

Sea Level Rise Economics:

Impacts on California Beach Communities



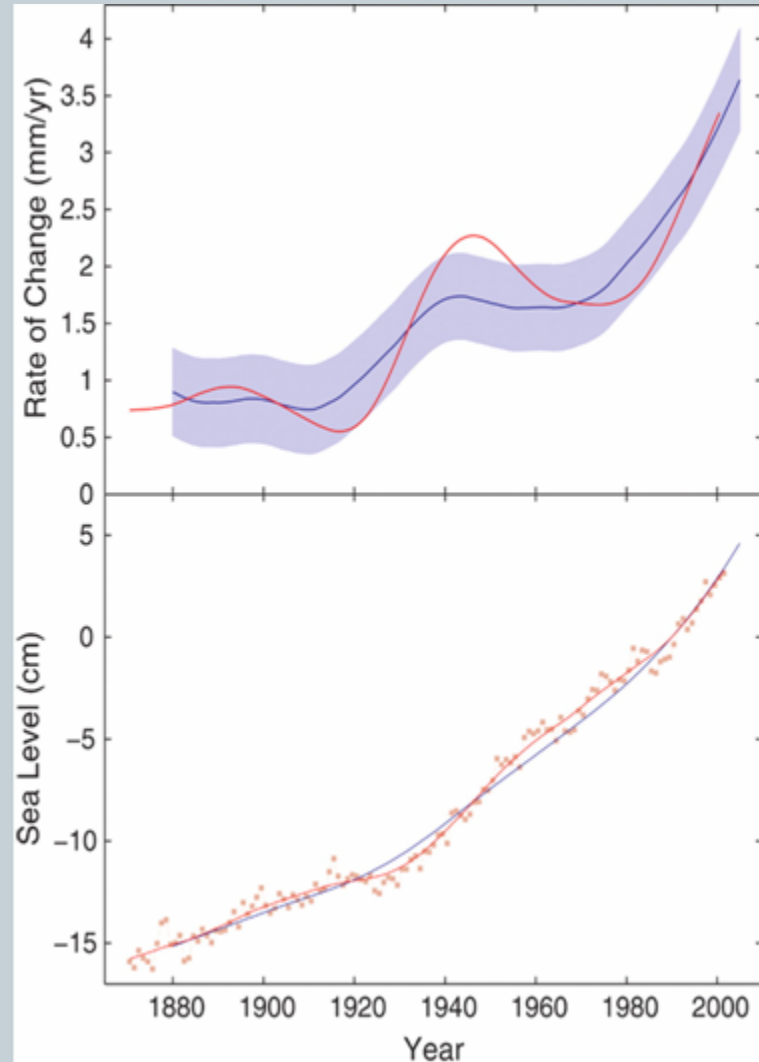
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Sea-Level Rise:

Introduction

- Global climate change is accelerating SLR worldwide
- Thermal expansion of the oceans
- Excessive melting of polar ice and glaciers
- Top: *Rate* of SLR (note recent acceleration)
- Bottom: Sea level (zero at 1990)



S. Rahmstorf, *Science* 315, 368-370 (2007)

SLR Cost Studies:

- Yohe Approach (1989, 1996, 1998)
 - Cost-benefit analysis: Protection vs. abandonment
 - Examines change in mean sea level, ignoring storm surge and extreme events
- Pacific Institute (1990)
 - 1m sea-level rise → \$48 Billion threatened in SF Bay
- Pacific Institute / PWA (March 2009)
 - Updated climate scenarios, modern analytical tools (GIS)
 - Inundation and erosion analysis – 100yr storm event
 - Economic cost based on replacement value of buildings and their contents (FEMA / HAZUS model)
 - Comprehensive study of entire California coast

Significance:

Economic Impacts Overview

Flood Risk

- Utilizing Scripps MOP Wave Model for site-specific parcel and infrastructure analysis
- Residential and commercial real estate valuation and damage risk

Erosion Risk

- Beach erosion – recreational value impacts
- Bluff erosion – total property loss

