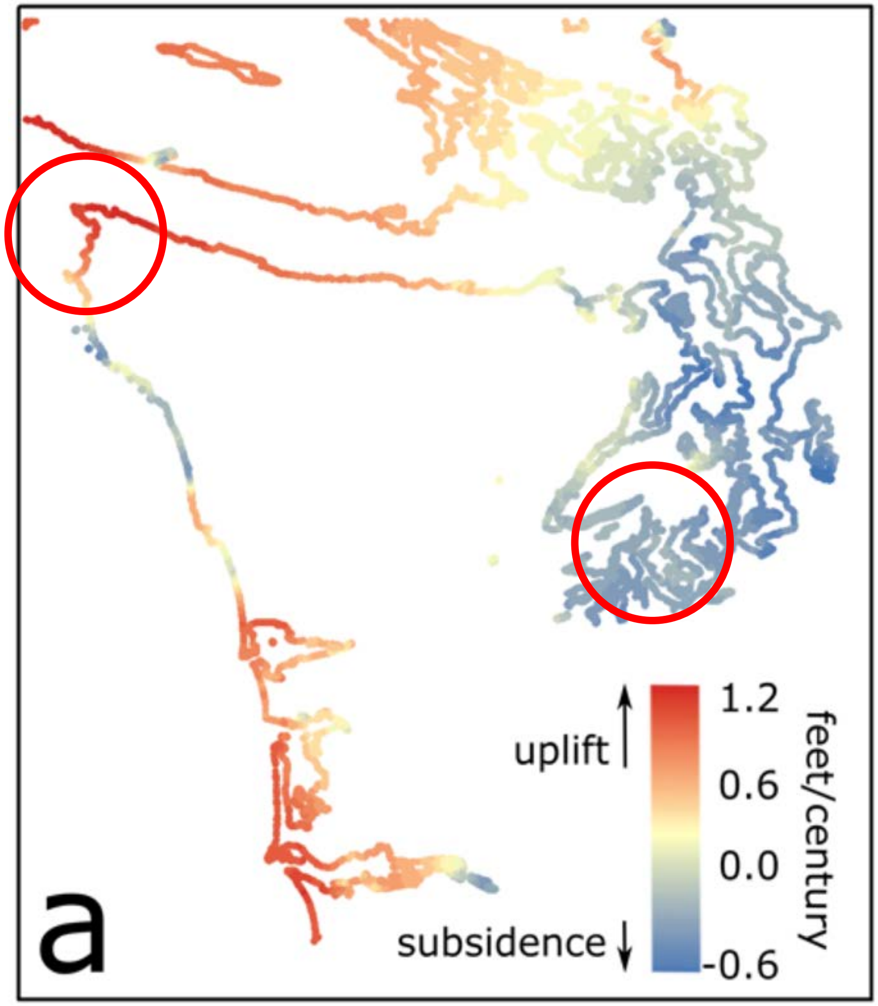
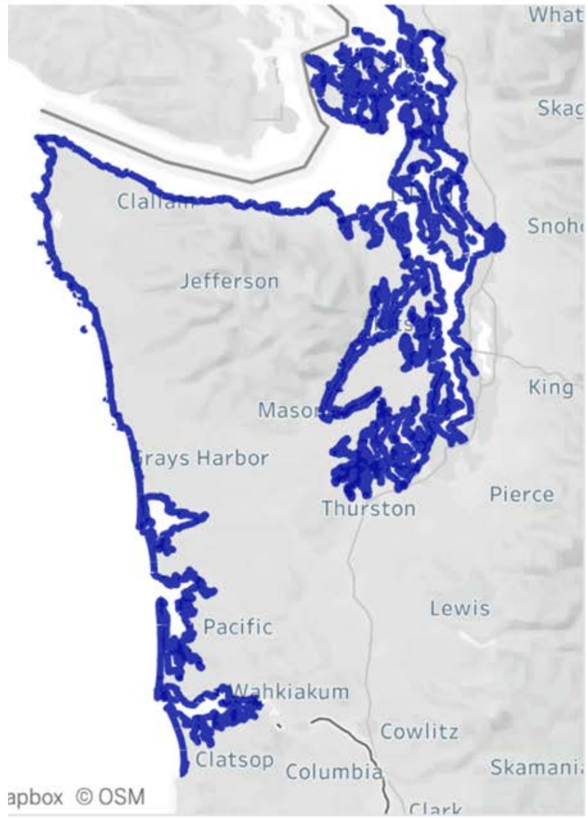
Focus on Vertical Land Movement



We conducted a Vertical Land Movement (VLM) study for Washington state



VISUALIZATION #1: Projected sea level change by year



https://wacoastalnetwork.com/chrn/research/sea-level-rise/

VISUALIZATION #1: Projected sea level change by year

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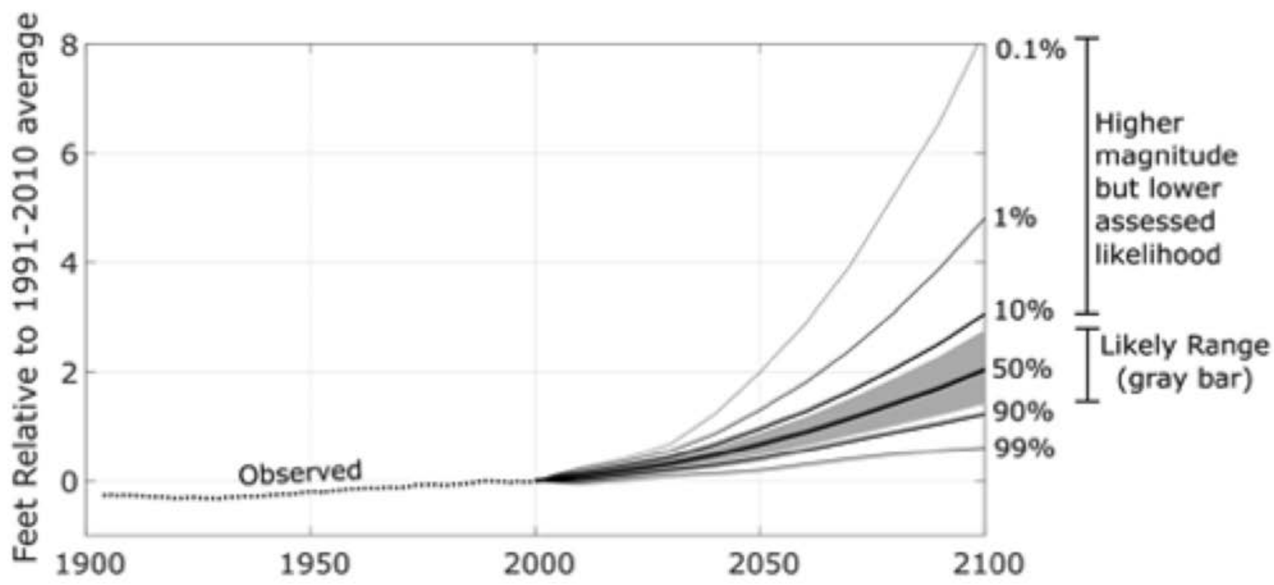
Washington State sea level rise projections 2018



