Understanding California sea level rise studies and guidance

Smart Coast California Summit

Nancy Watkins, FCAS, MAAA
Principal & Consulting Actuary, Milliman

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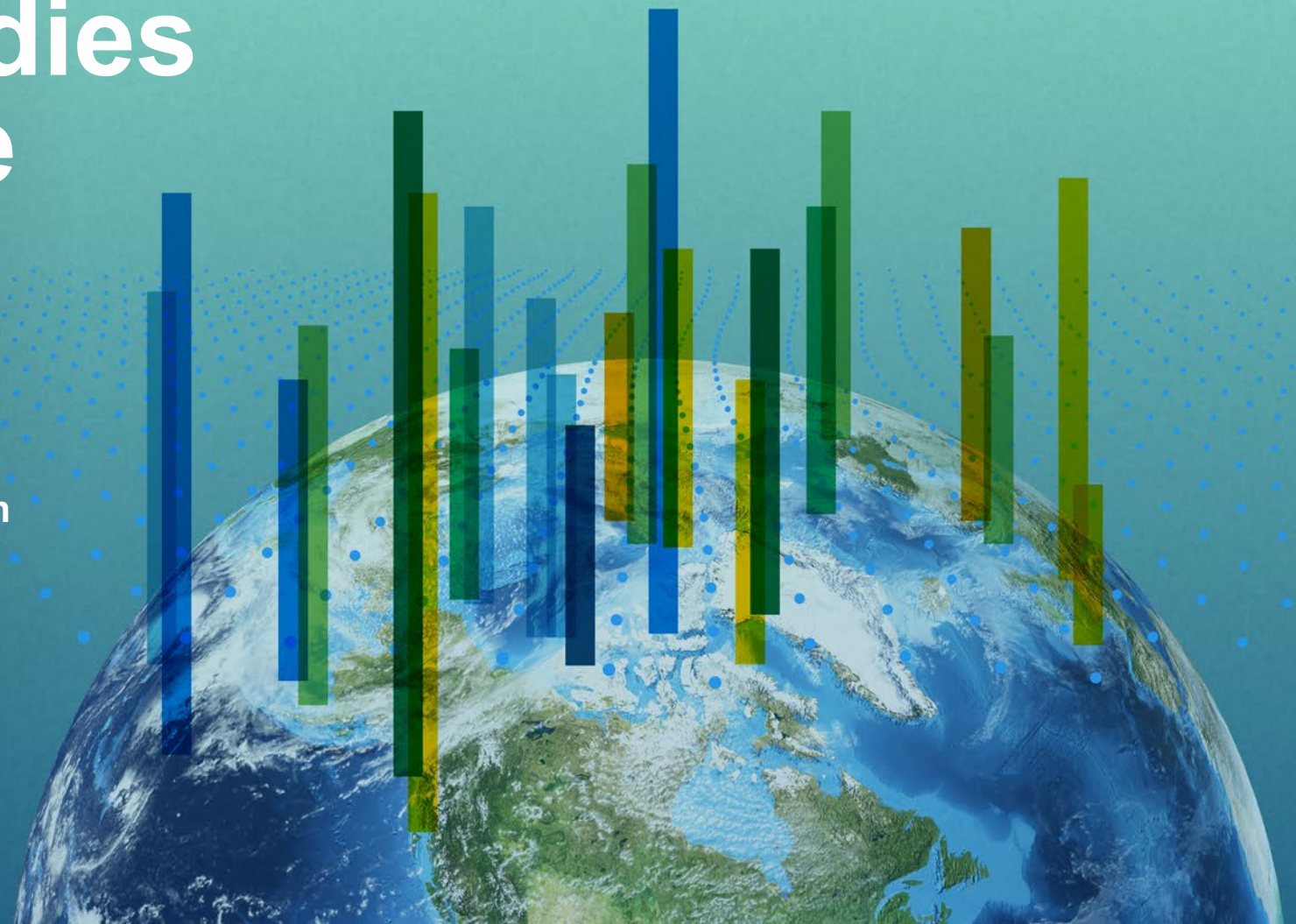


Milliman

Agenda

- Highlights of Milliman work in flood and climate change
- Review for Smart Coast California
  - Purpose and scope
  - Pertinent sea level rise scientific studies
  - California Coastal Commission sea level rise guidance
  - Local vulnerability assessments
  - Summary of recommendations

Highlights of Milliman work in flood and climate change

Milliman

National Association of REALTORS® (NAR)

Education and analysis to support legislative strategies

Questions to answer:

- How does the NFIP price its policies?
- How does the NFIP approach differ from the approach private insurers might use?
- What would happen to flood insurance premiums if private insurers offered flood?
- How are state insurance regulators encouraging or discouraging the private flood market?
- What would premiums look like under a federal program covering all catastrophe perils?

