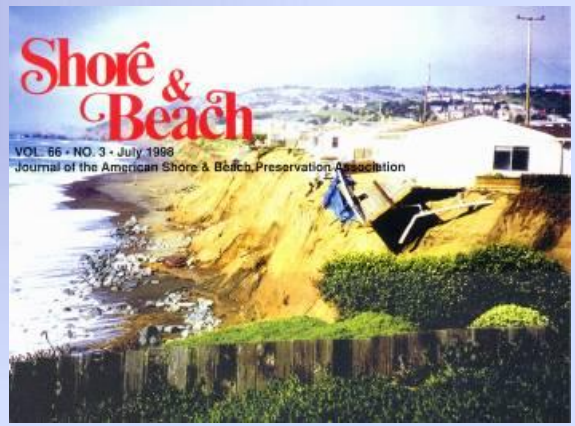
Coastal Hazards, Habitat Impacts and Making Room



David Revell – ESA PWA
drevell@esassoc.com

Coastal Habitat Conservation in a Changing Climate: Strategies and Tools in the Southern California Region

November 16, 2011

ESA PWA

Outline

- **SLR Vulnerability**
- **Vulnerability Case Studies**
  - **Habitat Response**
  - **Beach and Wetlands**
    - **Lower Santa Ynez River**
  - **Managed Retreat**
  - **Surfers Point**

General Approach - Vulnerability

- Adopt updated CA Energy Commission scenarios
  - Downscaled GCM for CA (Cayan et al 2009)
  - Scenarios A2 (1.4m), B1 (1.0m) sea level rise
- Map flood and erosion hazards for CA coast at multiple planning horizons.
- Quantify populations and infrastructure at risk.

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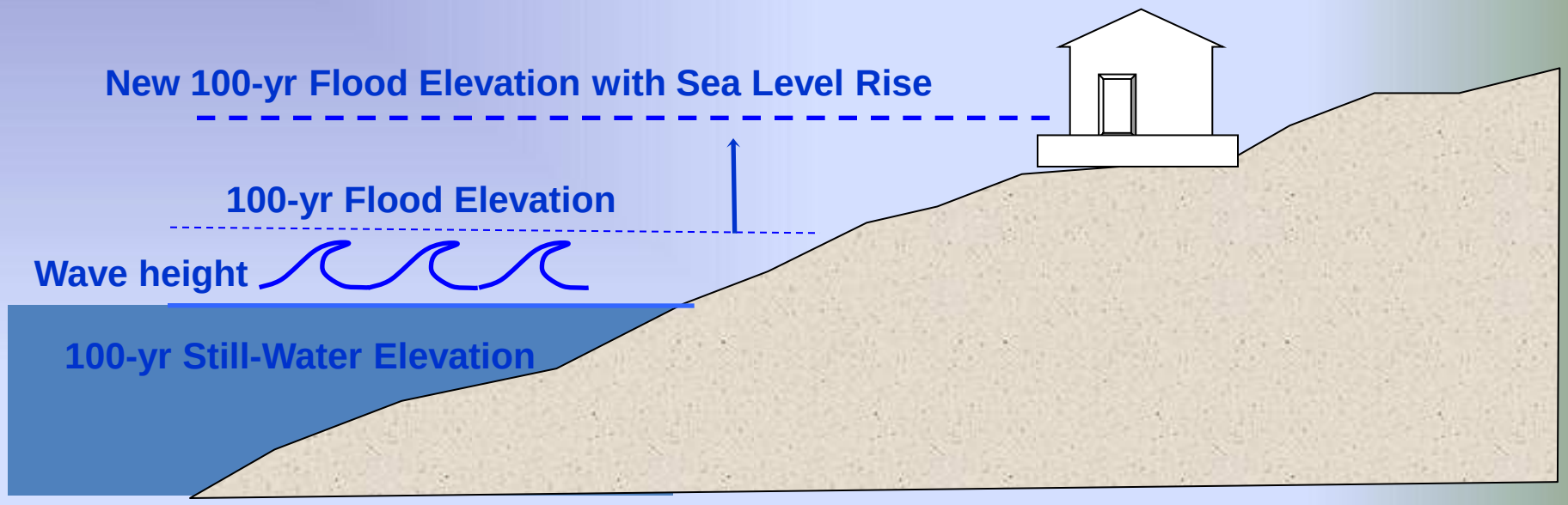
Risk - Mapping Flood Hazards



- Review all existing FEMA Flood Insurance Studies
- Extract Coastal Base Flood Elevations into GIS
- Add Sea level rise scenarios to BFE elevations
- Map inundation using terrain datasets

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Risk - Mapping Erosion Hazards