Here is an example of a probability table for sea level rise

Probability of Exceedance

	99%	95%	90%	83%	50%	17%	10%	5%	1%	0.1%
2030	0	0.1	0.1	0.2	0.4	0.5	0.6	0.6	0.7	0.9
2040	0	0.2	0.2	0.3	0.5	0.8	0.8	0.9	1.1	1.4
2050	0	0.2	0.4	0.5	**0.8**	1.1	1.2	1.3	1.6	2.1
2060	0.1	0.4	0.5	0.6	1	1.4	1.5	1.7	2	3
2070	0.2	0.5	0.7	0.8	1.3	1.7	1.9	2.1	2.7	4.1
2080	0.3	0.6	0.8	1	1.6	2.1	2.4	2.6	3.4	5.4
2090	0.4	0.8	1	1.2	1.9	2.6	2.8	3.2	4.1	7
2100	0.4	0.9	1.2	1.5	2.2	3.1	3.4	3.8	5	8.6

We use **three key factors** to selecting Sea Level Rise projections

Timeframe

Risk tolerance

Greenhouse Gas Scenario

Timeframes

Timeframes/Life Spans for assessing SLR projections may be different depending on type of analysis

Vulnerability Assessment

General Planning

Project Design

Restoration Project

Examples of Life Span
(from Santa Monica Coastal Plan)

TYPE OF STRUCTURE	# of YEARS
a. **Temporary structures**:	*up to 5*
b. **Ancillary development**:	*25*
c. **Residential/commercial structures**:	*75-100*
d. **Critical infrastructure**:	
• Asphalt roadway	*25-50*
• Concrete pavement	*50-75*
• Bridges	*75*
• Water mains	*100*
• Storm drains	*100*
• Electrical and gas	*100*

Risk or Probability of Exceedance

SOME TERMINOLOGY:

- Low-probability projections (0.1 – 17%)
  - Low chance sea levels will rise to this level
- Hi-probability projections (65-99%)
  - High chance (pretty darn certain) sea levels will rise to this level
- Mid-range (likely) projections (17 – 65%)
  - 50/50 chance sea levels will rise to this level

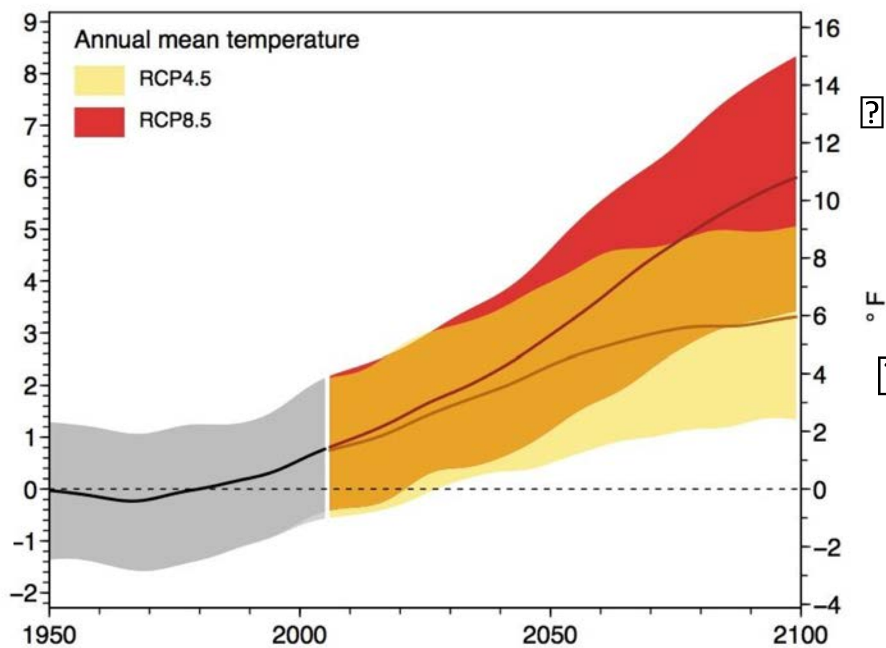
Risk in context of selecting SLR projections

Decision	Strategy	Approach	Example
Risk Averse	Avoid worst-case outcomes	Low probability, high impact sea level rise projections. **5%, 1%, and 0.1%**	Wastewater Treatment Facility
Risk tolerant	Adaptive management	Best case or central projection. **50% - 99%**	Beach park

Green House Gas Scenarios

Sea Level projections depend in part on GHG Scenarios

Temperature Increases



Year

High emissions
RCP 8.5

Low emissions
RCP 4.5

OSU Climate Impacts Consortium

Island County Sea Level Rise Average Projections

RCP 4.5 Sea-level rise projections averaged for Island County in feet based on Miller et al projections.

