

CLIMATE CHANGE AND WATER QUALITY MANAGEMENT



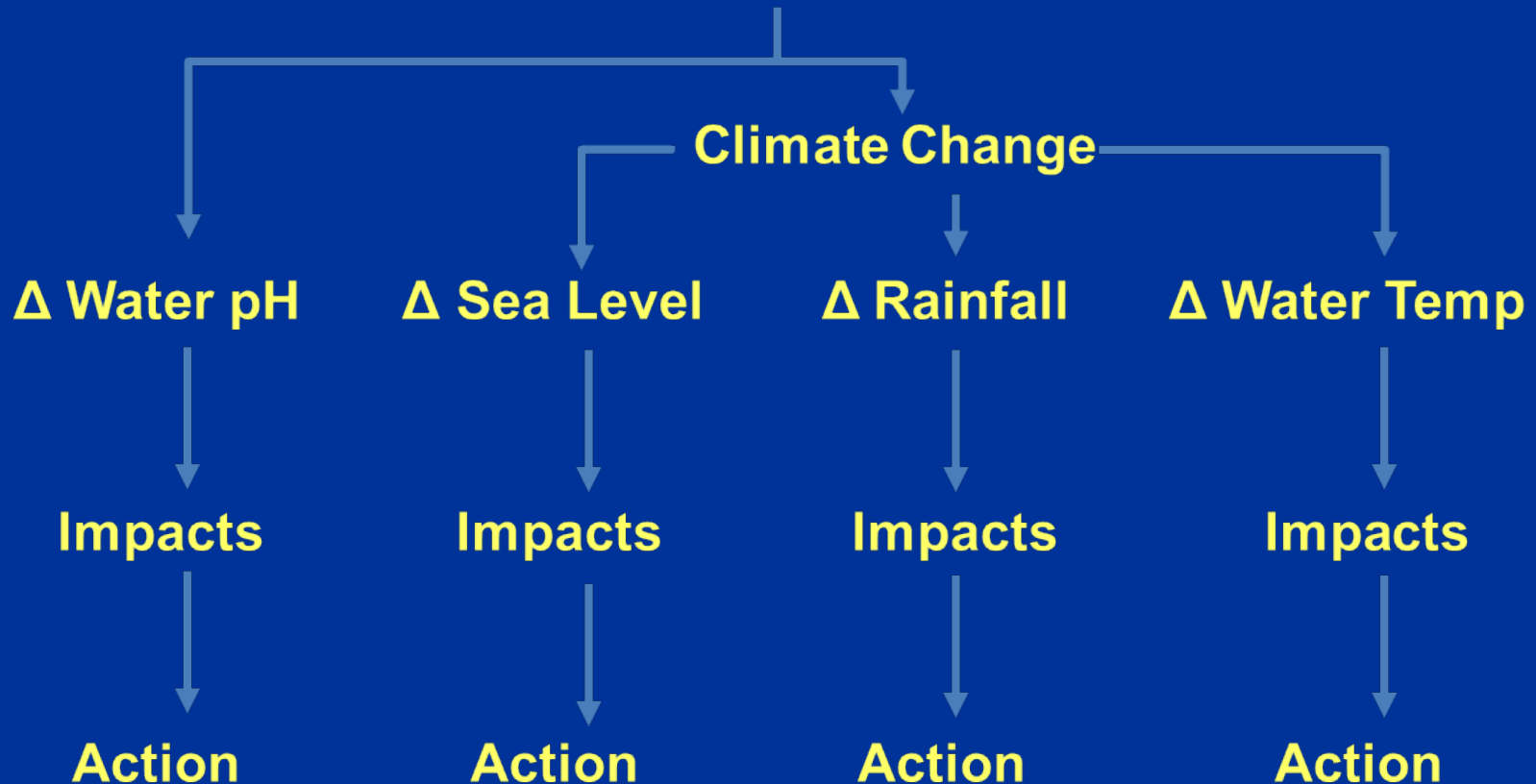
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GOALS FOR THIS PRESENTATION

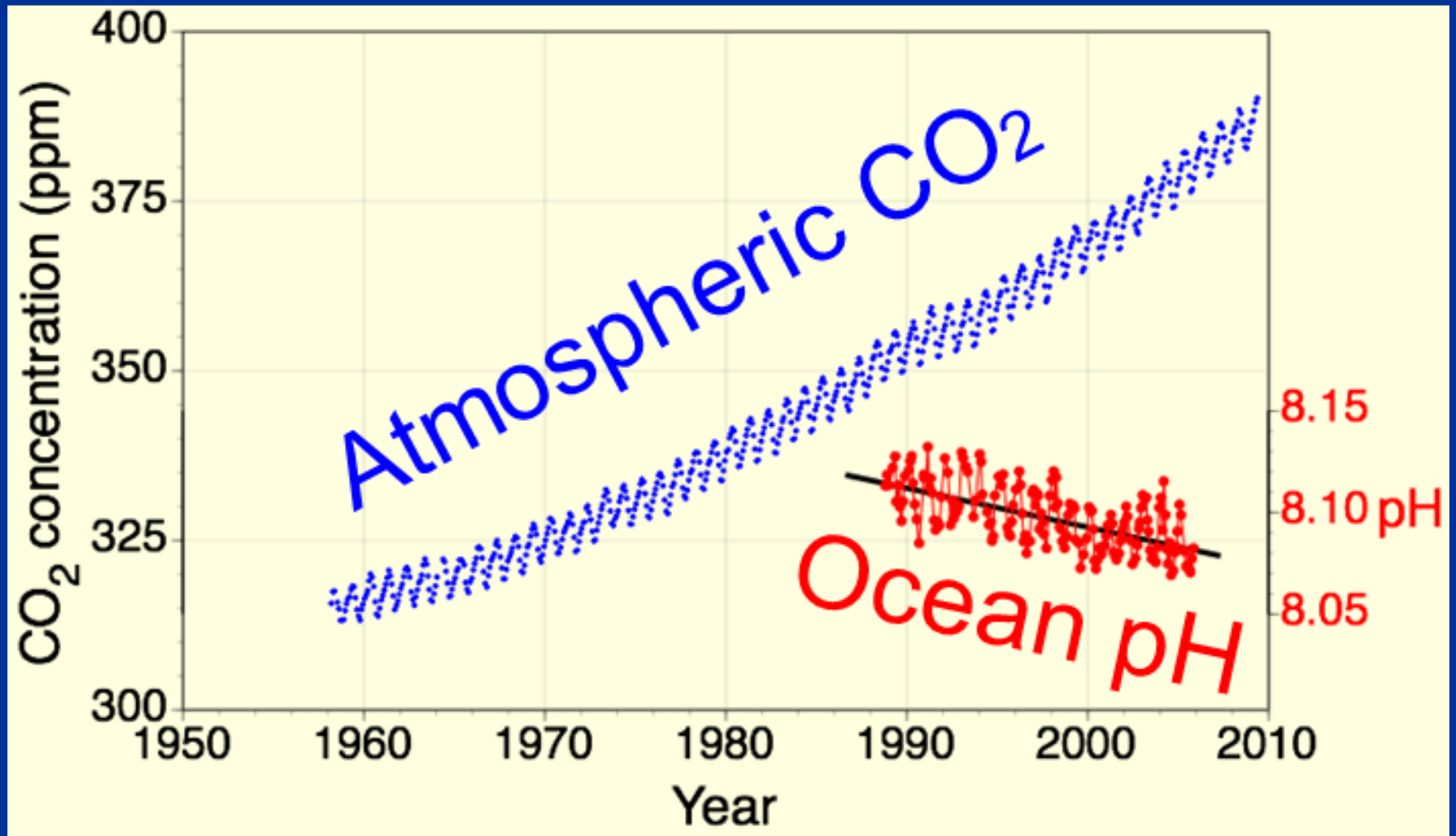
- **Define a climate change conceptual model that links increased atmospheric CO₂ to changes in beneficial uses**
- **Identify some management actions that affect RWQCB decisions**
- **What I won't do is focus on infrastructure**
 - others are already doing this