NATIONAL ASSOCIATION OF REALTORS®

FEMA / FIMA / NFIP Risk Rating 2.0

Strategic transformation of NFIP pricing and communication of flood risk

Questions to answer:

- How do we evaluate commercially available catastrophe models?
- How do we make the most out of the NFIP's 50 years of data?
- How do we incorporate all sources of flood risk into NFIP premiums?
- How do we measure flood risk in areas outside the SFHA?
- How do we deliver rates that are actuarially sound, equitable, easier to understand and better reflect a property's flood risk?

NATIONAL FLOOD INSURANCE PROGRAM

FEMA

Better intelligence. Smarter decisions. Safer world.

As experts in many different types of risk, Milliman has a unique view into our climate future and its cascading effects on governments, communities, and businesses. That’s why we’ve created a powerful climate risk coalition to open new pathways to resilience.

Milliman Climate Resilience Initiative (MCRI)

Worldwide expertise for a global challenge

Climate risk mitigation and adaptation

Provide risk-informed analysis to communities, regulators and government entities to support strategic decisions for effective risk mitigation and risk transfer

Flood insurance

Evaluate rapidly changing flood risk through granular data and advanced modeling, and promote resilience by increasing flood insurance penetration

Catastrophe model analysis and validation

Understand and compare complex, leading-edge catastrophe models and data, and evaluate appropriateness for specific use cases

Microinsurance

Improve stability and security of vulnerable populations through innovation

Mortgage & credit risk

Integrate the impact of climate into mortgage and credit models for pricing and capital analysis

Complex risk assessment

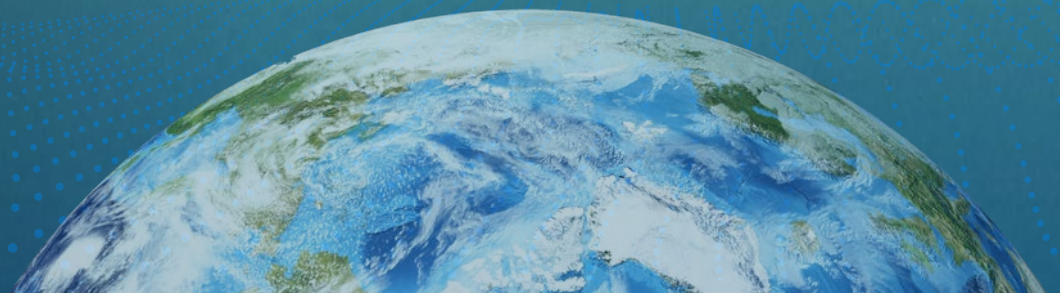
Anticipate complex non-financial risks like human behavior, population movement, and social change

Health

Understand the potential impact of climate change on human health

Enterprise risk management

Integrate climate and related risk for more informed, effective decisions



Volunteer work

Milliman interaction with leaders in global climate resilience

Insurance Development Forum

Milliman's Chairman, Ken Mungan, sits on the IDF Steering Committee, and MCRI members are collaborating on an open source global catastrophe model.

InsuResilience Global Partnership

The MicroInsurance Centre at Milliman is a member of the InsuResilience Global Partnership, working to promote a shift from reactive crisis response to proactive investment in global prevention, preparedness, and early action.

United Nations Capital Development Fund (UNCDF)

Milliman experts are members of UNCDF's Climate Insurance Linked Resilient Infrastructure Finance (CILRIF) working group, a cross-industry collaboration to bring a comprehensive climate insurance product to stakeholders in developing countries.

Wharton Risk Management and Decision Processes Center

Milliman's Nancy Watkins sits on the Advisory Board of the Center's Role of Insurance in Climate Adaptation project.

Urban Land Institute (ULI)

Milliman experts partnered with ULI and other industry leaders to provide an in-depth analysis on climate risk and real estate.

House Select Committee on the Climate Crisis

Milliman's Nancy Watkins briefed the U.S. House Select Committee on the Climate Crisis on the financial impacts to coastal communities from the threat of sea-level rise.

What's on our mind

A selection of 2021 MCRI R&D objectives

How do regulators evaluate complex catastrophe and AI models and ensure that they do not result in unfair discrimination?

How does the insurance industry collaborate to make climate forecasts accessible to the global community?

How do you pre-finance mitigation for long-term risk and premium reductions?

How do you know whether low-income and BIPOC communities have fair access to health facilities and property insurance?

How does wildfire smoke affect the health of the population?

How does increased flood risk threaten real estate values and mortgages?