RPC 4.5

	Very Likely 95% [illegible]	Likely 50% [illegible]	Unlikely 1% [illegible]	Mid-Range 17 - 83% [illegible]ability
2050	[illegible]	[illegible]	[illegible]	[illegible] - 1.0
2070	0.5	1.1	2.4	0.7 - 1.5
2100	0.7	1.8	4.4	1.1-2.5

RCP 8.5 Sea-level Rise Projections Averaged for Island County in Feet based on Miller et al projections

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RISK LEVELS

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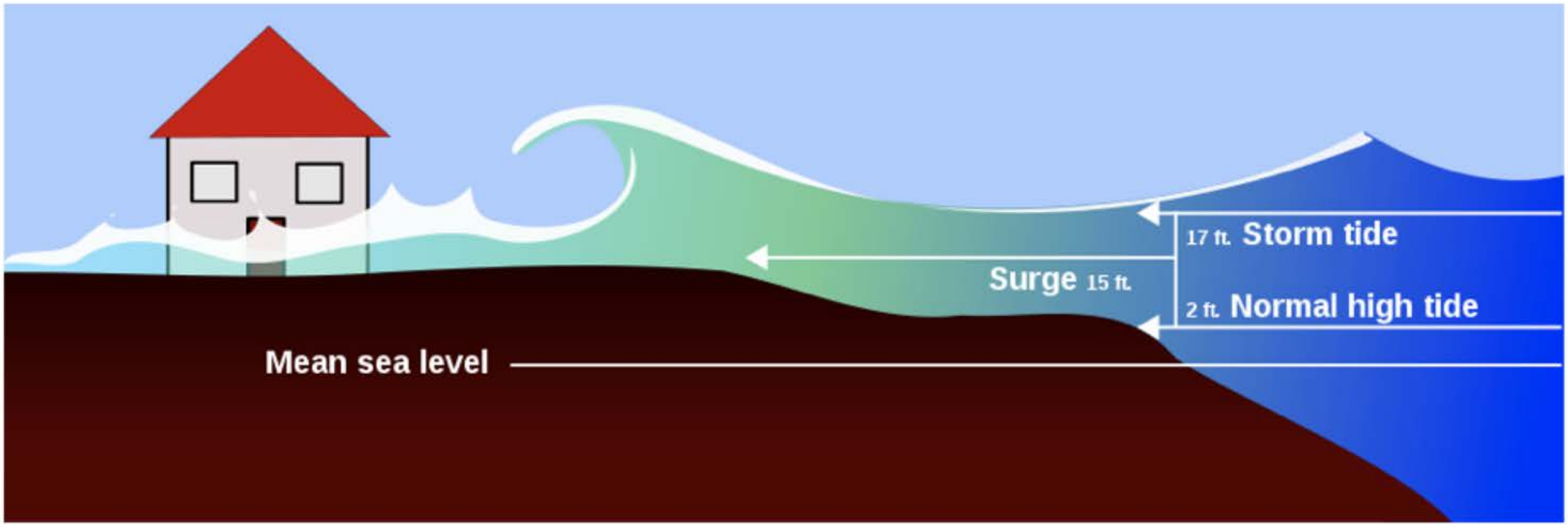
Its more than just
the rising of the
sea level....



Source: Wikipedia

From Miller et al., 2019, “Extreme Coastal Water Level in Washington State: Guidelines to Support Sea Level Rise Planning”