CONCEPTUAL MODEL

Increased Atmospheric CO₂



CHANGING pH OF MARINE WATER (OCEAN ACIDIFICATION)



Measurements from the Mauna Loa Observation Program

POTENTIAL IMPACTS OF OCEAN ACIDIFICATION

- **Organisms have trouble forming shells**
 - CO₂ consumes carbonate ions needed by calcifying organisms
- **Bioavailability of contaminants**
 - Higher acidity increases bioavailability of toxic trace metals
- **Cascading biological changes across trophic levels**
 - Changes to community composition, vertical distribution patterns, etc.

Pteropod



Urchin



Sea star



Healthy Organisms

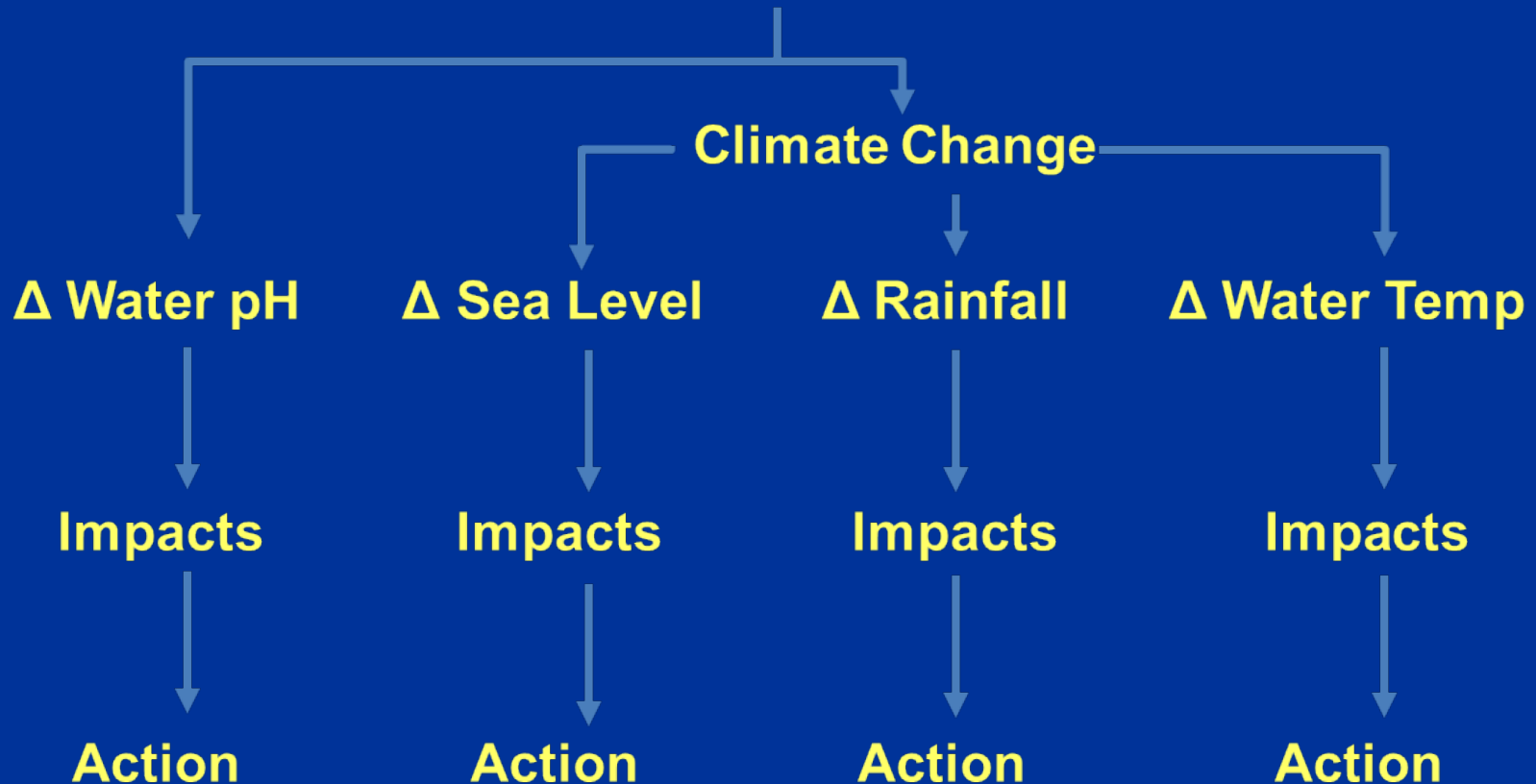
Organisms under acidified conditions

POTENTIAL ACIDIFICATION MANAGEMENT ACTIONS

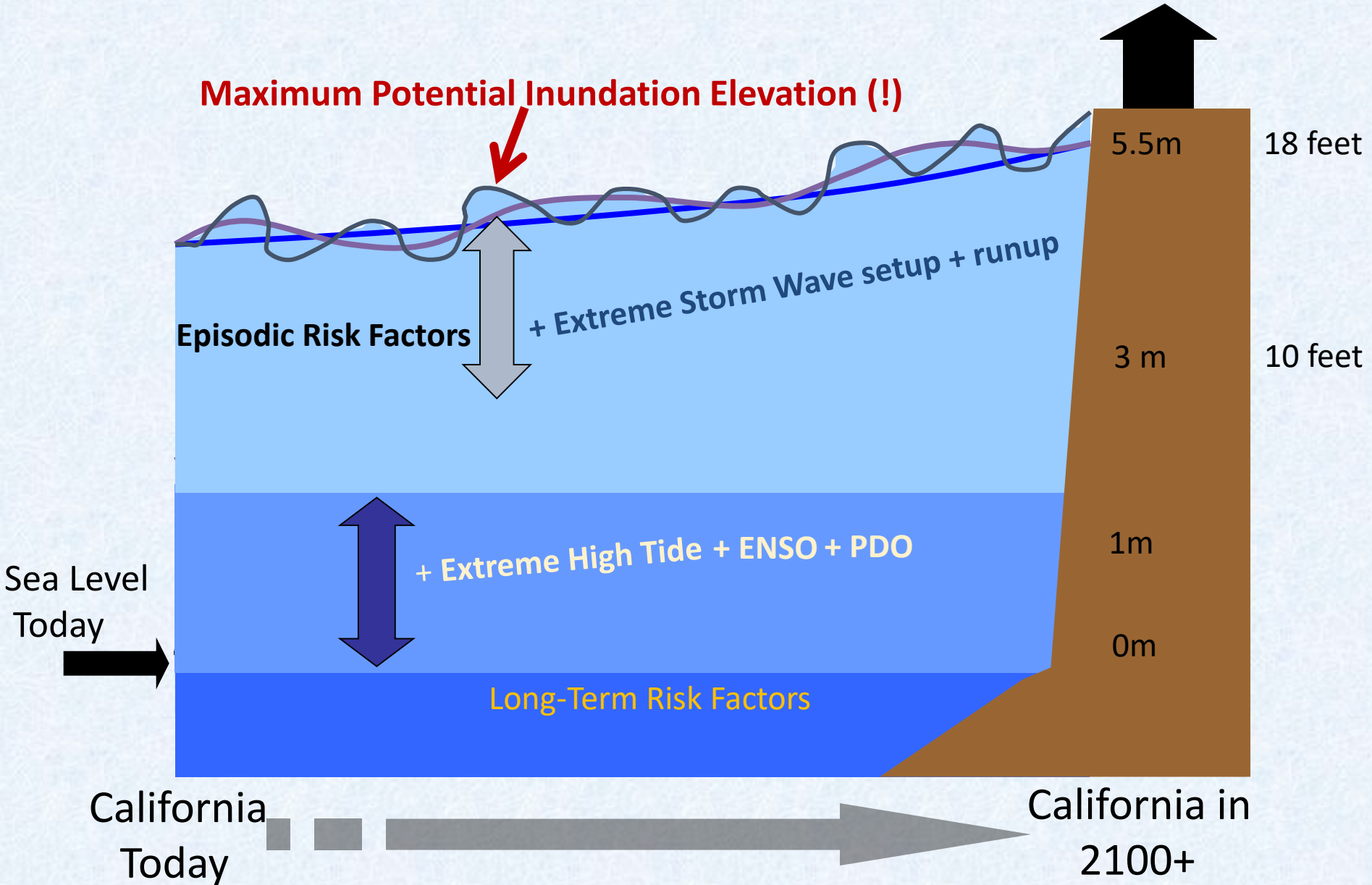
- **Reduce nutrient emissions that lead to algal blooms**
 - May decrease the rate of acidification
- **New water quality criteria and monitoring approaches for pH**
 - Aragonite saturation state
- **Create refugia for impacted species/ecosystems**
 - Maximize the resilience offered by marine protected areas
- **Carbon sequestration**
 - What are the best mechanisms and locations to remove dissolved carbon?
- **Use genetic modification to help species adapt**
 - Hatcheries are considering this for commercial species

CONCEPTUAL MODEL

Increased Atmospheric CO₂



Sea Level Rise – PLUS!!



slide adapted by Sarah Giddings from Bill O'Reilly and Reinhard Flick

POTENTIAL IMPACTS OF SEA LEVEL RISE

- **Threats to infrastructure**
 - Storm surge particularly problematic
- **Threats to water supply**
 - Salt water intrusion on groundwater
- **Physical changes to ecologically sensitive habitats**
 - Alterations in spatial distribution, type, function/services
- **Loss in beneficial use habitat**
 - Wetland loss



Dozens of leopard sharks died near the mouth of the Tijuana River. (Serge Dedina)