Review for Smart Coast California

Purpose and scope of Milliman review

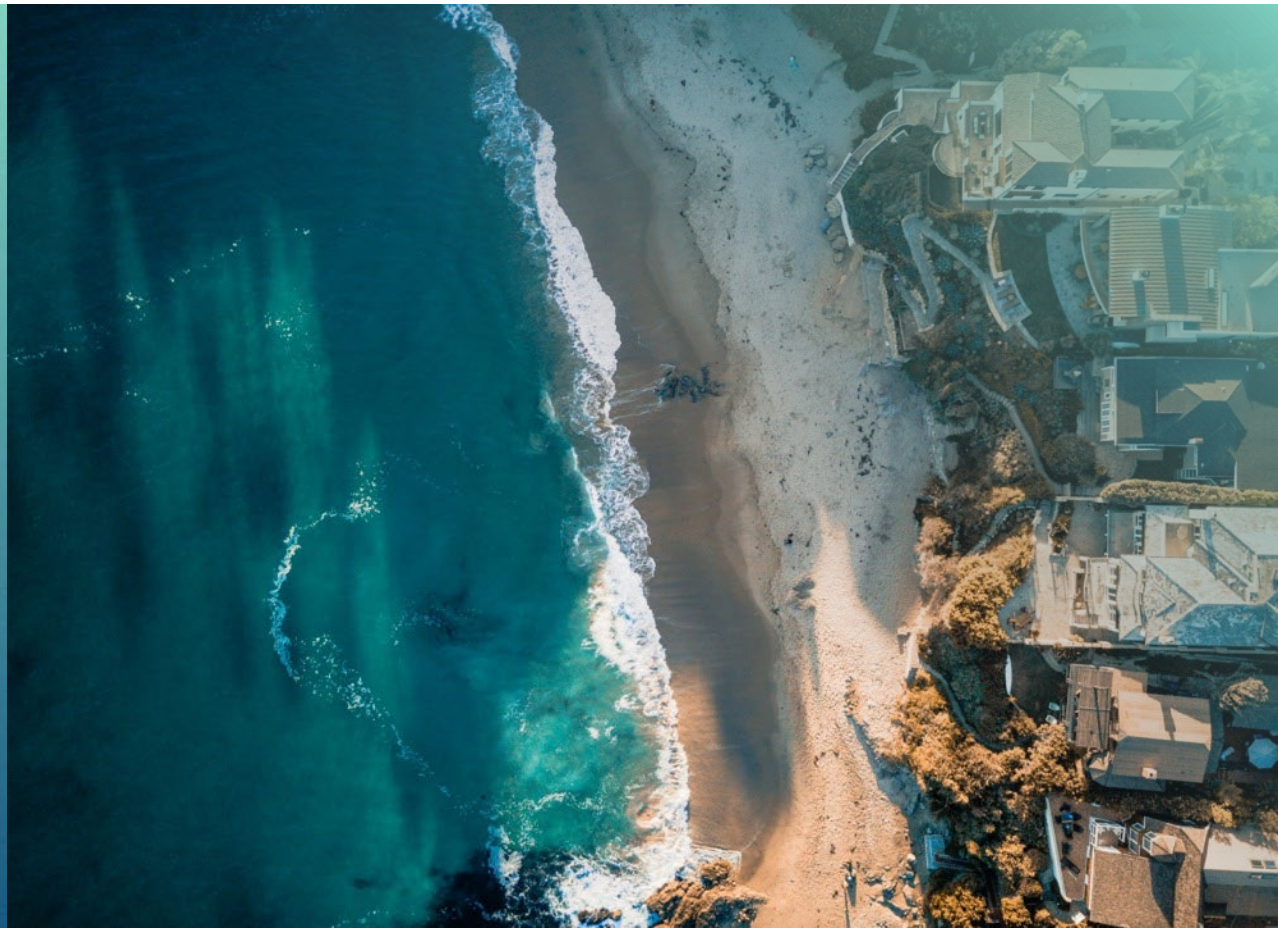
Purpose

- Understanding the information used by the Coastal Commission and local planners in the Local Coastal Program amendment process
- Is everything being done consistently and reasonably?

Scope of review

- Four sea level rise studies that have been pertinent to the Coastal Commission over the past decade
- Coastal Commission's guidance on incorporating sea level rise considerations into the Local Coastal Programs
- Seven local climate change vulnerability studies