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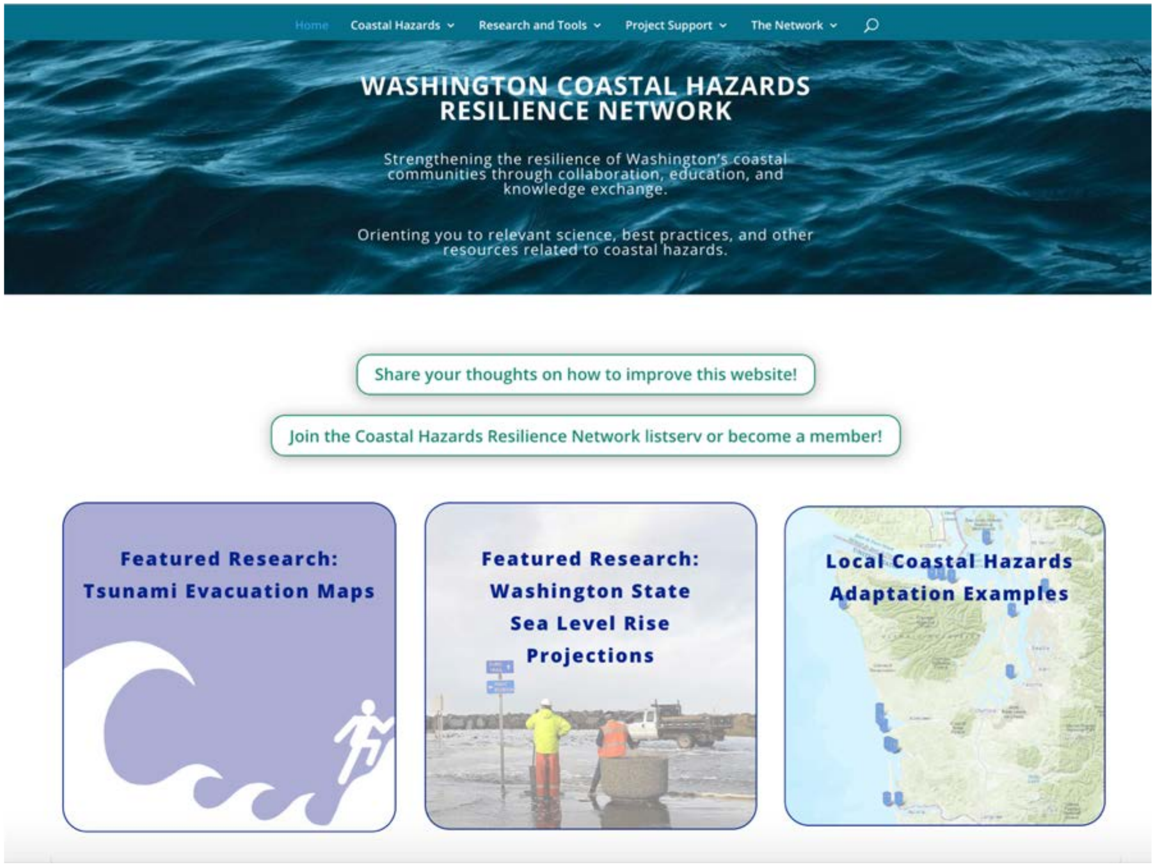
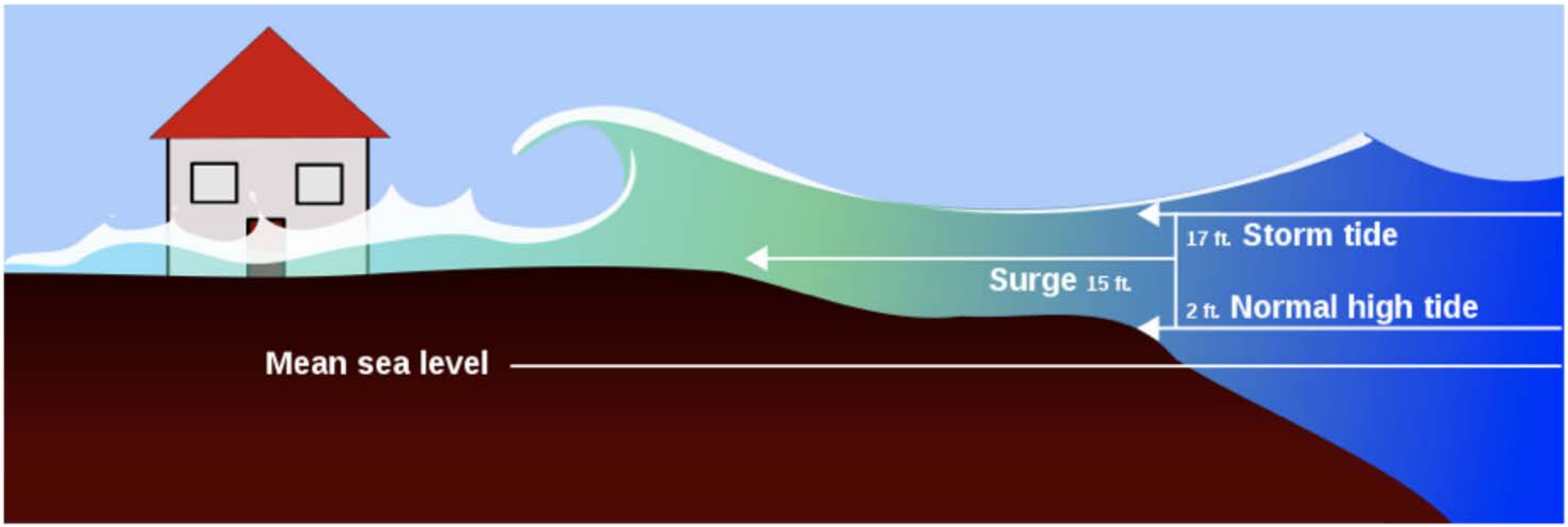
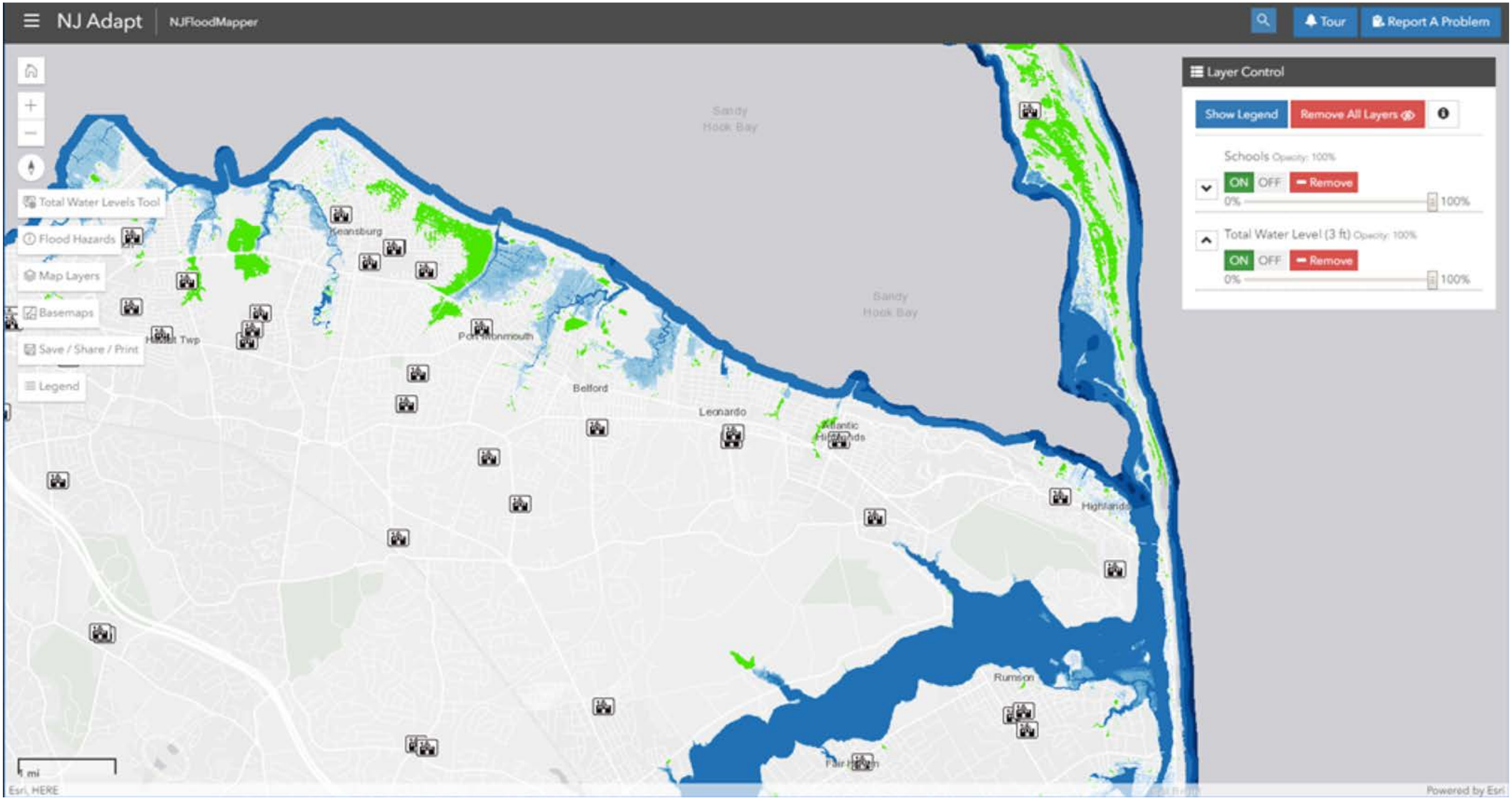
Website with data and resources:
http://www.wacoastalnetwork.com/