Spread of *Spartina* into former pickleweed areas at Mugu

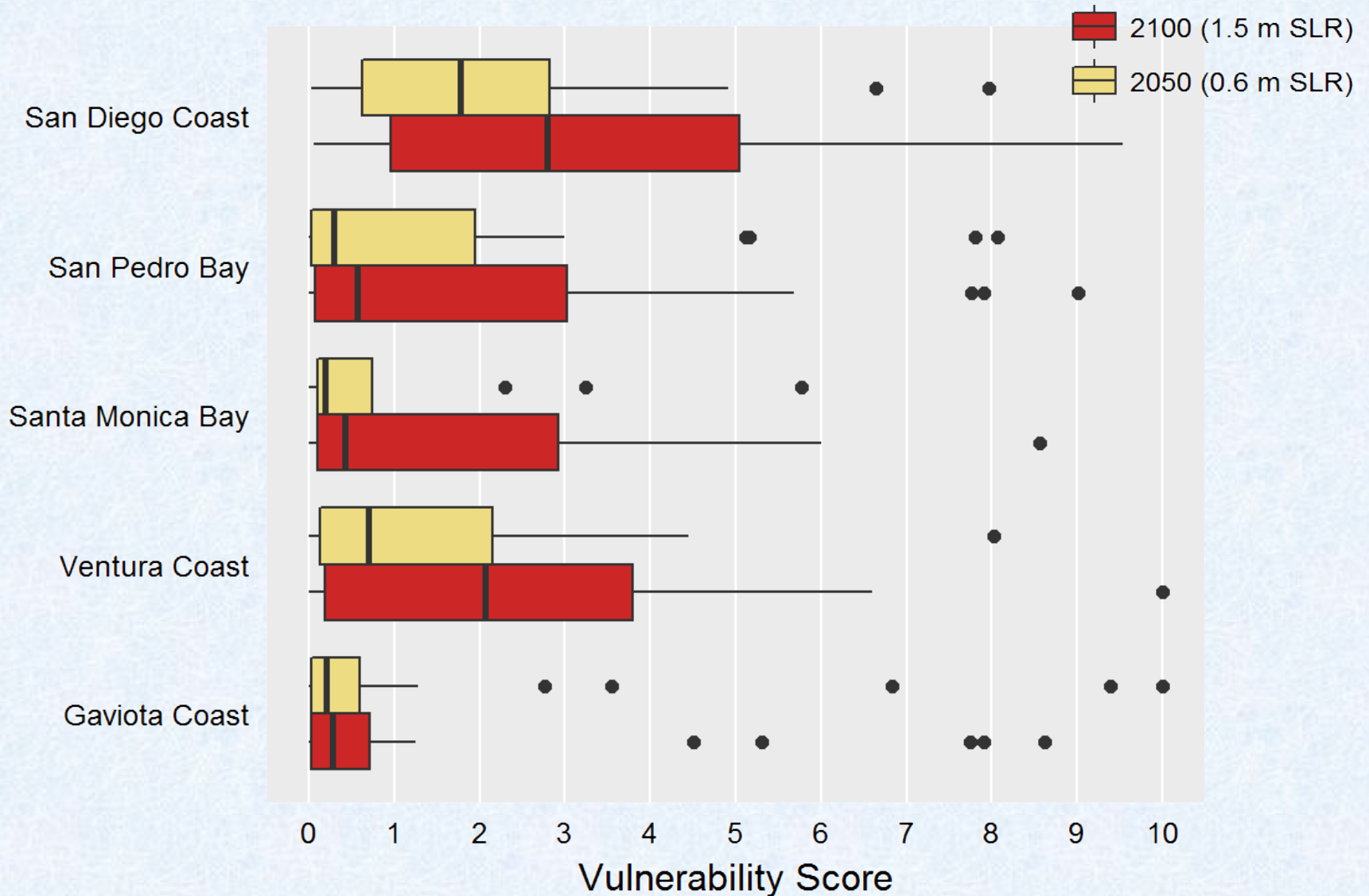


Subsidence and inundation at Seal Beach



Pickleweed dieback at Carpinteria

Vulnerability by Subregion

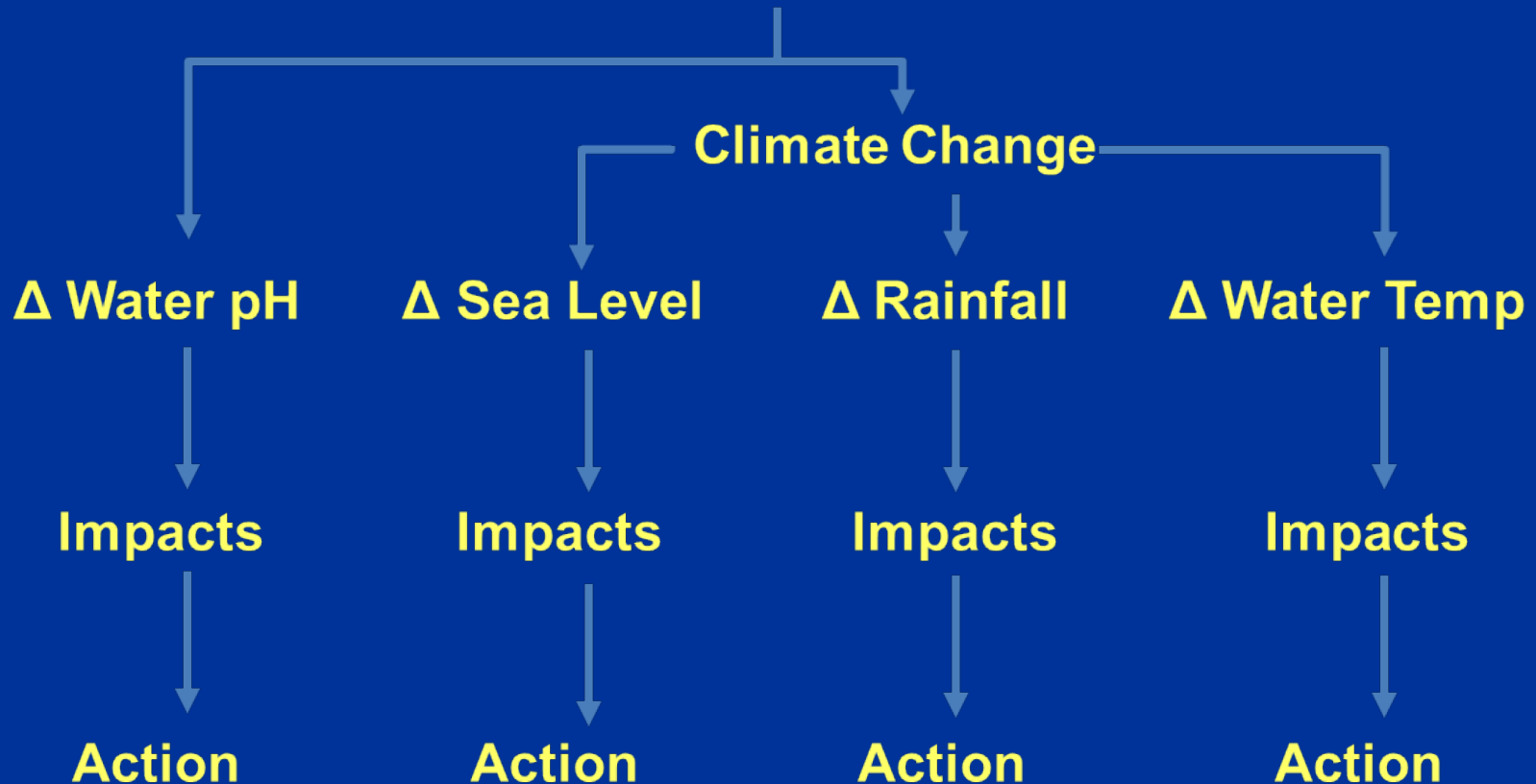


POTENTIAL SEA LEVEL RISE MANAGEMENT ACTIONS

- **Wetland type conversion**
- **Armoring**
 - Mouth management
- **Transgression**
- **Enhanced accretion**