Recommendations for Coastal Commission and local planners



Sea Level Rise (SLR) studies

Summary of key points

“Best science” estimates of future SLR still have significant uncertainty

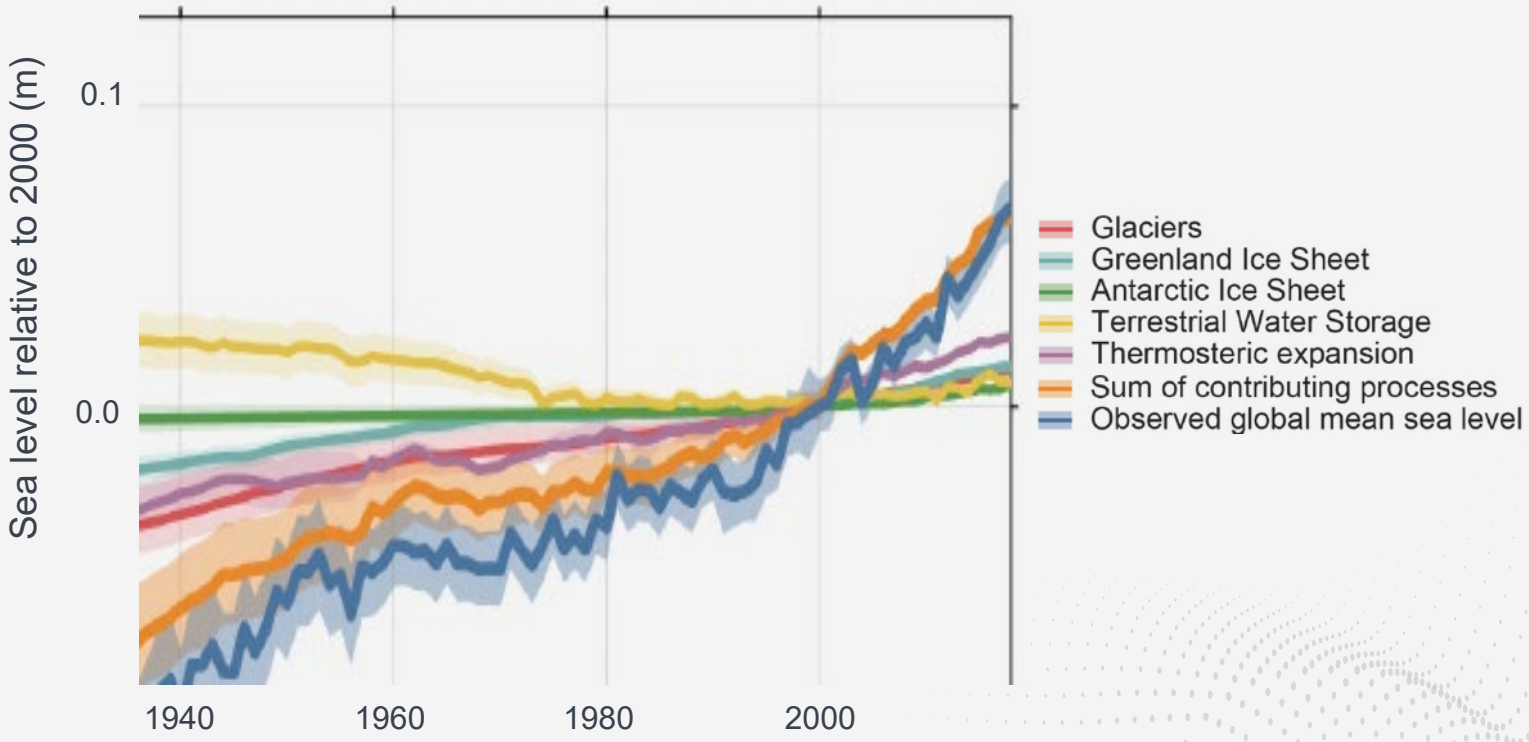
To be useful, estimates must be developed, presented, and understood probabilistically

Probabilities can be challenging to understand and use in practice

Without a clear understanding of uncertainty, users may assign false precision to the estimates

“Best science” estimates of future SLR have significant uncertainty

- Many complex contributing factors
- Long time scale
- Impact of human behavior



Source: “Global and Regional Sea Level Rise Scenarios for the United States,” NOAA, 2022