Total Water Levels

- Sea Level Rise
- Tides
- Wave Run-up
- Storm Surge
- El Ninos

Exceeds

Elevation of the Toe of Cliff or Dune

Causes

Erosion Response

- Backshore Type
- Geology
- Failure Mechanism
- Shoreline Change

California Coastal Records Project

Climate Change

- Sea Level Rise
- Wave Climate

Shore Change

- Accelerated Erosion
- Inland Migration of Shore
- Loss of Upland

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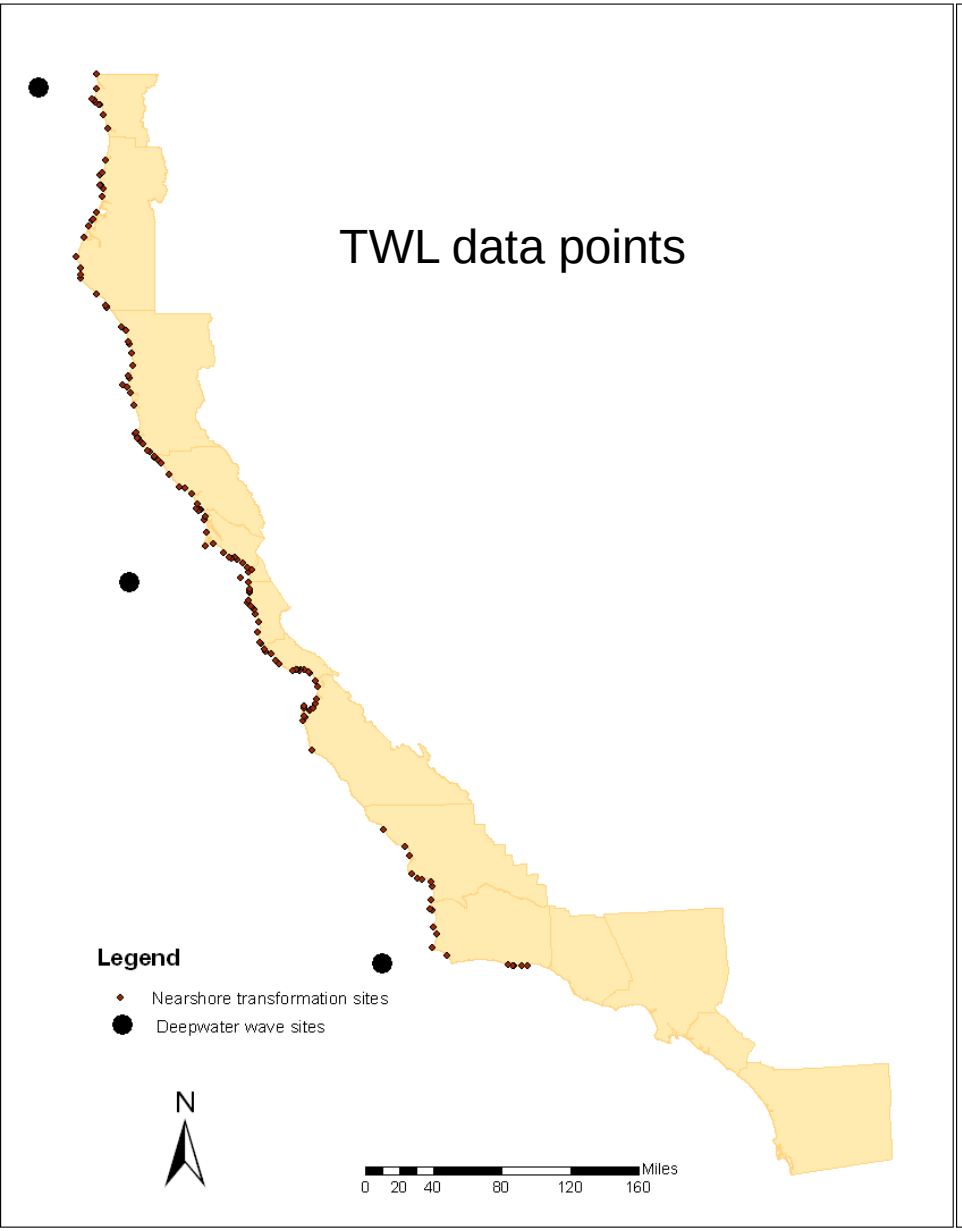
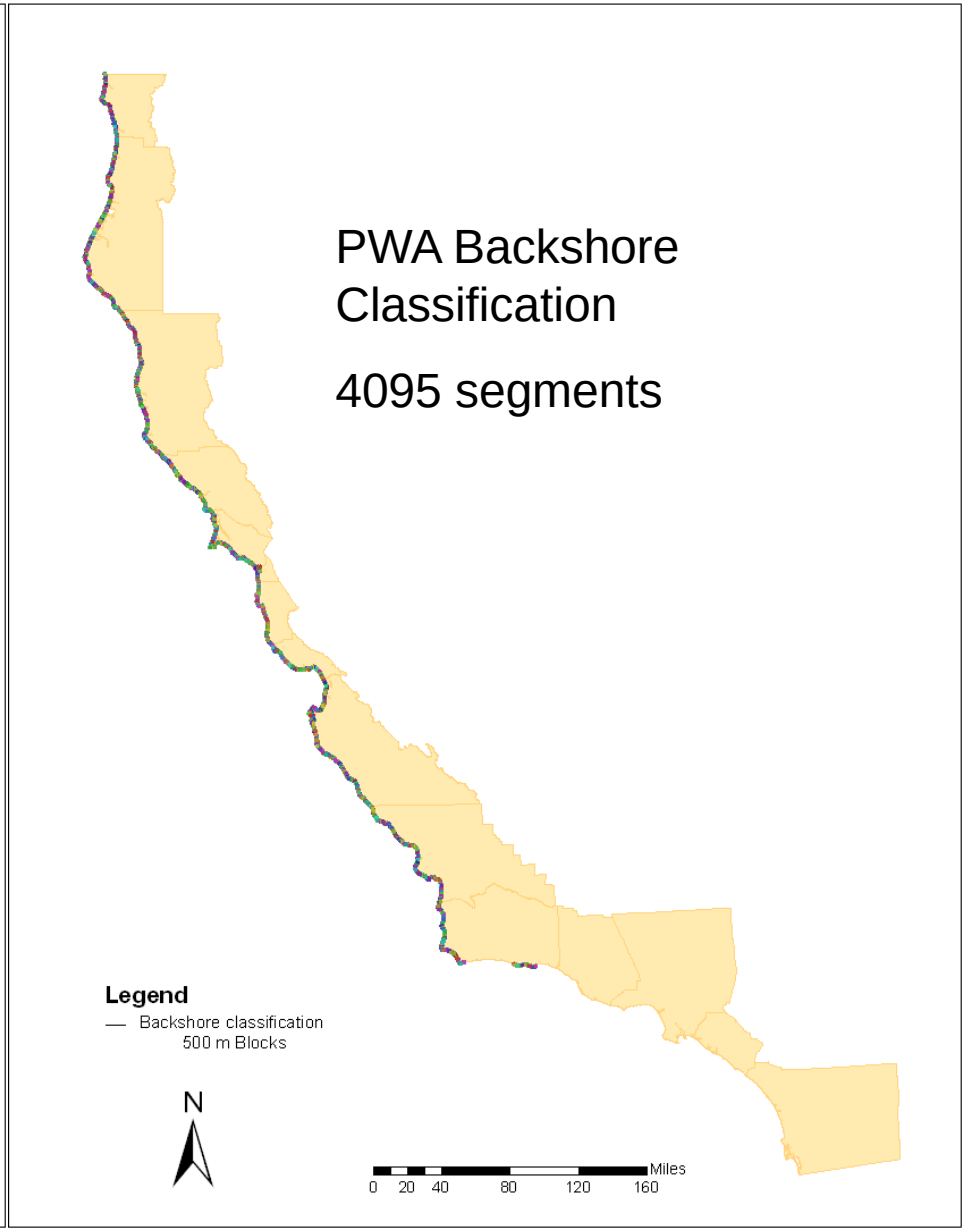
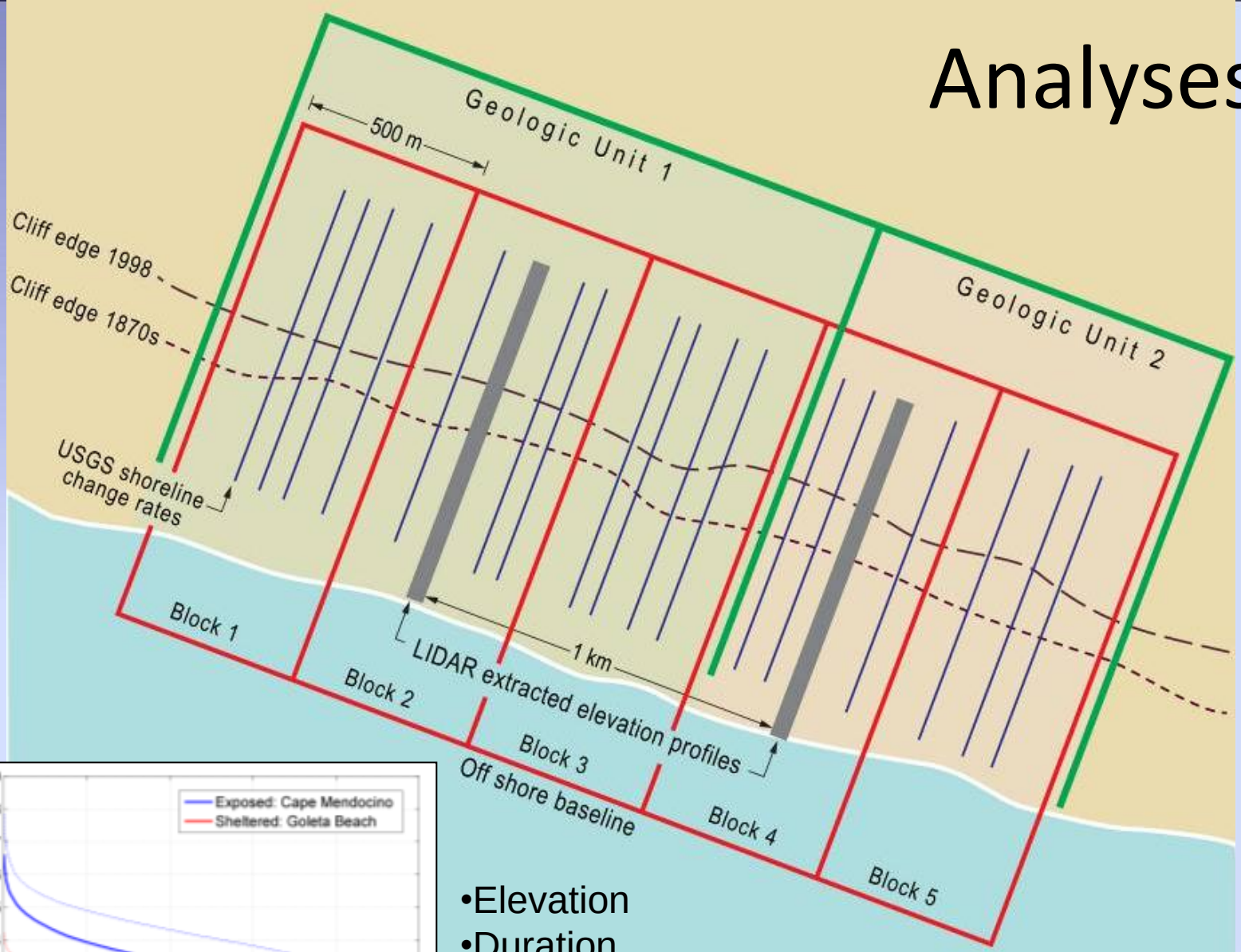
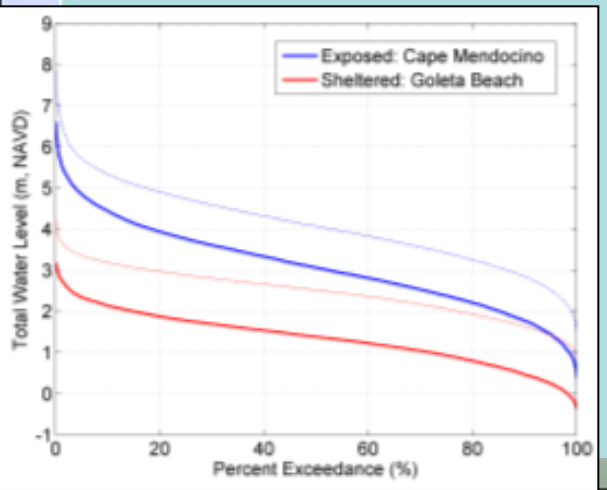
Existing BFE Info





Analyses Scale





- Elevation
- Duration

Generated excedance curves for each subdivided geologic unit (500m) using individual slopes and toe elevations

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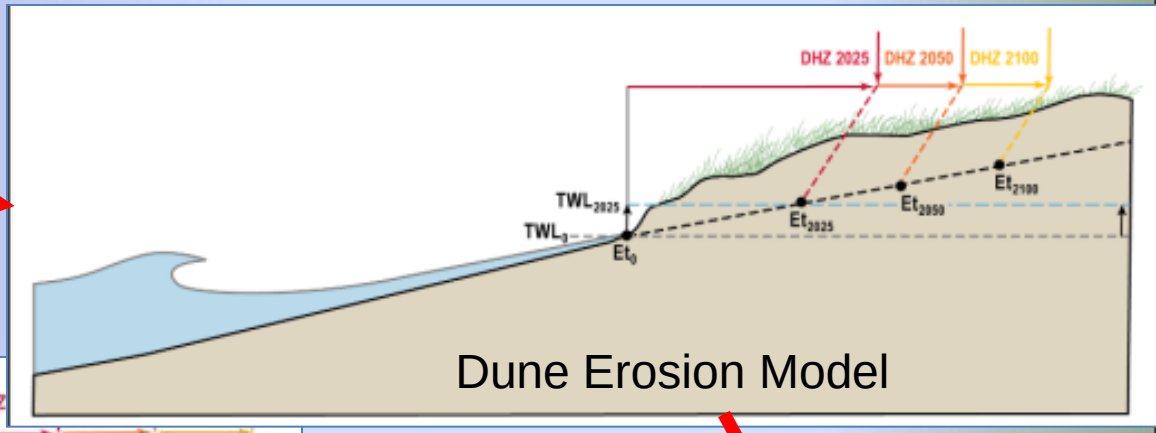
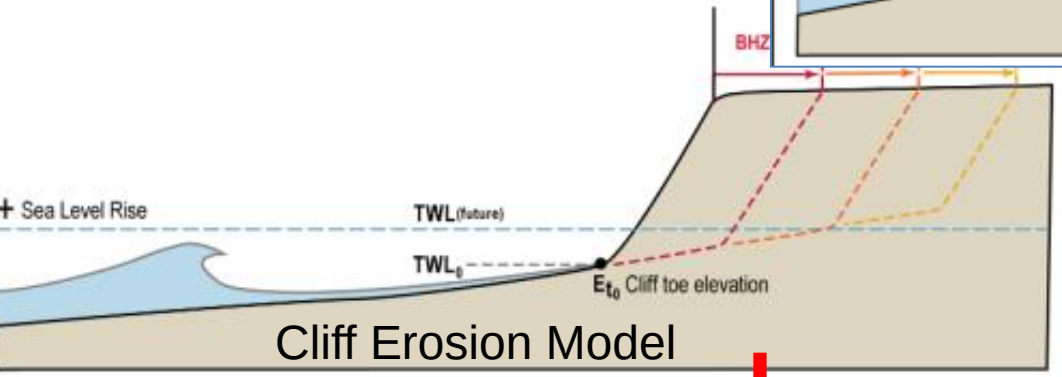
Erosion Modeling