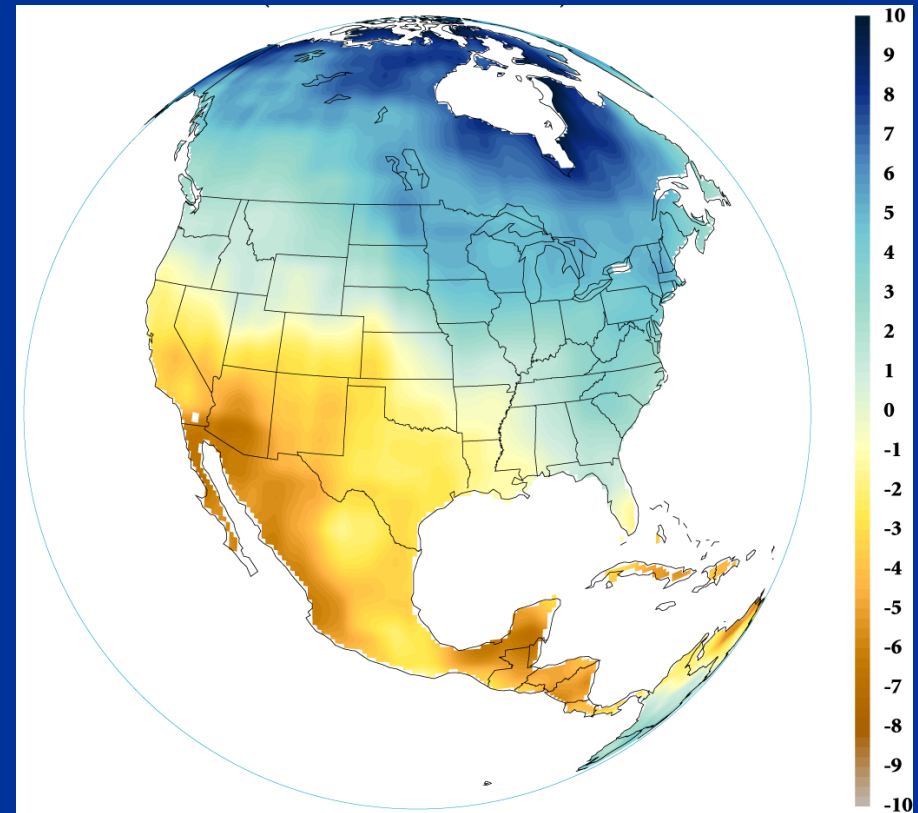
CONCEPTUAL MODEL

Increased Atmospheric CO₂



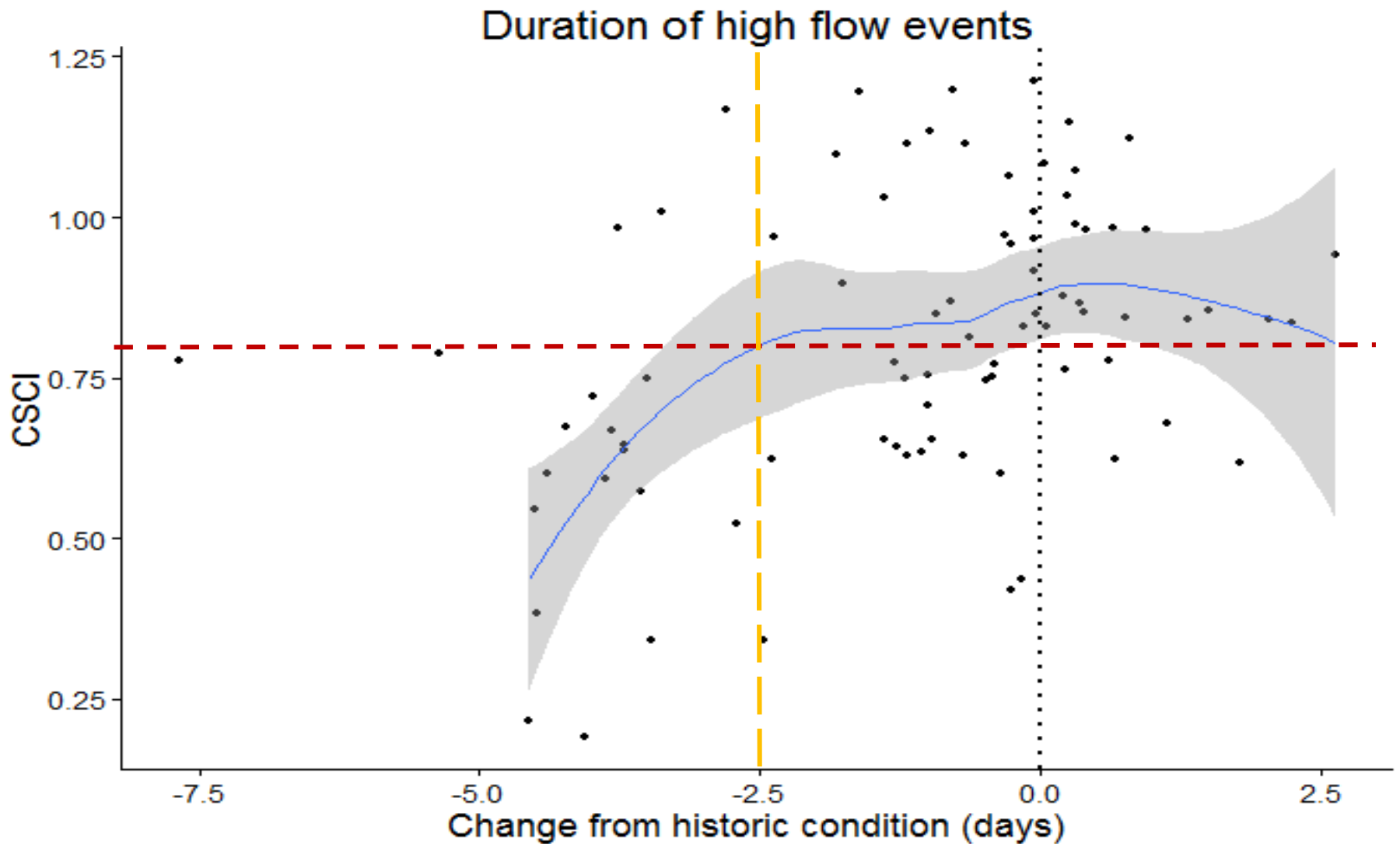
POTENTIAL IMPACTS OF CHANGING RAINFALL

- **Rainfall patterns expected to change**
 - Likely to see longer drought periods punctuated with intense wet years
 - Snowmelt and peak streamflow occurring earlier
- **Changes in rainfall leads to changes in pollutant loading**
 - Our biggest loads come during our largest storms
- **Stream flows will change**
 - Exacerbated by water capture and reuse



Percentage changes in projected precipitation across North America, 1950-2000 to 2021-2040