Emission scenarios underlying SLR projections referenced by Coastal Commission

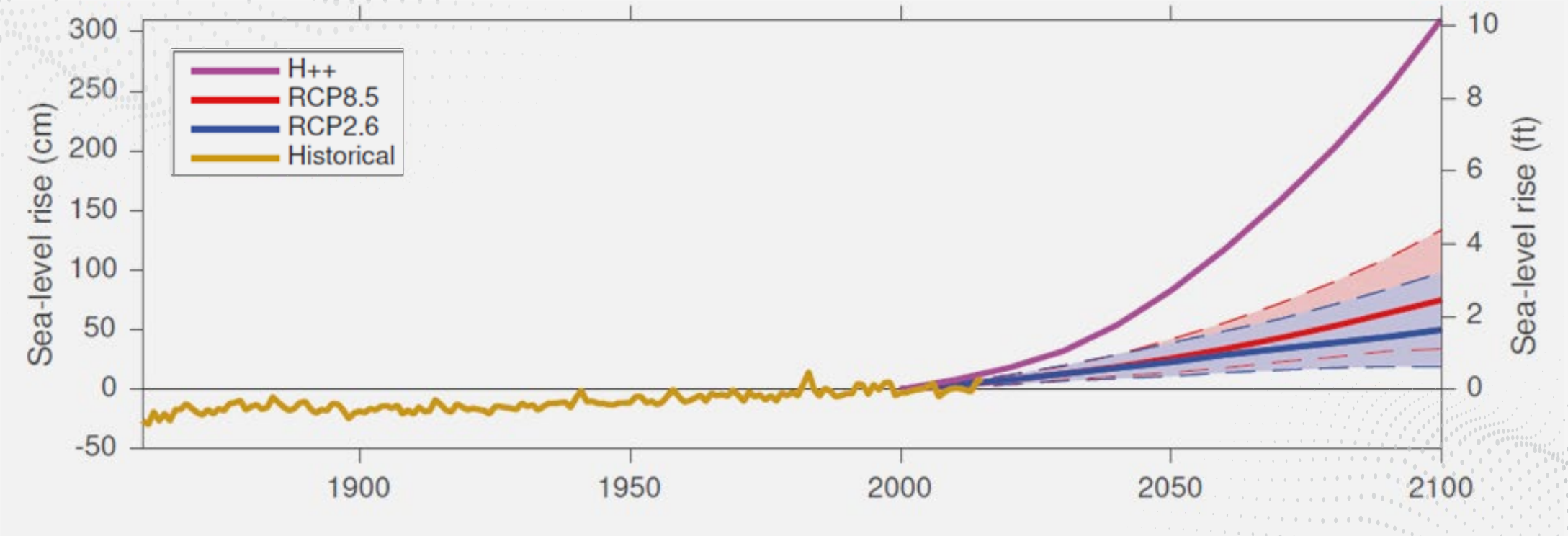
- Three Representative Concentration Pathway (RCP) scenarios promulgated by Intergovernmental Panel on Climate Change (IPCC) in 2014, representing greenhouse gas concentration
- H++ scenario corresponds to the Extreme scenario from a separate 2017 study (Sweet et al.) and represents a world consistent with rapid Antarctic ice sheet mass loss

Source: "Rising Seas in California: An Update on Sea-Level Rise Science," California Ocean Protection Council Science Advisory Team Working Group, 2017. H++ scenario from Sweet, W.V., et. al. "Global and Regional Sea Level Rise Scenarios for the United States," 2017.

Scenario name	Description
RCP 2.6 (Low)	Stringent emissions reduction scenario; assumes that global greenhouse gas emissions will be significantly curtailed.
RCP 4.5 (Intermediate)	Intermediate scenario; emissions peak around 2040, then decline.
RCP 8.5 (High)	No significant global efforts to limit or reduce emissions.
H++ (Extreme)	Extreme scenario with rapid Antarctic ice sheet mass loss.

Different global scenarios could result in drastically different local outcomes

Relative sea level in San Francisco, Rising Seas (2017)



Source: "Rising Seas in California: An Update on Sea-Level Rise Science," California Ocean Protection Council Science Advisory Team Working Group, 2017..

To be useful, estimates must be developed, presented, and understood probabilistically

Projected SLR in La Jolla in feet, OPC 2018

Multiple ways of framing probabilities

		Probabilistic Projections (in feet) (based on Kopp et al. 2014)					H++ scenario (Sweet et al. 2017) *Single scenario
		MEDIAN	LIKELY RANGE		1-IN-20 CHANCE	1-IN-200 CHANCE	
		50% probability sea-level rise meets or exceeds...	66% probability sea-level rise is between...		5% probability sea-level rise meets or exceeds...	0.5% probability sea-level rise meets or exceeds...	
				Low Risk Aversion		Medium - High Risk Aversion	Extreme Risk Aversion
Low emissions	2100	1.7	1.1 -	2.5	3.3	5.8	
High emissions	2100	2.6	1.8 -	3.6	4.6	7.1	10.2