TWL + Site Characterization

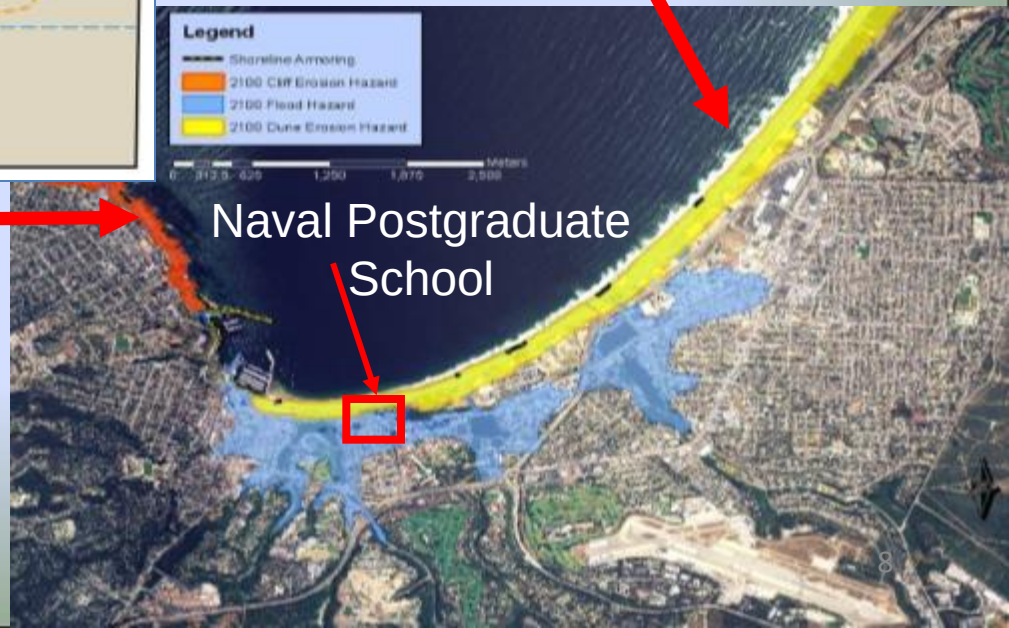


Dune Erosion Model



Cliff Erosion Model

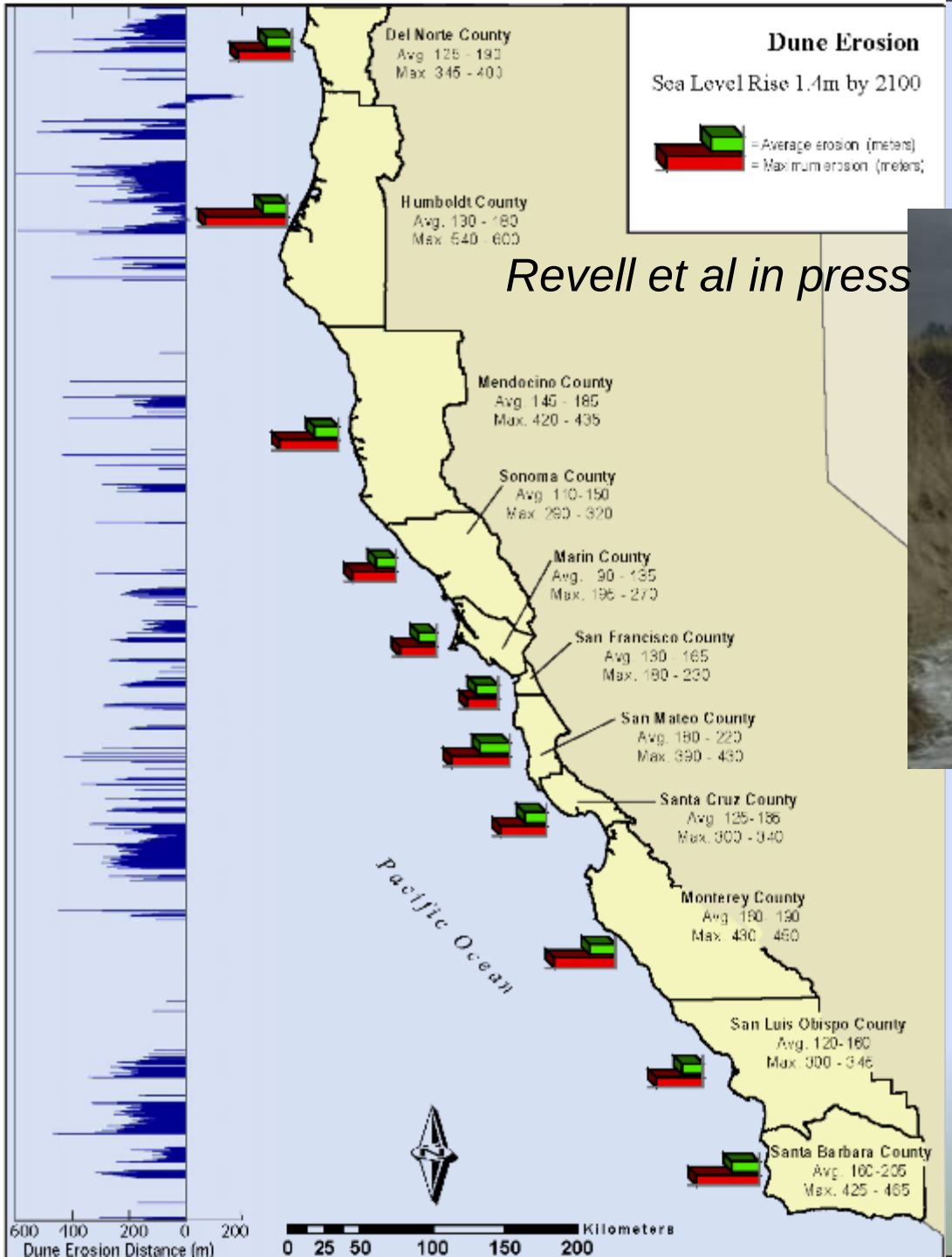
ESA PWA 2009



- **Model - Outputs**
  - Erosion rates each 10 years
  - TWL each 10 years
  - Hazard zones at planning horizons

=

Results - Dunes



Revell et al in press

- Majority of Norcal "accreting"
- Accreting to Erosion reversal in sign seen between 2050 and 2100
- 300 km or 185 miles