Biological Response To Altered Flow

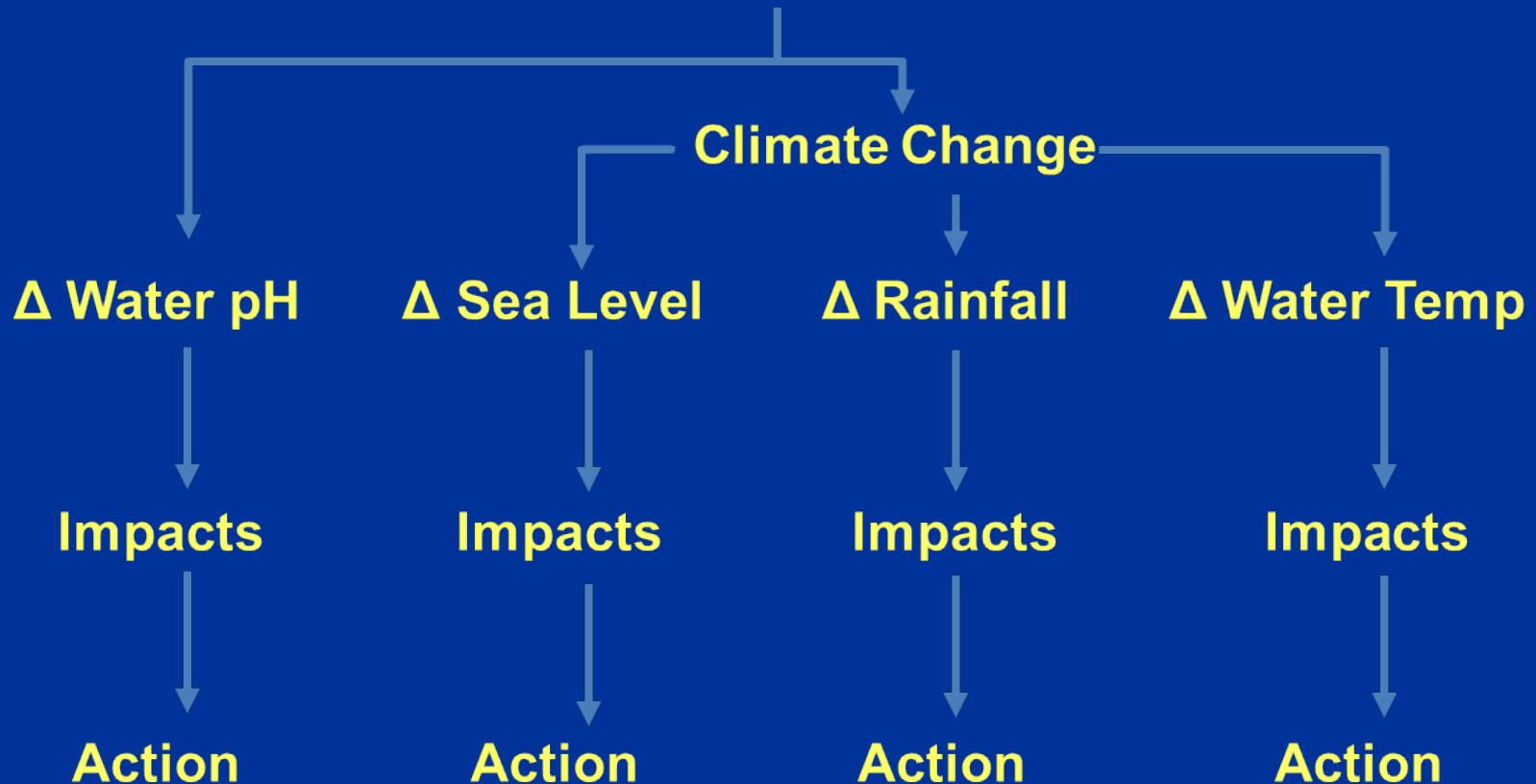


POTENTIAL MANAGEMENT ACTIONS ASSOCIATED WITH CHANGING RAINFALL

- **Refine water supply strategies**
 - Stormwater capture and wastewater recycling become a larger part of the portfolio
- **Alter flood control strategies**
 - BMP sizing or Low impact development requirements
- **Update and refine stream bioassessment indices**
 - Recalibrate stream reference condition
- **Realign hydromodification requirements**
 - Erosion control and sediment supply
 - Dredging