Multiple global warming scenarios

Multiple points in time from 2030-2150

Projections range from 1.1 feet…

Multiple use cases

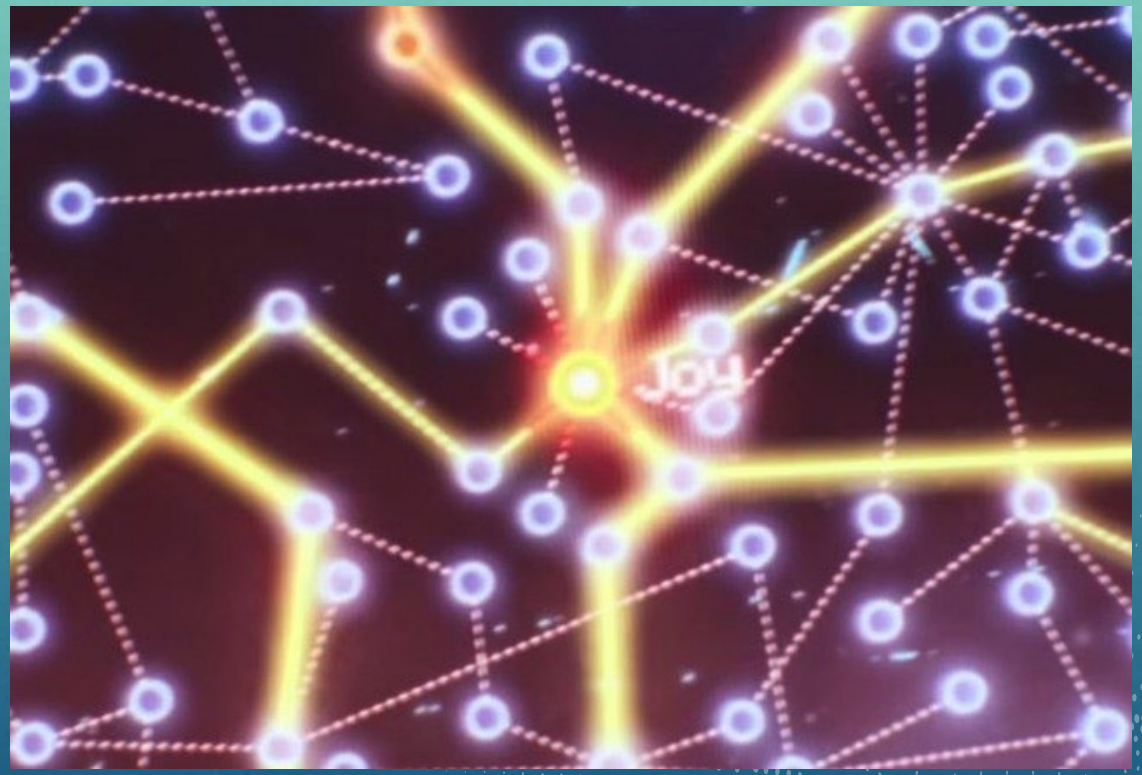
…to 10.2 feet.

Source: "State of California Sea-Level Rise Guidance," California Ocean Protection Council, 2018.

When it comes to SLR, what do we mean by probabilities?

One present

Many possible futures



Probabilities can be challenging to understand and use

La Jolla SLR projections, Year 2100

Without a clear understanding of uncertainty, users may assign false precision to the estimates

1.8 feet

10.1 feet

Coastal Commission guidance

Guidance for how to…

- Understand and use sea level rise projections
- Use scenario-based analysis
- Incorporate effects of sea level rise into planning

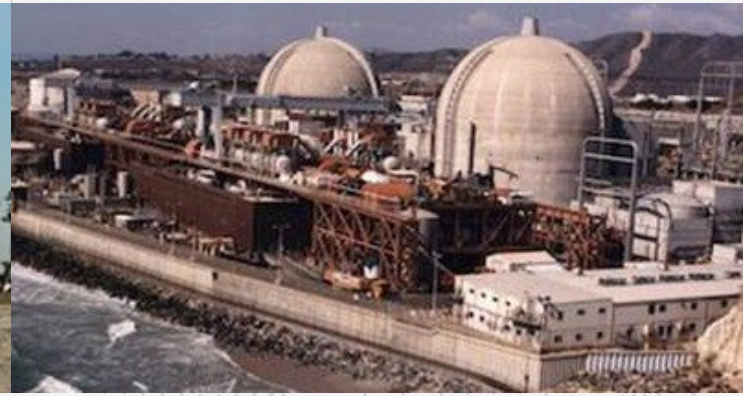
This guidance is useful and necessary, but there are opportunities to improve

Original Guidance unanimously adopted – August 12, 2015
Science Update unanimously adopted – November 7, 2018

Coastal Commission guidance

Projected sea level rise (in feet): La Jolla

	Probabilistic projections (in feet) based on Kopp et al. 2014)		H++ scenario (sweet et al. 2017)
	Low risk aversion	Medium-high risk aversion	Extreme risk aversion
	Upper limit of “likely range” (~17% probability SLR exceeds…)	1-in-200 Chance (0.5% probability SLR exceeds…)	Single scenario (no associated probability)
2100	**3.6**	**7.1**	**10.2**



Source: “Sea Level Rise Policy Guidance,” California Coastal Commission, 2018.