How will sea-level change
impact flooding
in our community?
Matt Campo, Rutgers



Source: Wikipedia


NJ Adapt
NJFloodMapper
Tour
Report A Problem
Total Water Levels Tool
Flood Hazards
Map Layers
Basemaps
Save / Share / Print
Legend
Layer Control
Show Legend
Remove All Layers
Schools Opacity: 100%
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Total Water Level (3 ft) Opacity: 100%
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Sandy Hook Bay
Sandy Hook Bay
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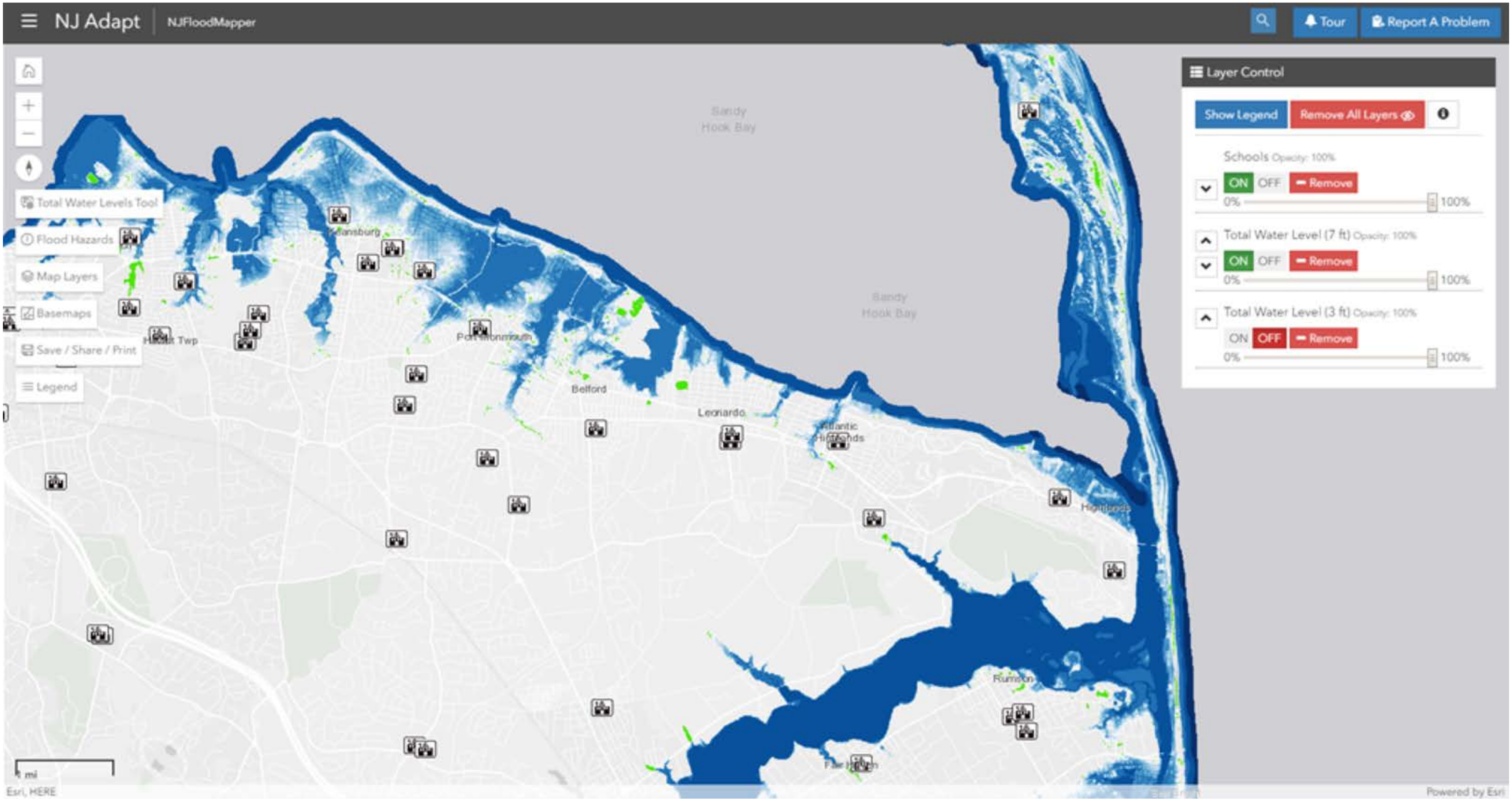
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Sandy Hook Bay
Sandy Hook Bay
Belford
Leonardo
Rumson
Layer Control
Show Legend
Remove All Layers
Schools Opacity: 100%
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Remove
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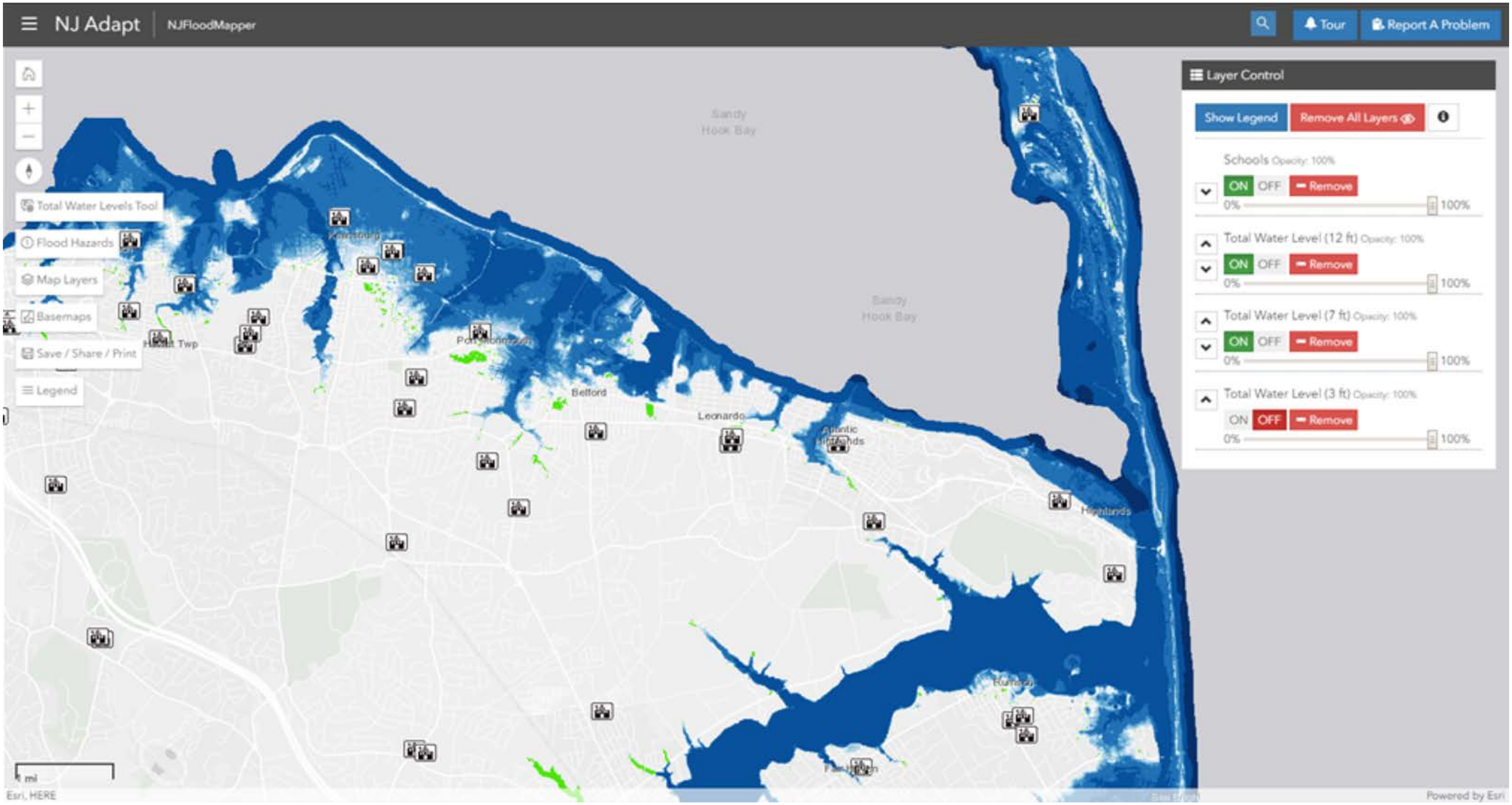