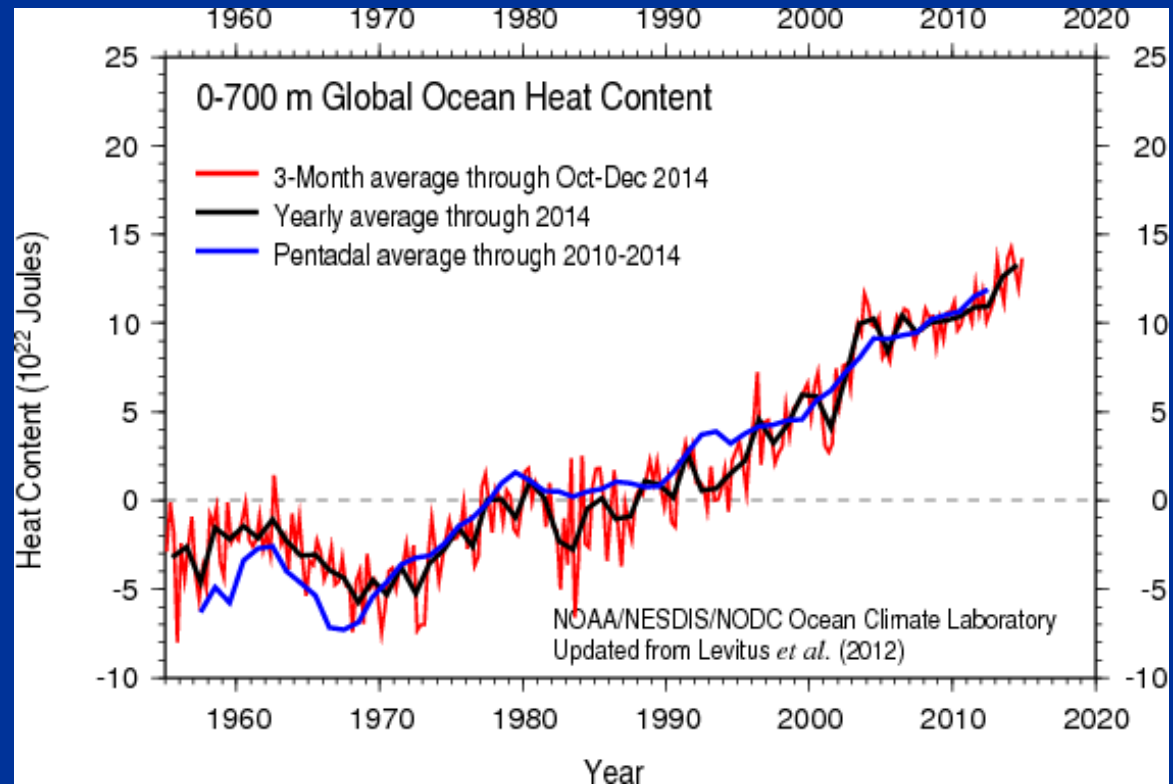
CONCEPTUAL MODEL

Increased Atmospheric CO₂



CHANGING WATER TEMPERATURE

- **Water column temperature up 0.32°F over the past 60 years**
 - About 15 times faster than at any other time in past 10,000 years
 - Surface temperatures up 1.4°F over the past century