Interaction of scenarios, probabilities and use cases

Drilling down on Coastal Commission guidance and standards selected

Projected SLR in La Jolla in feet, OPC 2018

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		MEDIAN	LIKELY RANGE		1-IN-20 CHANCE	1-IN-200 CHANCE	
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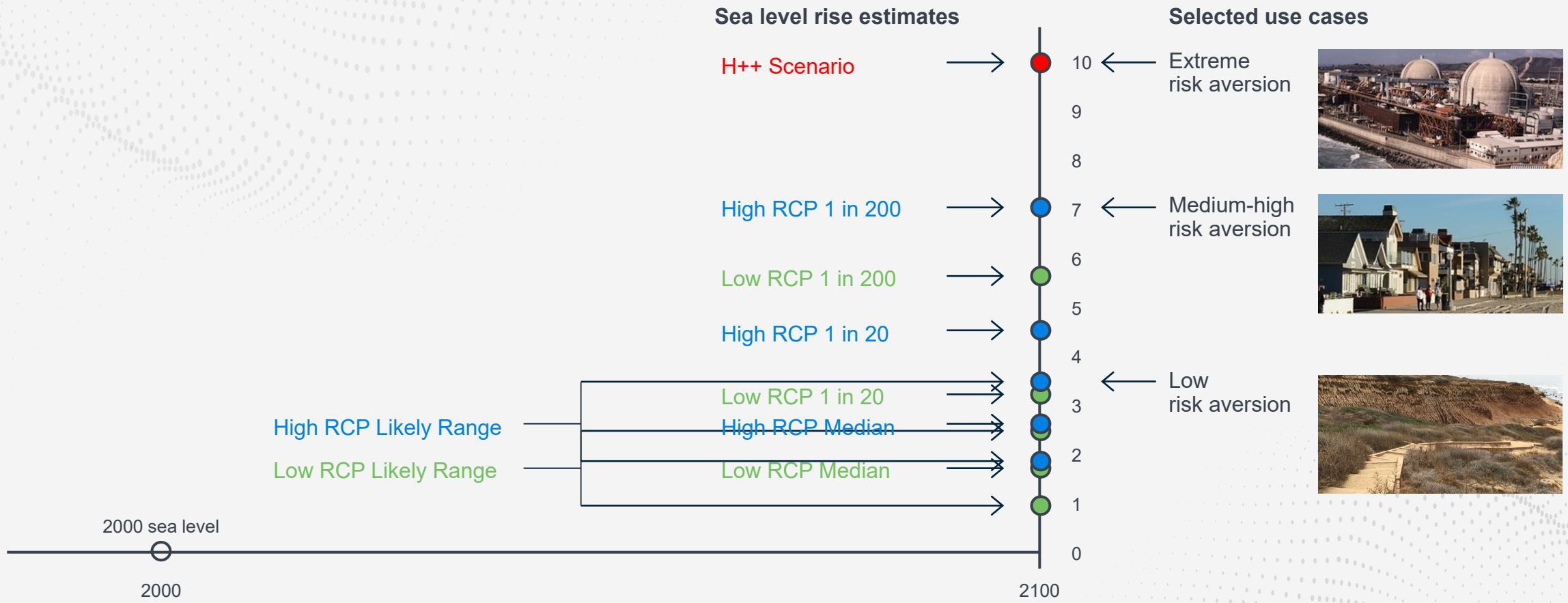
Source: “State of California Sea-Level Rise Guidance,” California Ocean Protection Council, 2018.

Interaction of scenarios, probabilities and use cases

La Jolla



Notes and comments on Coastal Commission standards selected

Three “risk” categories are associated with different use cases and not different emissions scenarios

- “Low risk” project: Unpaved coastal trail
- “Medium-high risk” project: Housing development
- “Extreme risk” project: Power plant

Low and Intermediate emissions scenarios are not included, and Extreme H++ scenario has subsequently been dropped by NOAA

Based on High RCP and Extreme H++ scenarios:

- 83% chance (6 out of 7) that SLR will be below and 17% (1 out of 7) chance that SLR will be above 3.6 feet, the “low risk” standard
- 0.5% (1 in 200) chance that SLR will be above 7.1 feet, the “medium-high risk” standard
- Extremely unlikely but theoretically possible chance that SLR will be above 10.2 feet, the “extreme risk” standard

These selections are very conservative. That may be appropriate for their applications, but that conservatism might not be clear enough.

Local vulnerability assessments

Coastal Commission relies on local communities to assess risk and incorporate findings into local planning

We reviewed seven local vulnerability studies across CA

Overall findings: inconsistencies in sea level rise assumptions, scenario planning, and modeling process

Inconsistency in vulnerability assessments may lead to:

- Discontinuous results and inability to plan at scale
- Potential for more drastic action than needed if only high scenarios considered
- Actions determined without full consideration to downstream costs or consequences

Disclosure of SLR projections

What emissions scenarios and probabilities are we considering?

Study 1

High estimate only

Study 2

Mid and High estimates

Study 3

Full range of estimates

Which paints the full picture?

Risk: Reader misinterpretation, more drastic action than needed
Recommendation: Standardization, clearly convey what projections represent

Scenario testing

Which possible futures should be planned for?

Study 1	Study 2	Study 3	Study 4
High sea level rise + 100-year storm	High sea level rise	Low / mid / high sea level rise + 100-year storm	None

What happens if neighboring cities plan for different futures?
How many scenarios are enough?

Risk: Discontinuous results at city boundaries, more drastic action than needed
Recommendation: Standardization, separate storm effects

Risk assessment models

What models are we using to measure damages due to SLR?

Study 1	Study 2	Study 3	Study 4
Model A	Model B	Blend of three models	No models

Which is reasonable?
Are they all reasonable?