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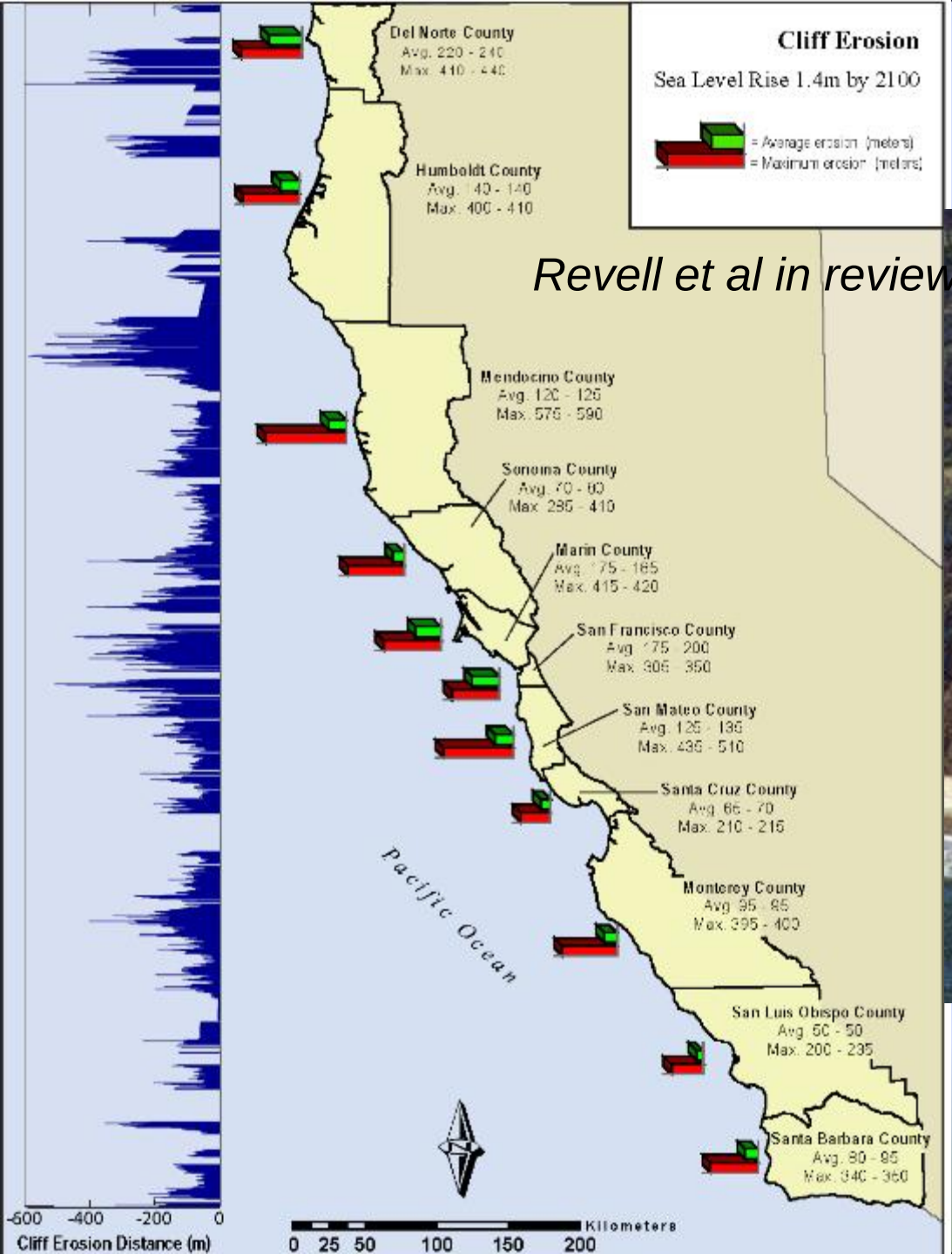
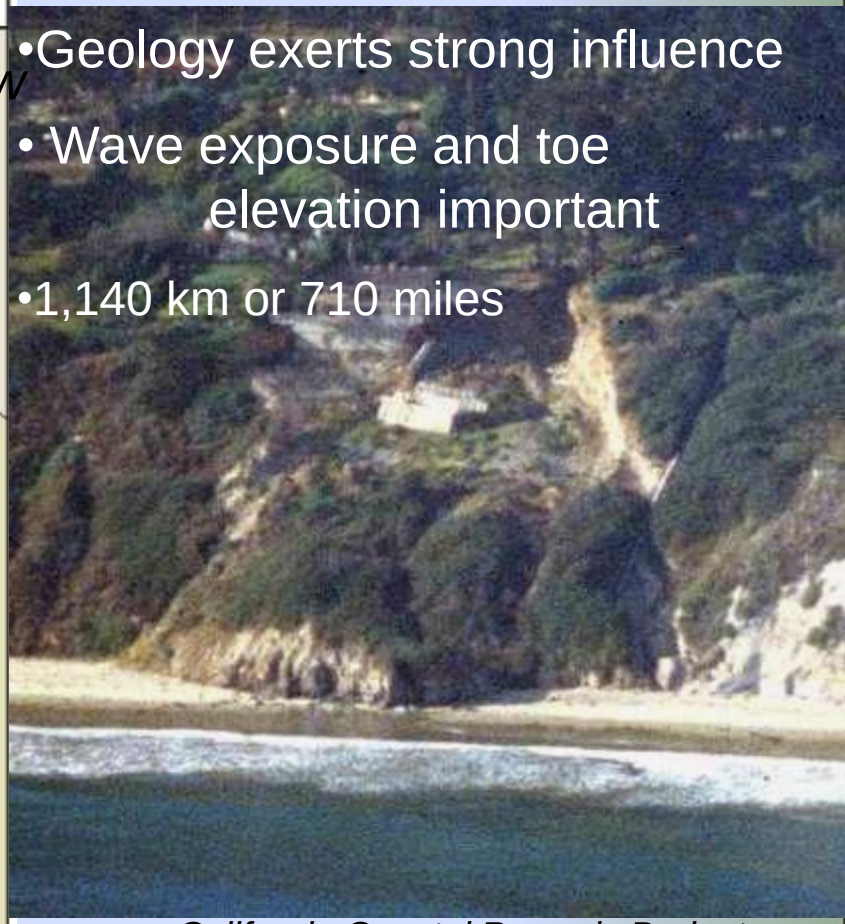
Results - Cliffs



Revell et al in review

- Geology exerts strong influence
- Wave exposure and toe elevation important
- 1,140 km or 710 miles



California Coastal Records Project

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Infrastructure at Risk

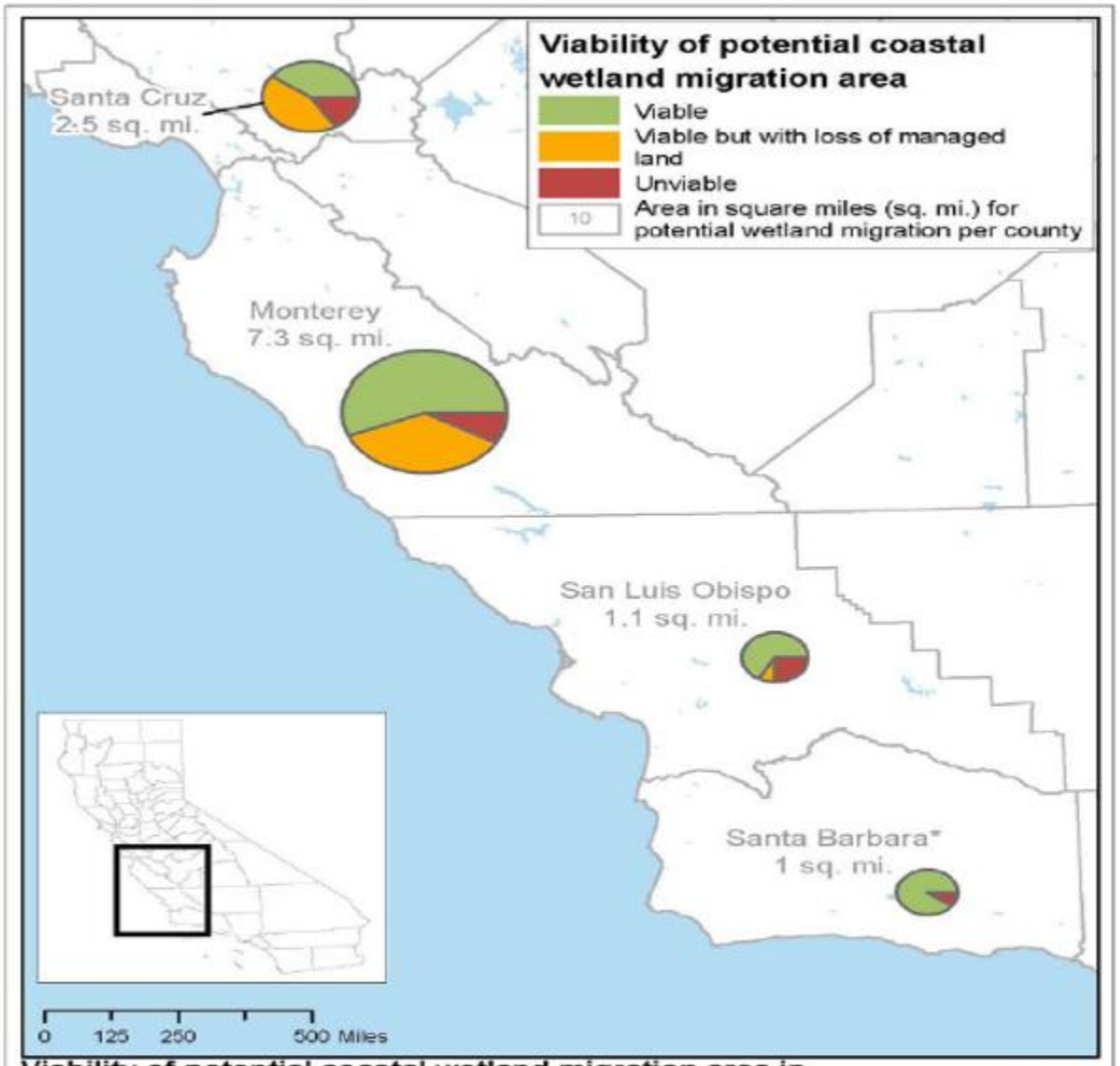
At Risk by 1.4m SLR

- Roads: 3,500 miles
- Highways: 400 miles
- Railroads: 300 miles*
- Schools: 139
- Hospitals: 55
- Police/Fire Stations: 34
- Power Plants: 30
- Wastewater Plants: 28