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Save / Share / Print
Legend
Sandy Hook Bay
Sandy Hook Bay
Belford
Leonardo
Highlands
Layer Control
Show Legend
Remove All Layers
Schools Opacity: 100%
ON OFF Remove
0% 100%
Total Water Level (12 ft) Opacity: 100%
ON OFF Remove
0% 100%
Total Water Level (7 ft) Opacity: 100%
ON OFF Remove
0% 100%
Total Water Level (3 ft) Opacity: 100%
ON OFF Remove
0% 100%
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What tools are available?

Matt Campo, Rutgers
Nicole Faghin, Washington Sea Grant

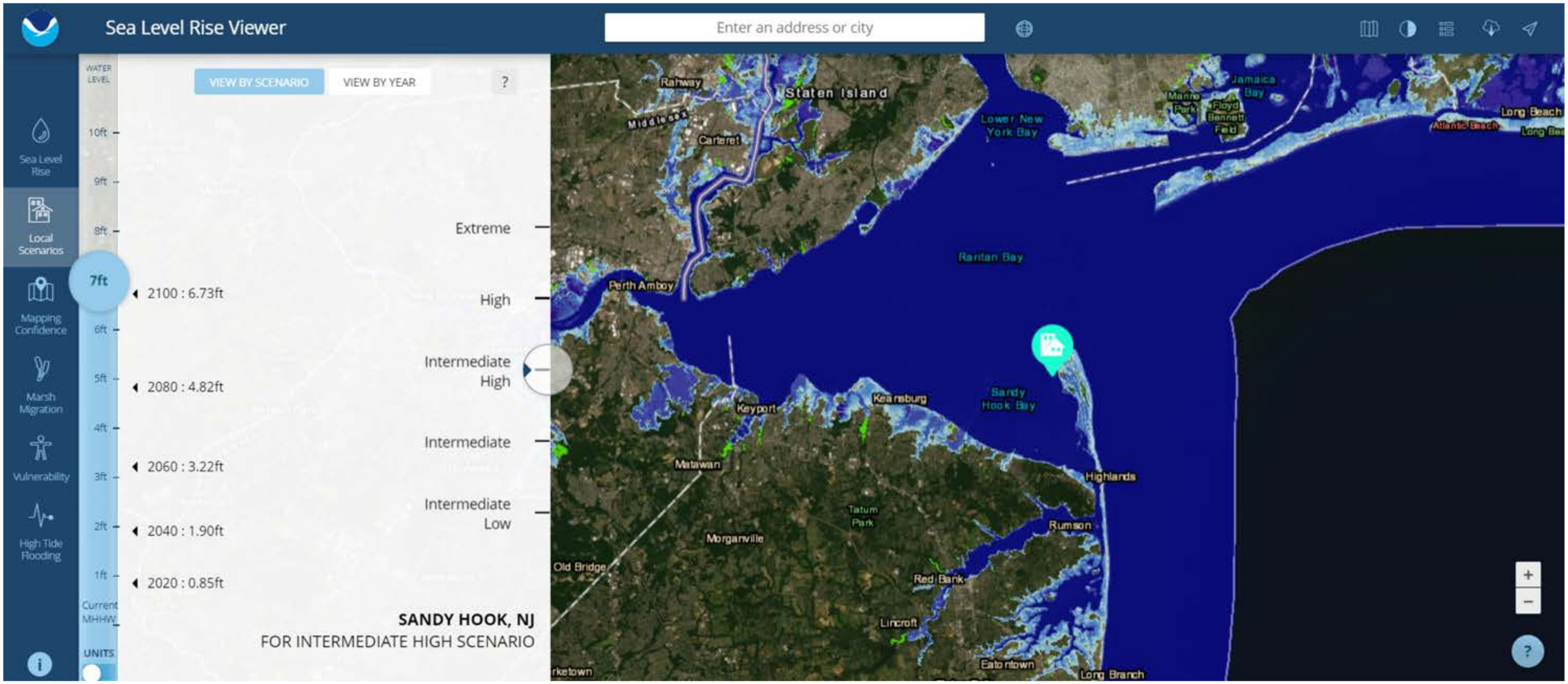
Do I have the right tool for the job?