Risk: Discontinuous results at city boundaries, inability to plan at scale
Recommendation: Standardization

Residential vulnerability

What homes are actually at risk?

Study 1	Study 2	Study 3	Study 4	Study 5
Residential acreage	Census population	Structure count	Replacement cost of structures	Market value of structures

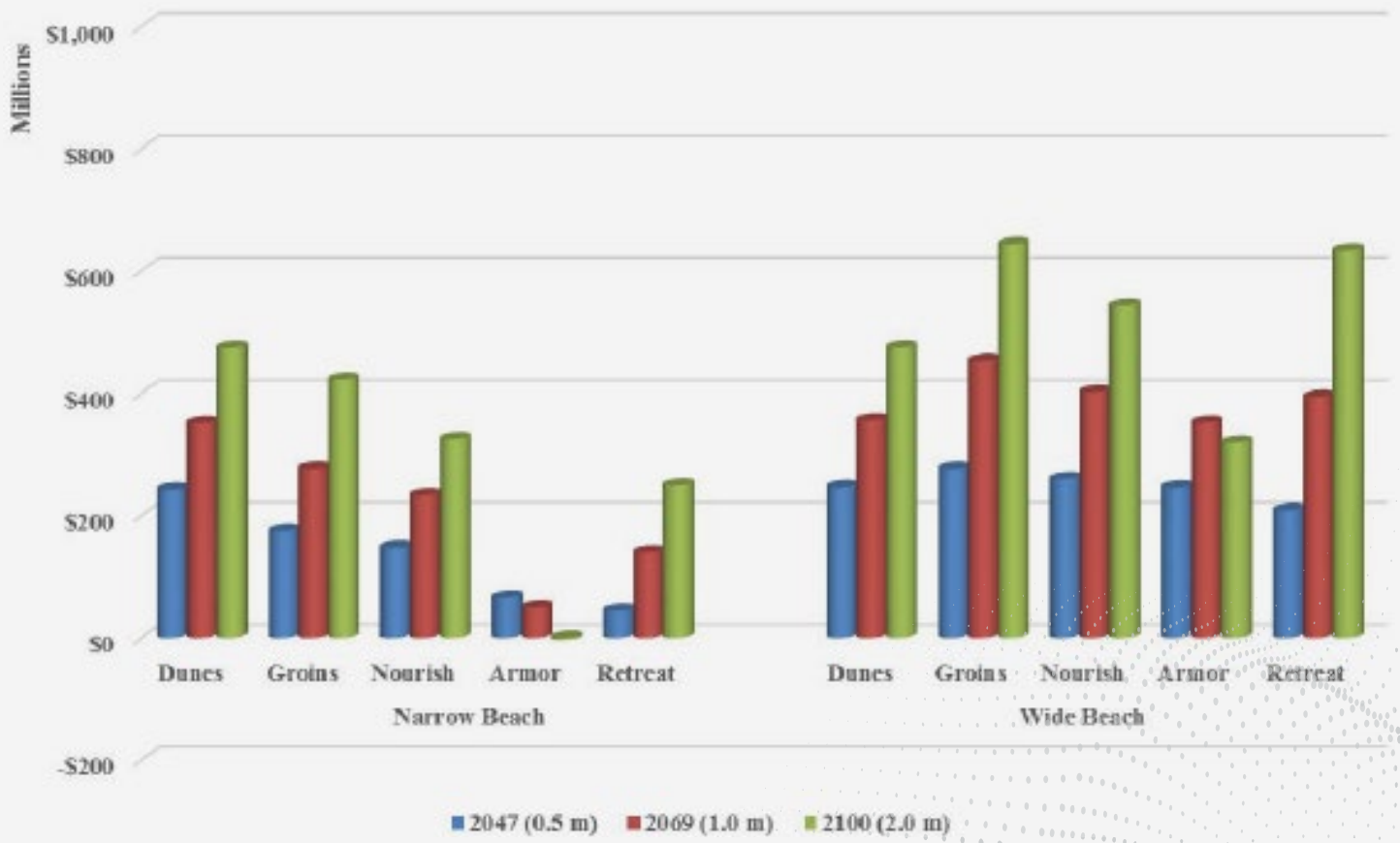
What can be done with this knowledge?

Risk: Action without full consideration to downstream costs or consequences
Recommendation: Understand full economic cost of action

Adaptive costs

Need cost-benefit analysis to inform decisions

- **Five different adaptation strategies**
- **Two different goals: Narrow Beach and Wide Beach**
- **Net benefit is economic benefit minus economic cost**



Source: "2017 City of Imperial Beach Sea Level Rise Assessment," Revell Coastal, LLC, 2016

Final recommendations for Coastal Commission and local planners

Clarity

Consistency

Strategy

Flexibility

Milliman

Thank you

Nancy Watkins

nancy.watkins@milliman.com