Transit interruptions

- Highway and rail closures, economic activity loss

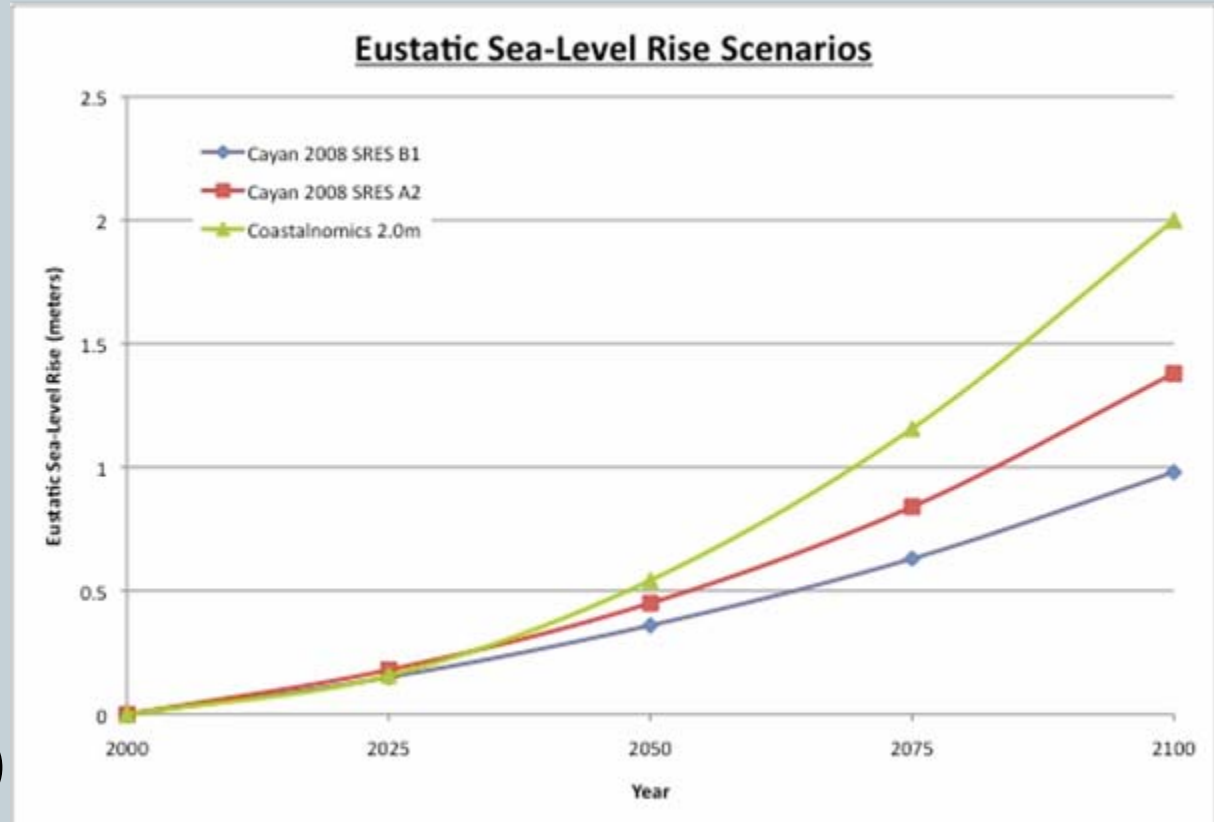
Ecosystem risk

- Critical beach habitat (e.g., Western Snowy Plover)
- Wetland migration

SLR Scenarios:

Eustatic SLR 2000-2100: 1.0, 1.4, 2.0 meters

- SRES B1 (1.0m) and A2 (1.4m) scenarios (Cayan 2008)
- Derived 2.0m curve (USACE/NRC methodology)
- Periodic analysis at 2025, 2050, 2075, and 2100



Scripps Institute MOP:

Monitoring and Prediction Model

- BETA model developed by Bill O'Reilly at Scripps
- Compounding wave action analysis
- Includes probabilistic extreme events



Image: Smashingmagazine.com

INPUTS	OUTPUTS
Latitude/longitude points	Time underwater
Date of interest	Depth of flooding
SLR Scenario	Sand depth

Study Areas:

- Torrey Pines State Beach
San Diego
- Manhattan Beach County Park
Los Angeles
- Zuma State Beach
Malibu
- Carpinteria State Beach
Santa Barbara
- Seacliff State Beach
Santa Cruz
- Ocean Beach
San Francisco



Torrey Pines, CA:



Sea-Level Rise Alone

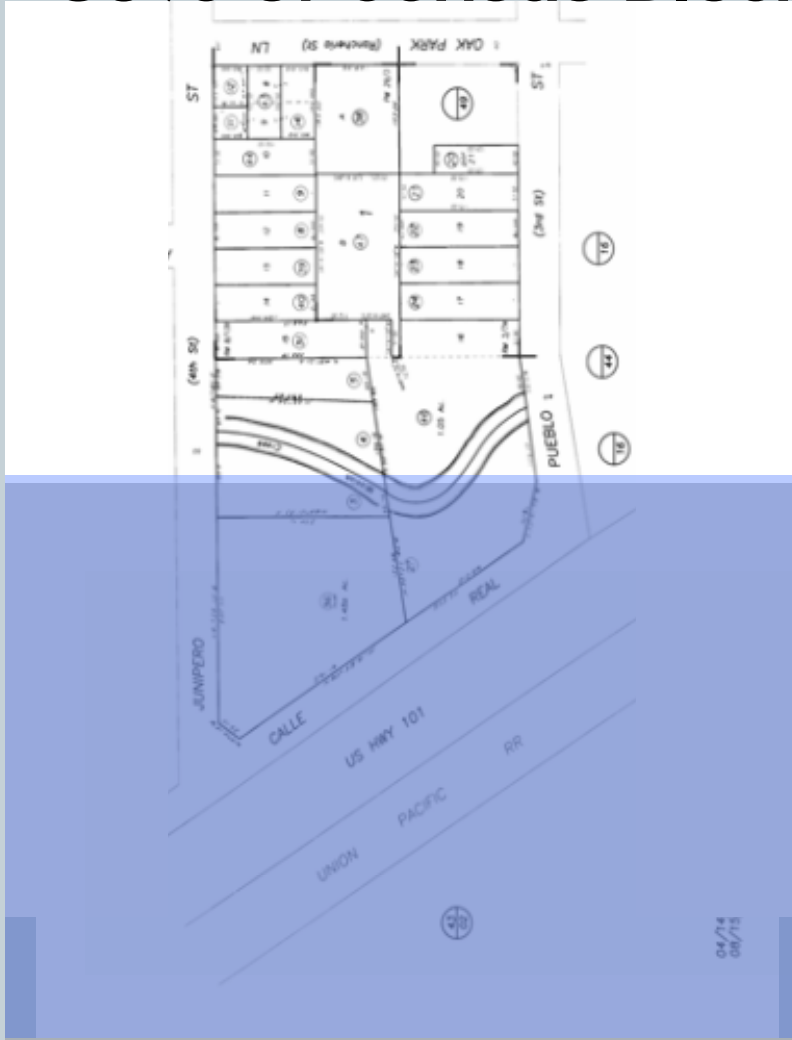


SLR + 100 year flood event

FEMA: Key Assumption

30% of Census Block flooded →

30% of total assets at risk
(Regardless of land use distribution)