What tools do you use?

Share them in the comment box for the webinar as we’re speaking!

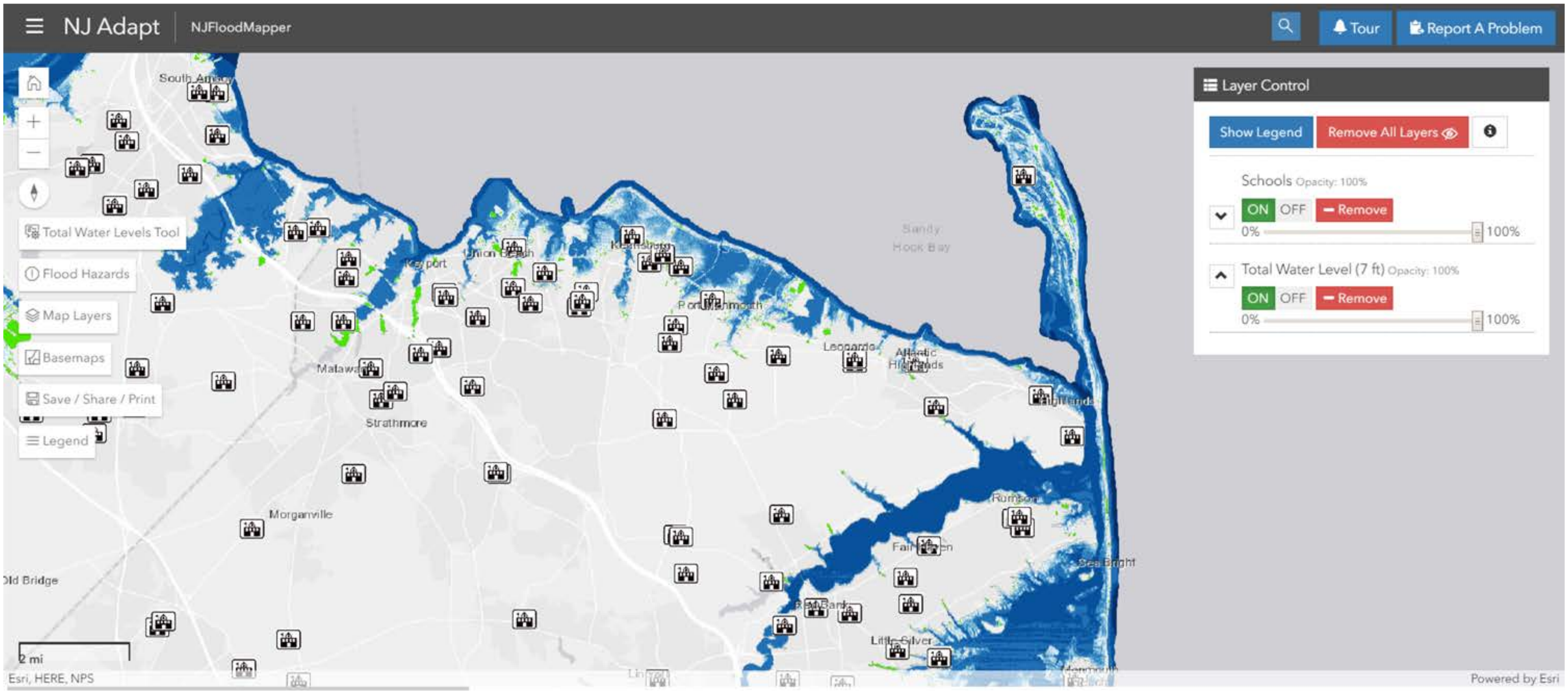
We’ll compile the list of hyperlinks and pass along to attendees.