Pacific Institute ESA PWA

Initial Wetland Migration

- Only 49% of SB County wetlands mapped
- Does not include erosion



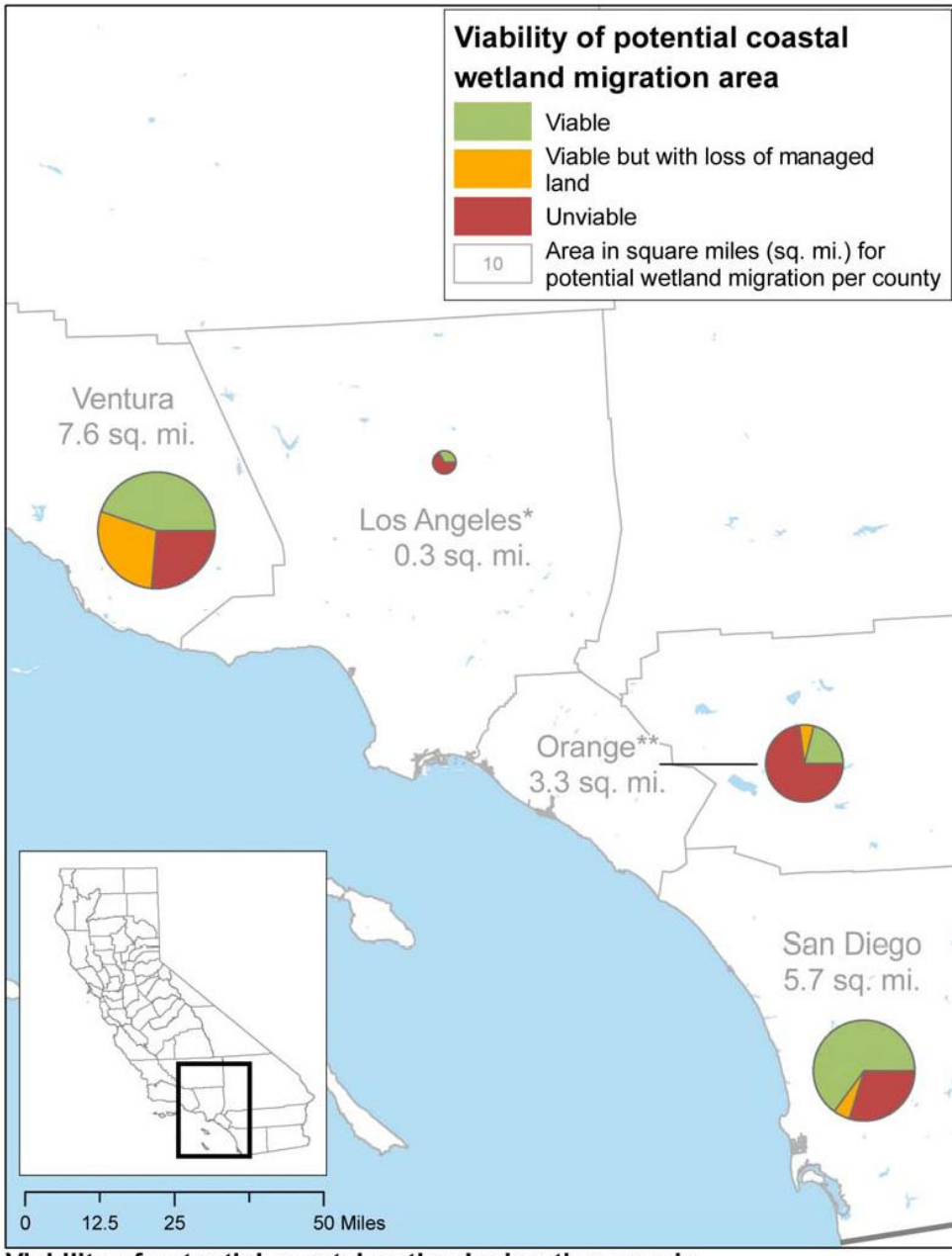
Viability of potential coastal wetland migration area in response to a 1.4 meter sea-level rise in Central California

* 49% of Santa Barbara County coastline mapped.
Data sources: USGS/Scripps Institution of Oceanography, NOAA Coastal Change Assessment Program, CaSIL, ESRI.
http://www.pacinst.org/reports/sea_level_rise

PACIFIC INSTITUTE

Wetland Migration

- Only 23% of LA County wetlands mapped
- Does not include erosion



Viability of potential coastal wetland migration area in response to a 1.4 meter sea-level rise in Southern California

* 23% of Los Angeles County coastline mapped. ** 65% of Orange County coastline mapped.

Data sources: USGS/Scripps Institution of Oceanography, NOAA Coastal Change Assessment Program.
http://www.pacinst.org/reports/sea_level_rise

PACIFIC INSTITUTE

There is an inherent conflict between the static property boundaries and the dynamic shoreline….

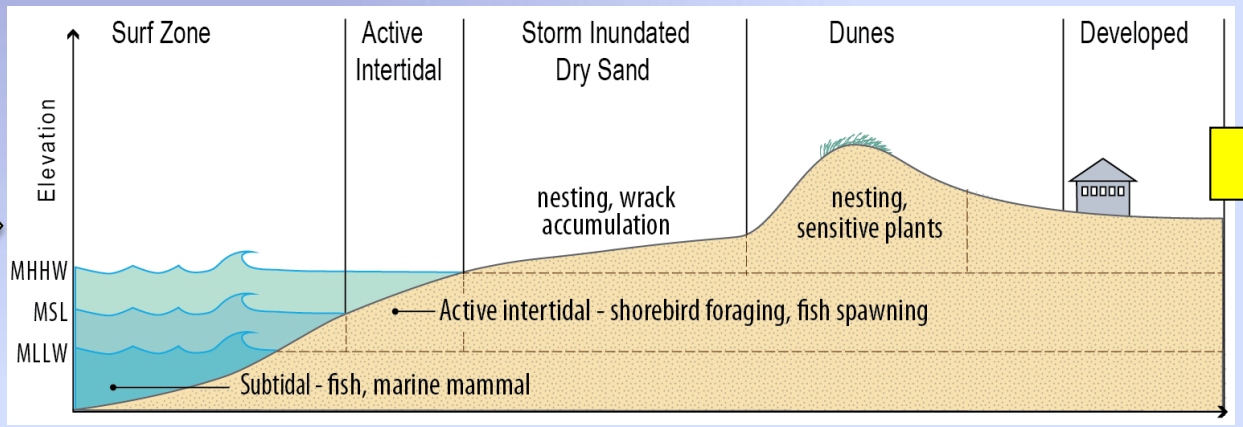
We need to continue to evolve our thinking to incorporate future changes.