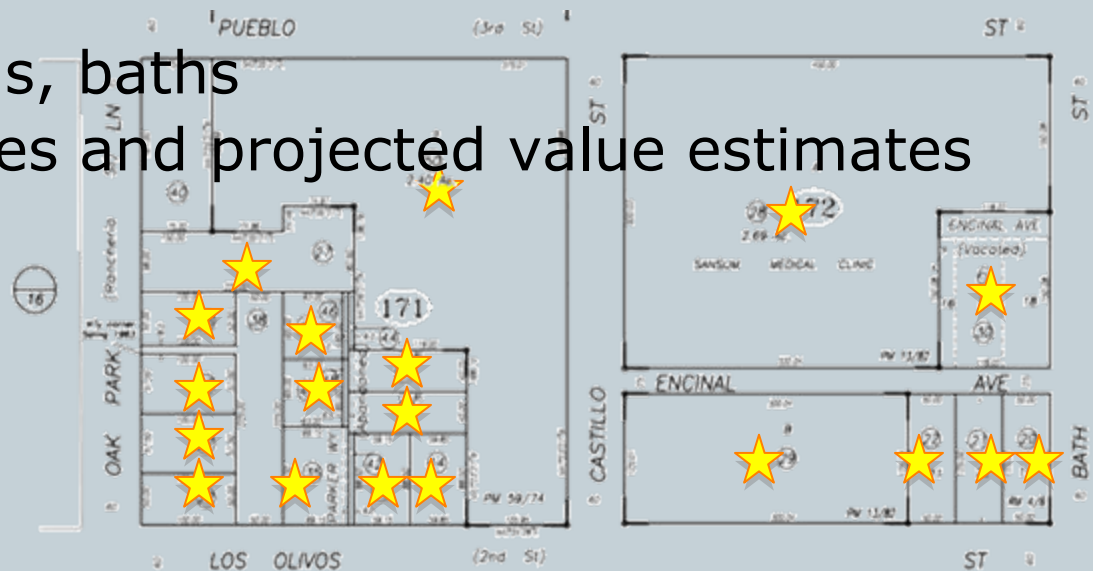


Ramifications:

- Overestimation of losses (flooded open space)
- Underestimation of losses (flooded critical/valuable infrastructure)
- We reconcile this assumption through parcel-by-parcel analysis

Parcel Specifics:

- Depth analysis for each parcel on or below highest flood polyline
- Lat/Longitude adjustment to structure location (if not on parcel centroid)
- Merged parcel characteristic datasets
 - Zoning (residential, commercial, industrial)
 - Year built
 - # Stories, beds, baths
 - Assessed values and projected value estimates



Value Estimates:

Residential Real Estate

- County assessed value inflated to date of interest
- Consultation of current real estate estimates (e.g. zillow.com has 90 million real estate listings and estimates)

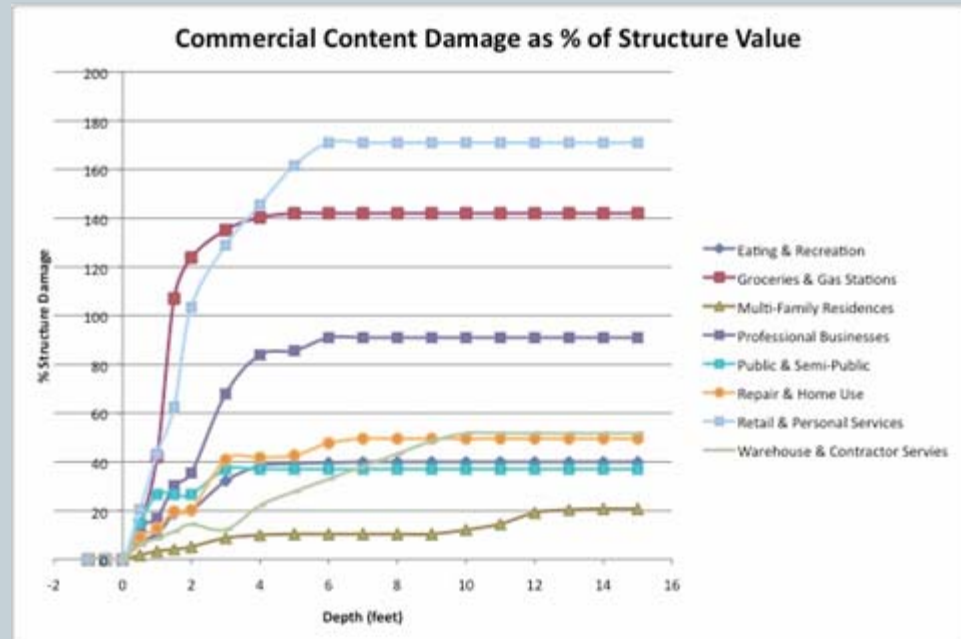
Commercial Real Estate

- County assessed value inflated to date of interest
- Current estimates hard to come by
- Regression comparing residential assessed → market relationship to Case-Shiller/CPPI trends

Flood Impacts:

USACE Depth-Damage Curves: Relating flood depth and % damage

- Residential and commercial structure and content curves
- Specific curves depend on construction, no. of stories, and building use



Erosion Impacts:



Beach Erosion

- Best- and worst-case scenarios
- Bruun's Rule for beach profile change
- Sand depth changes from MOP model
- Recreational value analysis

Bluff Erosion

- Philip Williams & Associates analysis (N of Pt. Conception)
- Extension of historic erosion rates
- Total property loss

Conclusion

- Study will provide estimates of economic losses under different SLR scenarios
- Study's main value added is a more detailed analysis of economic losses
- Scenario outcomes will aid managers and policymakers in decisions regarding mitigation and adaptation.