NOAA Sea Level Rise Viewer

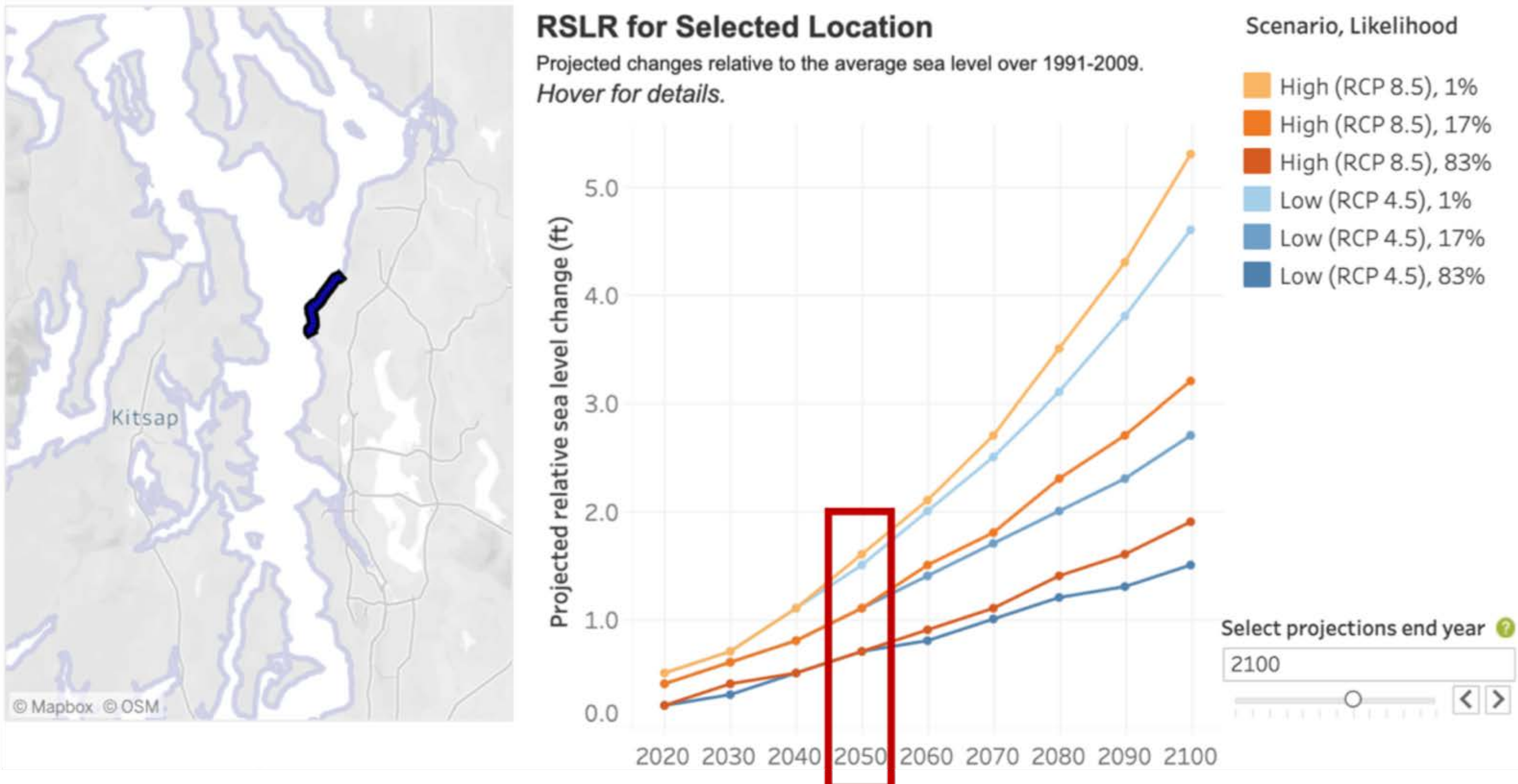


https://coast.noaa.gov/slr/#

Exposure Tools

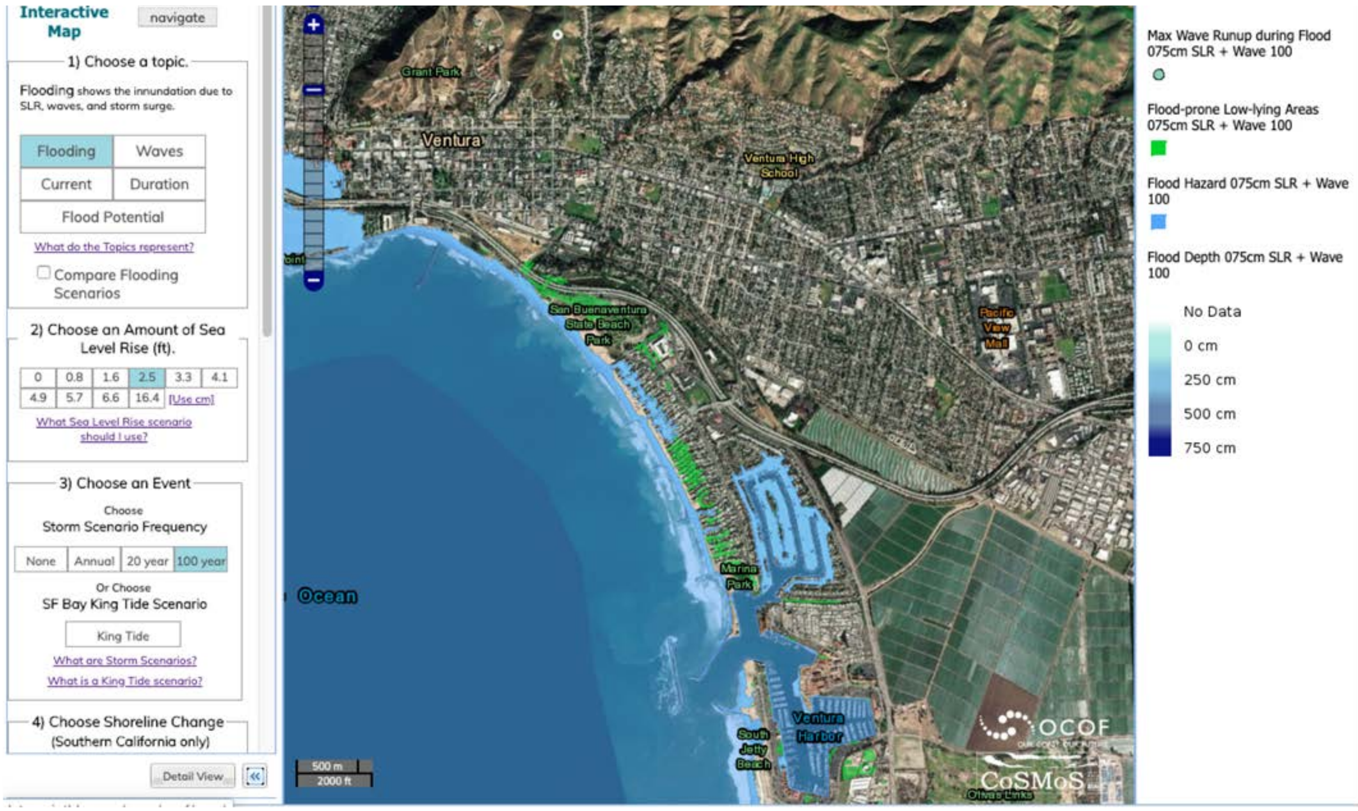


[Home Page | NJFloodMapper]



https://wacoastalnetwork.com/chrn/research/sea-level-rise/

Coastal Storm Modeling System CoSMoS



http://data.pointblue.org/apps/ocof/cms/index.php?page=flood-map

NEXT IN THE SERIES….

TOPIC: Integrating SLR Projections into plans

DATE: May 8, 2020

Contact Information

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