THIS IS THE SOLUTION WE'VE DEVISED FOR DEALING WITH THE FLOODING CAUSED BY CLIMATE CHANGE.
Chris Madden

ESA PWA

Sandy Beach Ecosystem Response

TWL + Erosion



Beach width & zones

Geomorphic evolution

Beach Zone Widths

Elevation Habitat Bands

Ecological responses

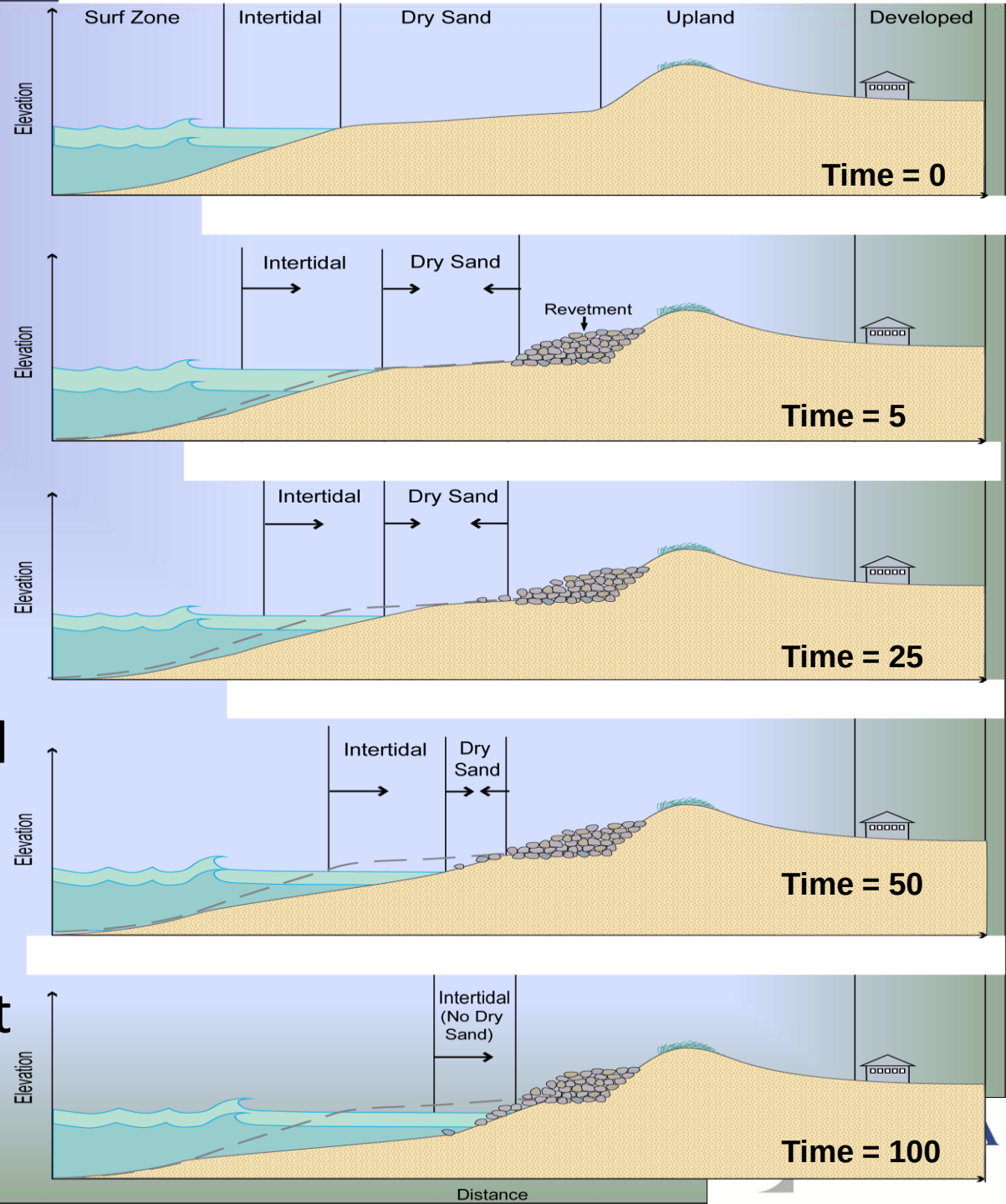
Wrack

Prey

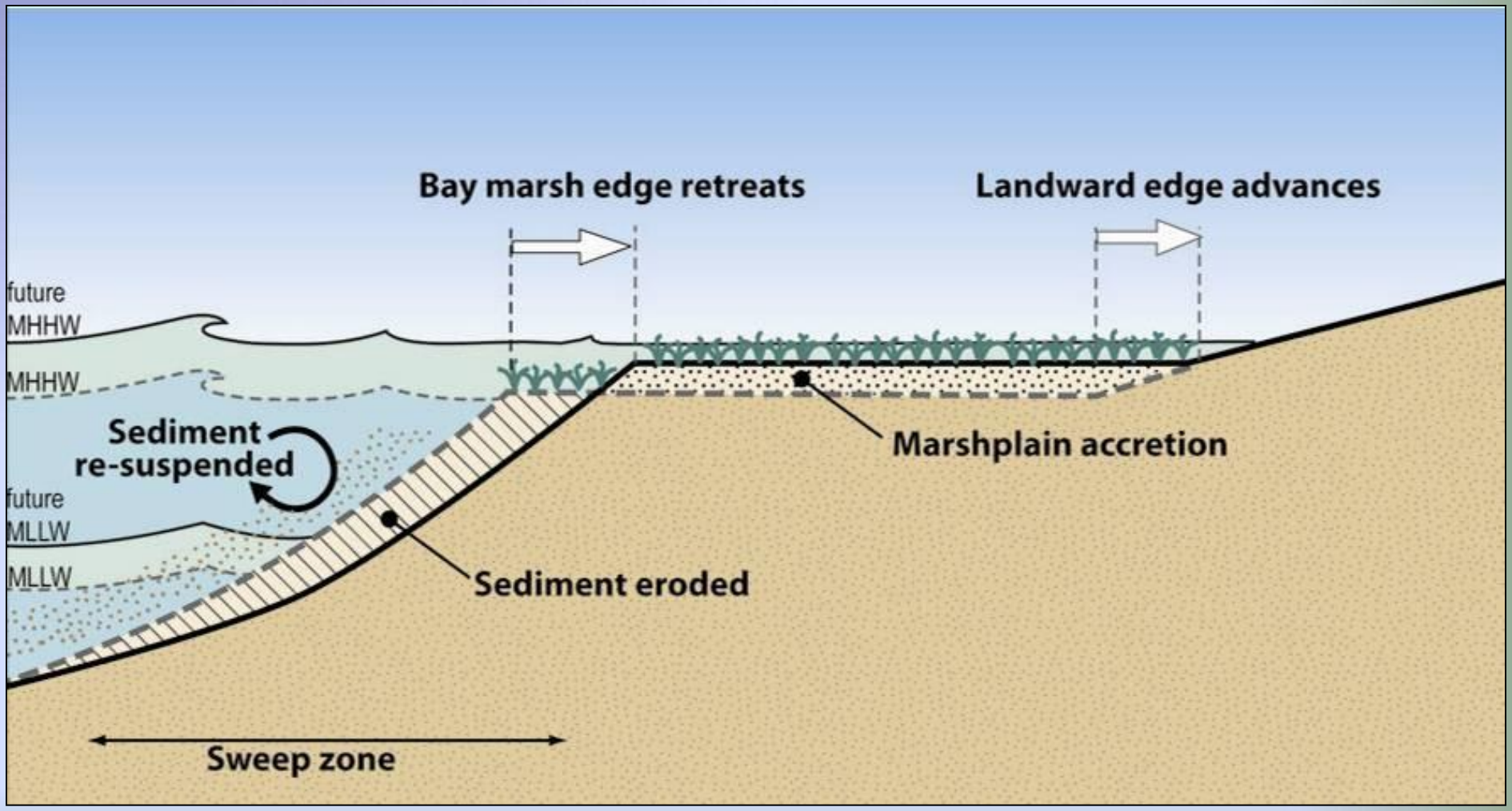
Shorebirds

Accounting for Zone Widths, Cost Benefits

- Account for storm impacts, taxes, recreation, ecosystem services
- Multiple recreational and habitat zones
- Multiple time horizons
- Important to support adaptation planning



Wetland Response to SLR



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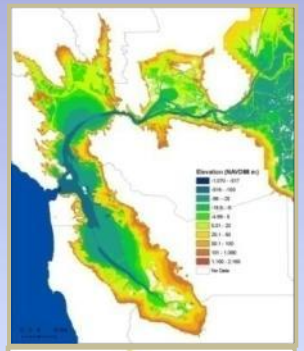
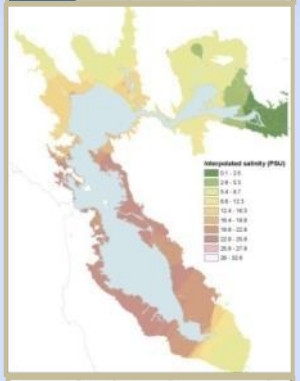
Wetland Evolution modeling

Spatial variation



Elev.

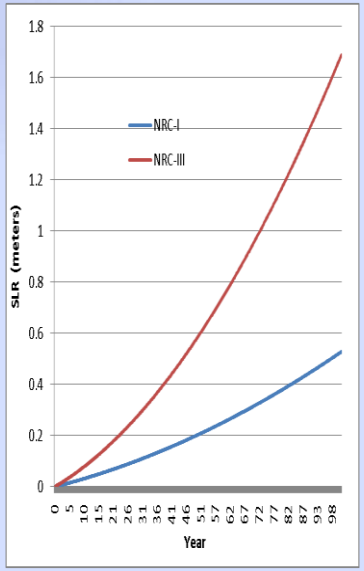


Salinity

SSC

Bed model (Marsh98)

Time series TWL



Habitat prediction maps

prbo

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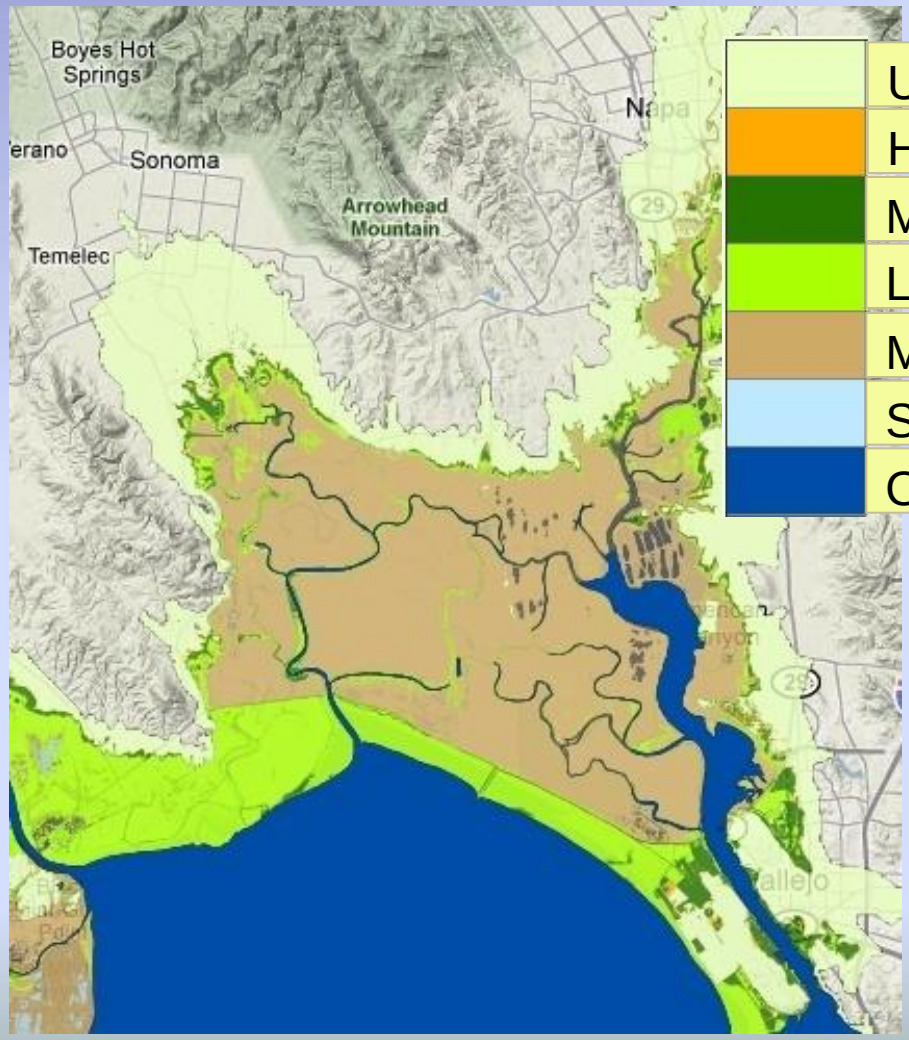
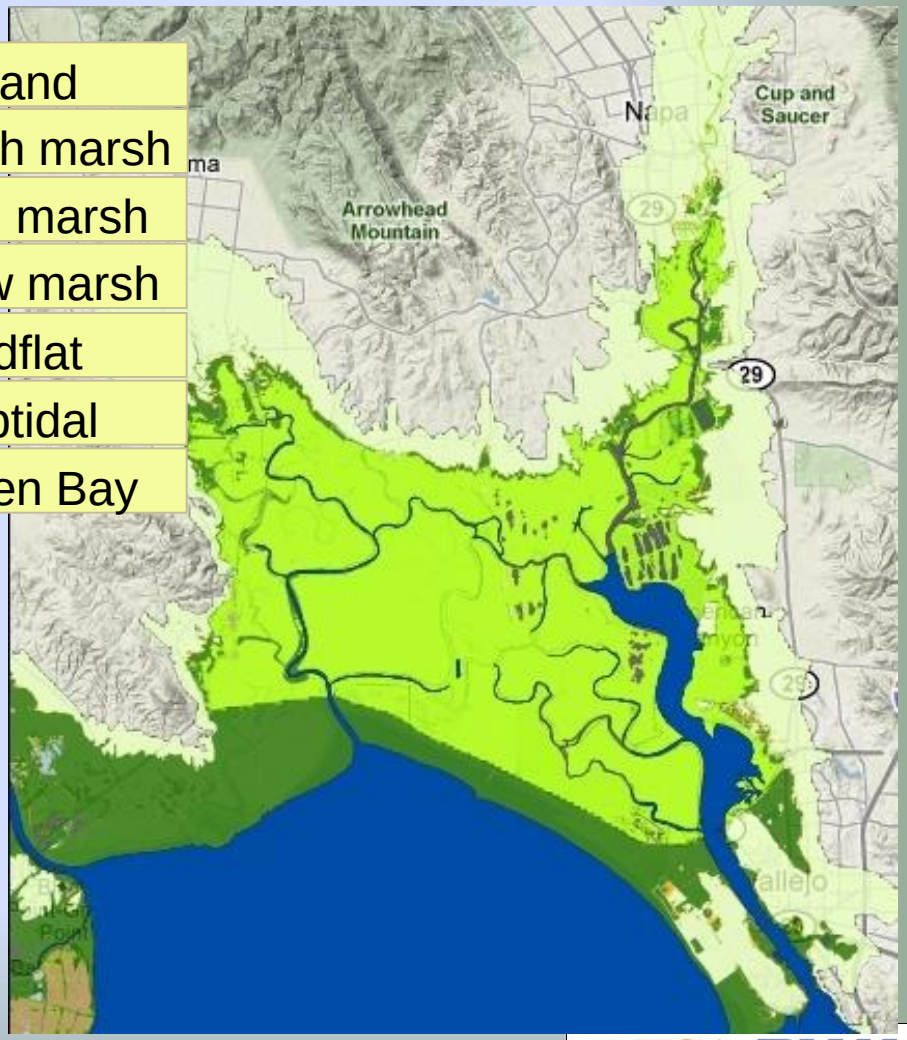
High SLR Scenario (NRC-III)