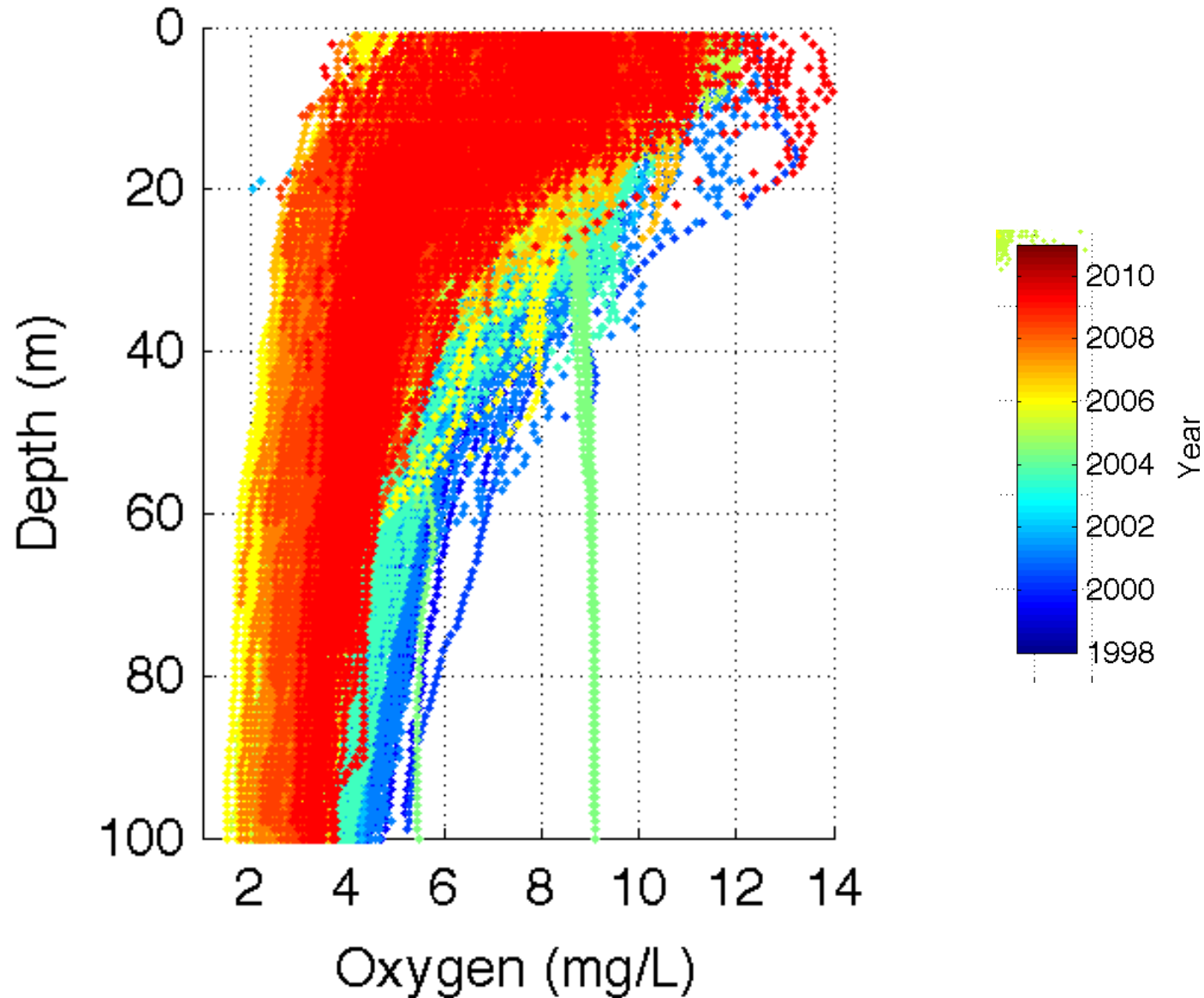


EFFECTS OF CHANGING WATER TEMPERATURE

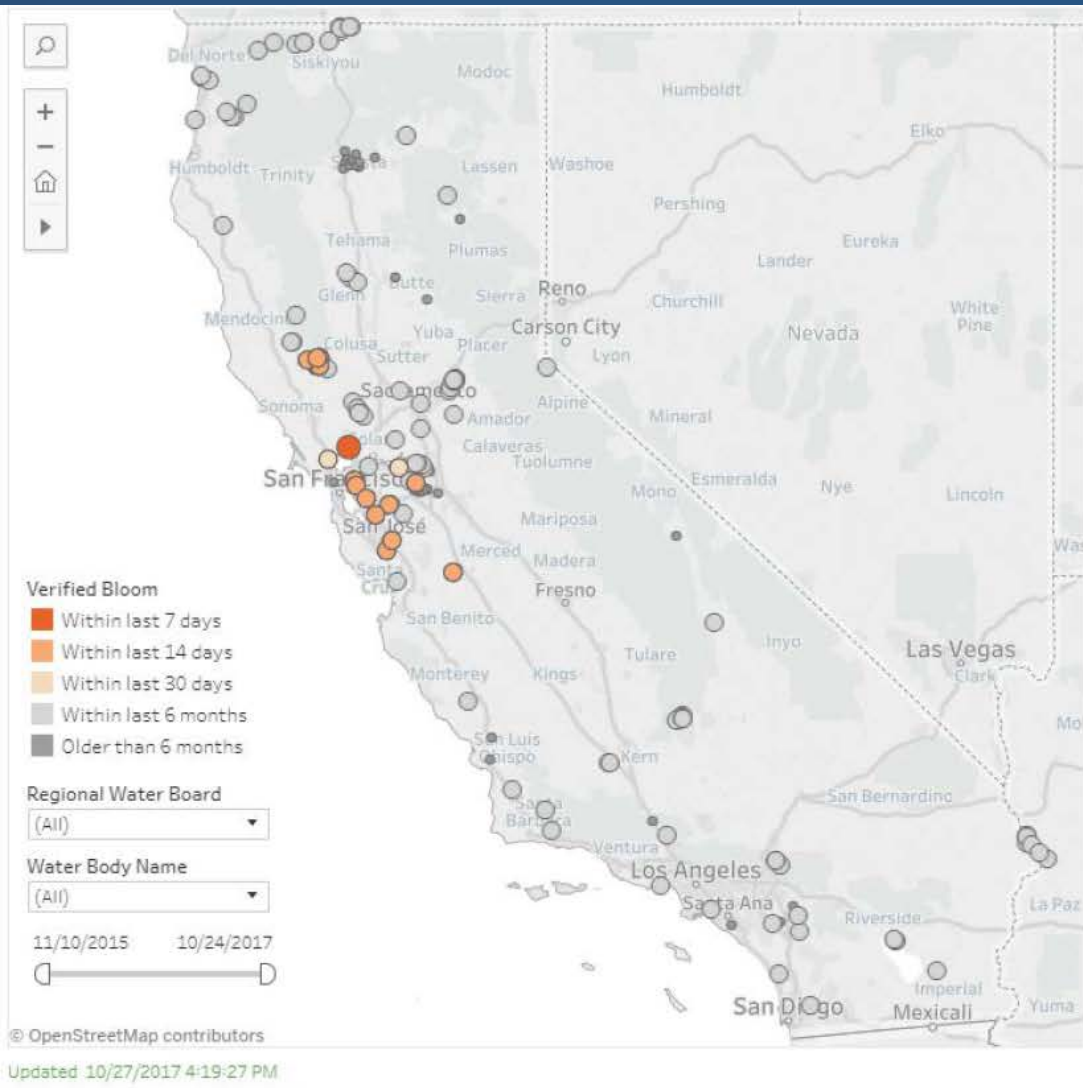
- **A more intense thermocline separating warm surface and cold deep waters**
 - Could affect the degree to which ocean discharges are trapped below surface
 - Increased shoreward migration of low oxygen, deep seawater
- **Changes in species distributions**
 - Southerly species become more prevalent
 - Potential presence of new disease organisms
- **Potential for Harmful Algal Blooms**

Offshore Water Column Profiles

(Southern California Bight Regional Monitoring Program Surveys)



California Cyanobacteria and Harmful Algal Bloom Monitoring Network (CCHAB)



2017 → 141 advisories

CAUTION

Harmful algae may be present in this water.
For your family's safety:

- Do not let pets and other animals drink the water or get into the water.
- Do not let children near the water.
- The fish caught here, **throw away guts and clean fillets with tap water or bottled water before cooking.**
- Do not eat shellfish from the water.

Call your doctor or water board if you or your pet get sick after using the water.
For information on water quality, go to mywaterquality.ca.gov/waterquality, contact your local water board, or call 1-800-953-5877.

99

WARNING

Toxins from algae in this water can harm people and kill animals

- No swimming.**
- Do not let pets or other animals get into or drink the water or get near the water.
- Do not use this water for drinking or cooking.
- Do not let children near the water.
- Do not eat shellfish from this water.