Low SSC



High SSC

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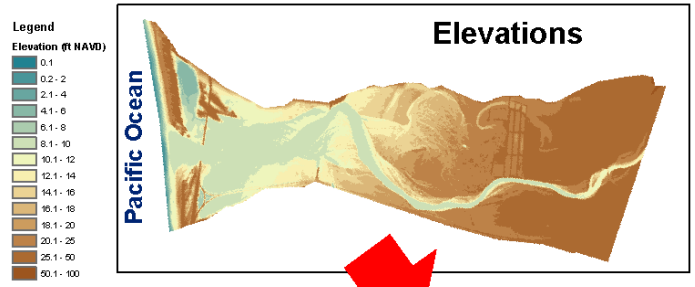
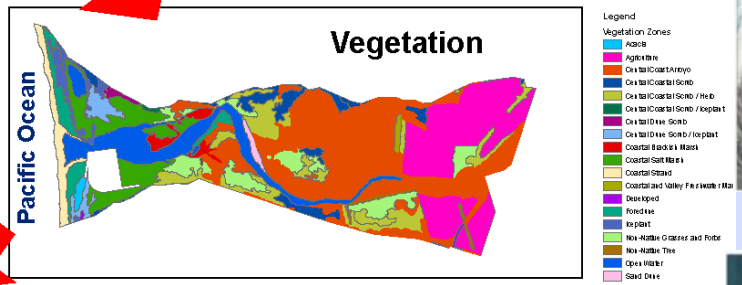
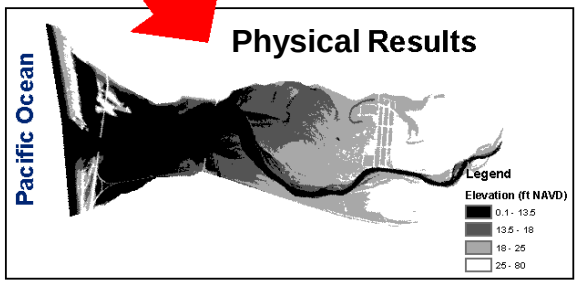
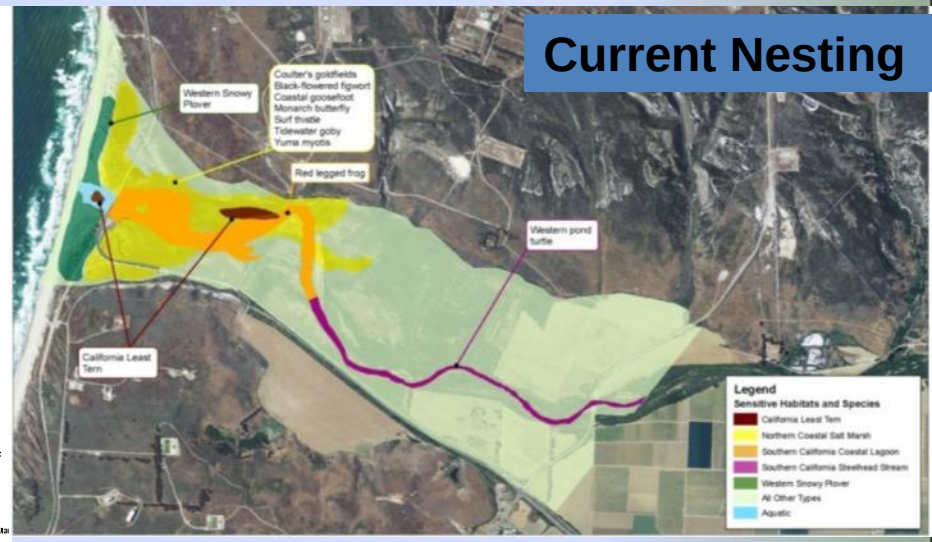
Lower Santa Ynez River

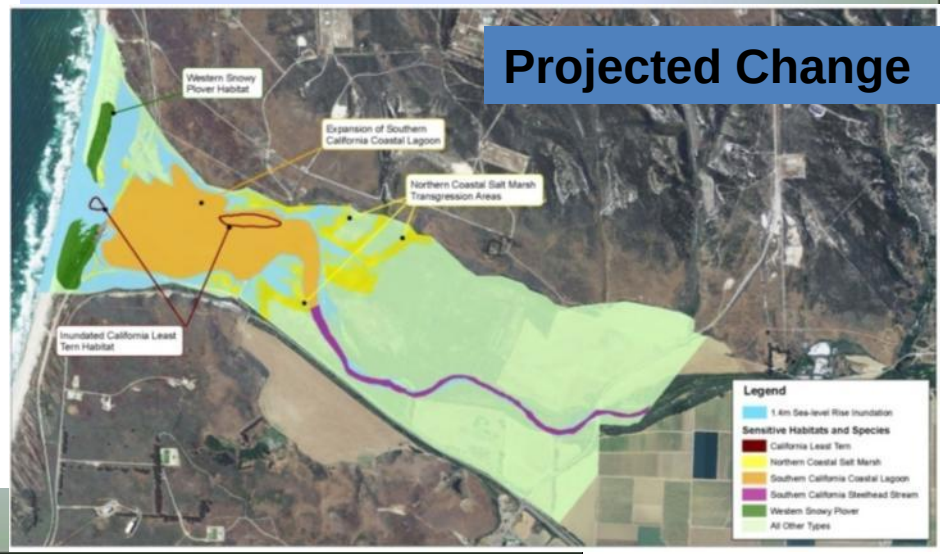




Physical Process Models
+
Field Data Collection







Managed Retreat – Ford Ord

- *getting out of the way gracefully*
- Various mechanisms
- Abandonment
- Phasing, relocate critical infrastructure, remove expendable structures as needed,
- realign transportation corridors, adaptively manage,
- purchase

2002

Source: California Coastal Records Project

2005

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Restoration – Surfers Point
Excavation of Fill

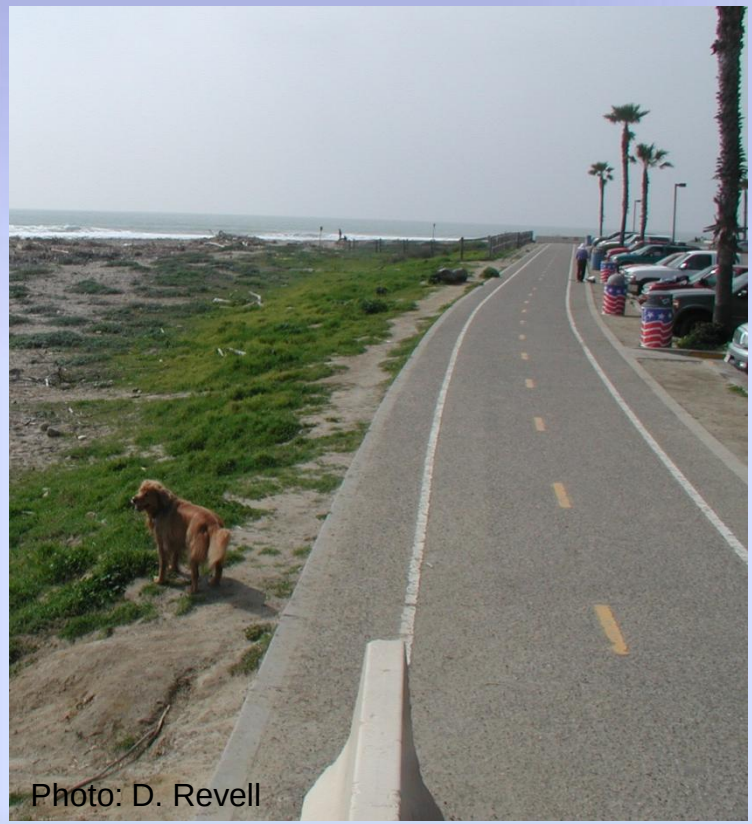
Photo: D. Revell

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Restoration – Surfers Point Cobble

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Restoration – Surfers Point Cobble and Sand

Photos: City of Ventura

Restoration – Surfers Point Cobble and Sand

Photos: City of Ventura

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Summary Thoughts

- Ecosystem Services need to be valued
- Coastal ecosystems are dynamic adaptation needs to work within those dynamics
- Habitat Adaptation requires room to transgress - protect riparian corridors
- Identify bottle necks and prioritize for retrofit
- Sediment is a resource for all coastal ecosystems – settle TMDL vs sediment transport debate