- The fish caught here, **throw away guts and clean fillets with tap water or bottled water before cooking.**

Call your doctor or water board if you or your pet get sick after using the water.
For information on water quality, go to mywaterquality.ca.gov/waterquality, contact your local water board, or call 1-800-953-5877.

42

DANGER

Toxins from algae in this water can harm people and kill animals

- Stay out of the water until further notice. Do not touch scum in the water or on shore.
- Do not let pets or other animals drink or go into the water or get near the water.
- Do not eat fish or shellfish from the water.

Call your doctor or water board if you or your pet get sick after using the water.
For information on water quality, go to mywaterquality.ca.gov/waterquality, contact your local water board, or call 1-800-953-5877.

<http://www.mywaterquality.ca.gov/habs/index.html>

POTENTIAL WATER TEMPERATURE MANAGEMENT ACTIONS

- **Revised interpretation of dissolved oxygen criteria**
- **Added shading for streams**
 - Altering cold water beneficial use designations
- **Improved HAB Monitoring and reporting system**
 - Updated regulatory thresholds

CLOSING THOUGHTS

- **Conceptual model attempts to link climate change impacts to your potential management actions**
 - RWQCB staff has options
- **There is uncertainty as to how much impact and when the impacts will occur**
 - This is why multiple future modeling scenarios are published
- **Uncertainty does not mean lack of action**
 - Managers charged with “at risk” locations are creating a range of options with a series of decision “tipping points”