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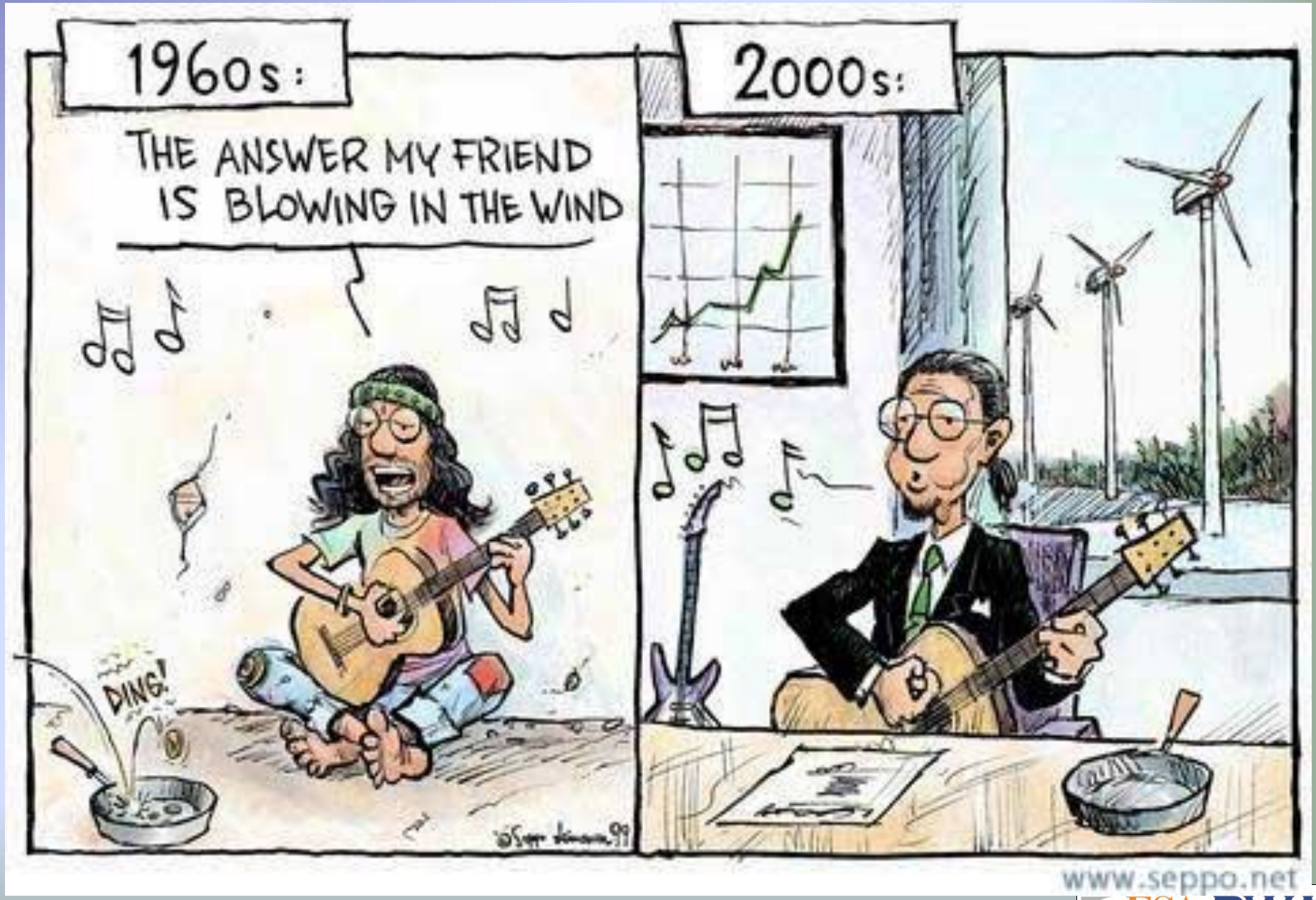
1960s:
THE ANSWER MY FRIEND IS BLOWING IN THE WIND
DING!
2000s:
www.seppo.net

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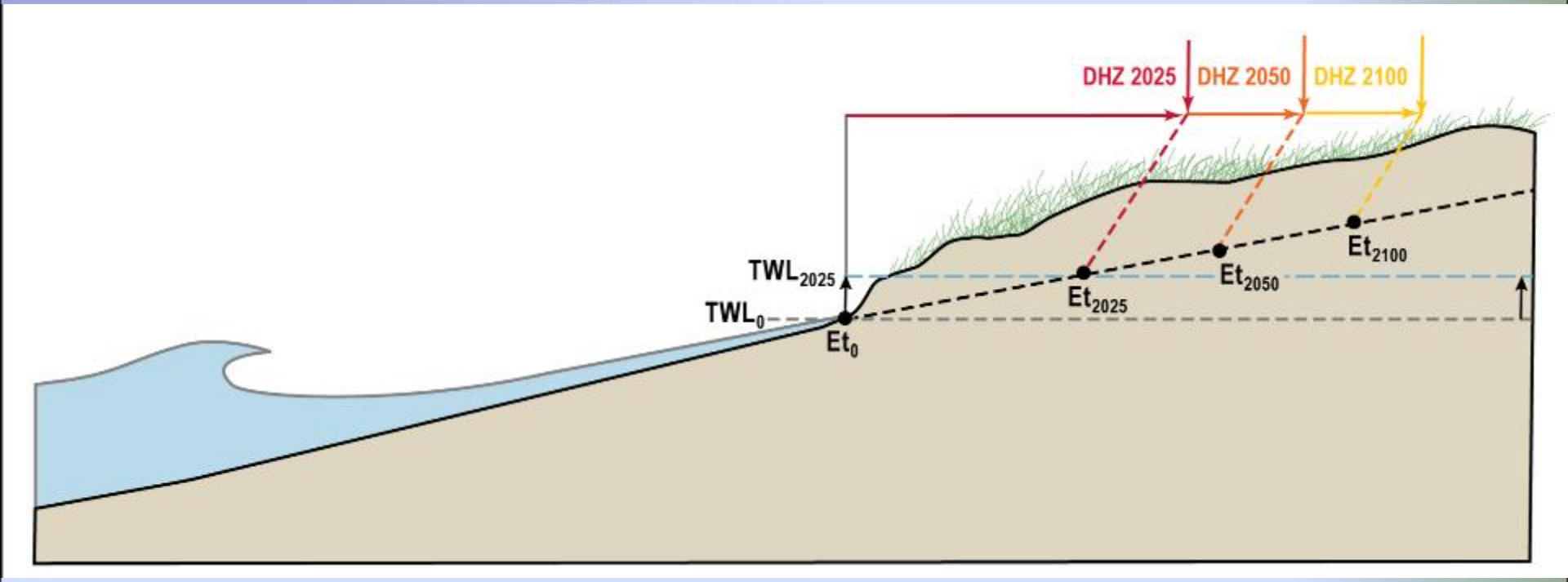
Dune Erosion Model



- 3 components –
  - Changes in TWL from SLR combined with shoreface slope
  - Historic shoreline trends (USGS)
  - Impact of a “100 year storm event”

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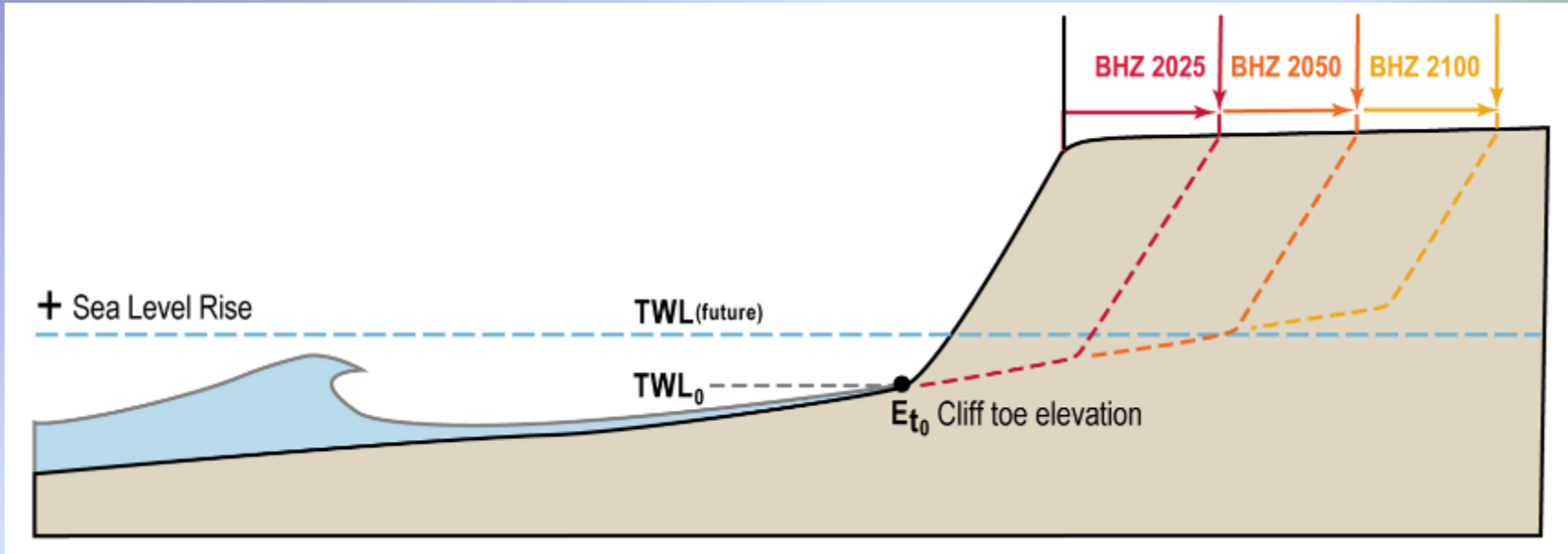
Cliff Erosion Model



- Acceleration of historic erosion rates (Rh)
- Prorated based on % increase in TWL exceeding the elevation of the toe of the beach/cliff junction
- Include geologic unit standard deviation x planning horizon to account for alongshore variability

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