A nighttime photograph of the Tijuana Estuary. The foreground shows dark, rocky terrain. In the middle ground, a body of water reflects the lights from a city in the background. The city lights are numerous and bright, creating a glowing horizon line. The sky is dark with some light pollution.

# Coupled Research & Management at the Tijuana Estuary

**Jeff Crooks**

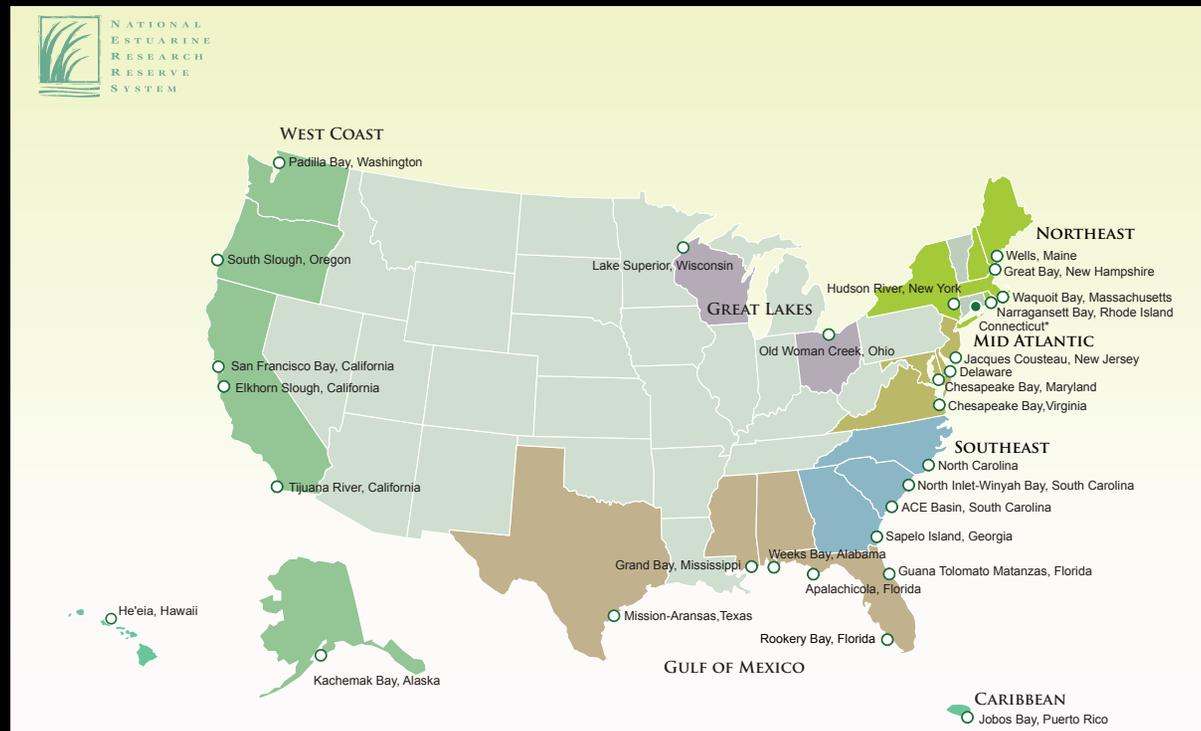
Tijuana River National Estuarine Research Reserve

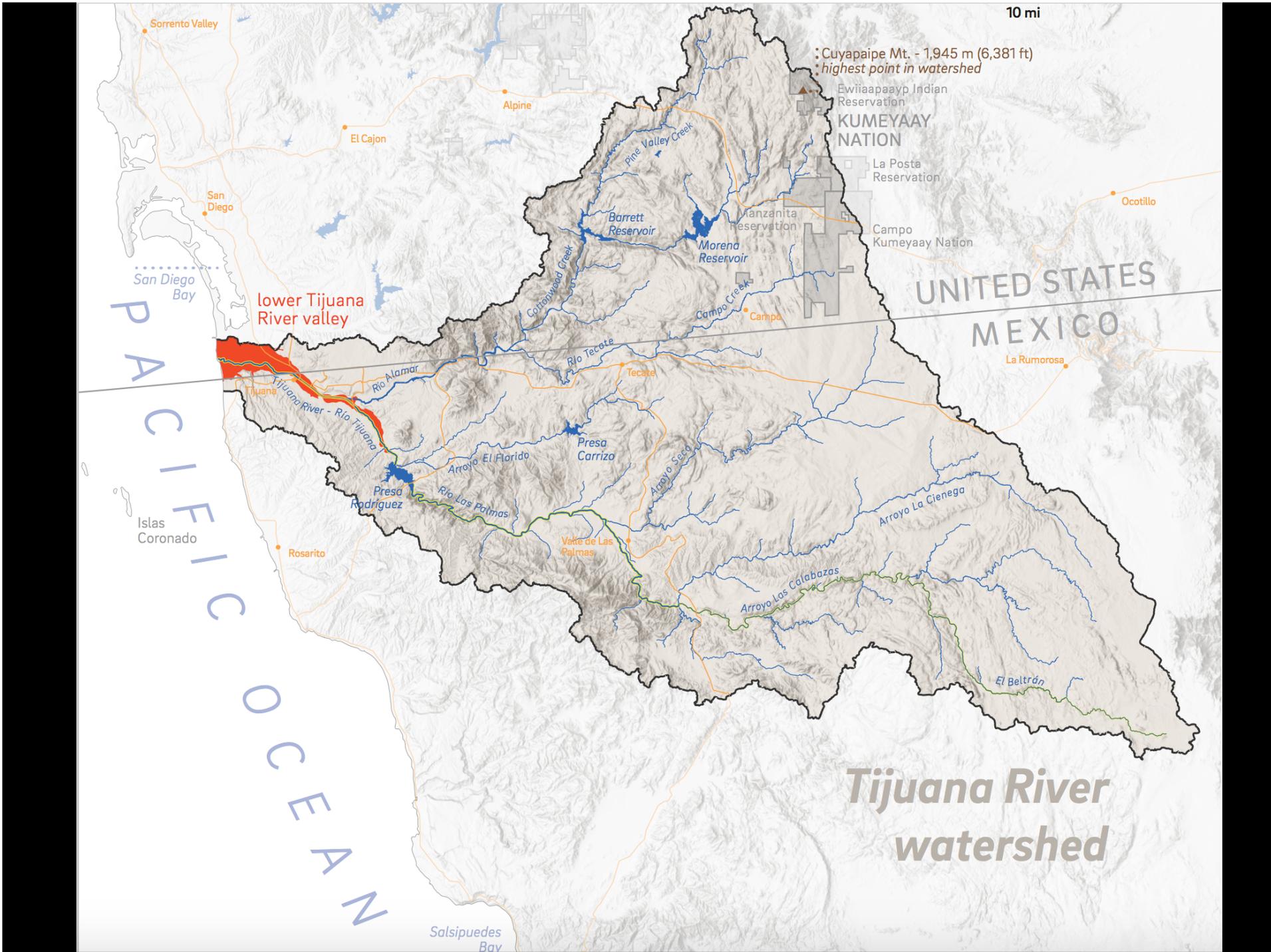


# National Estuarine Research Reserve System

## National Oceanic & Atmospheric Administration

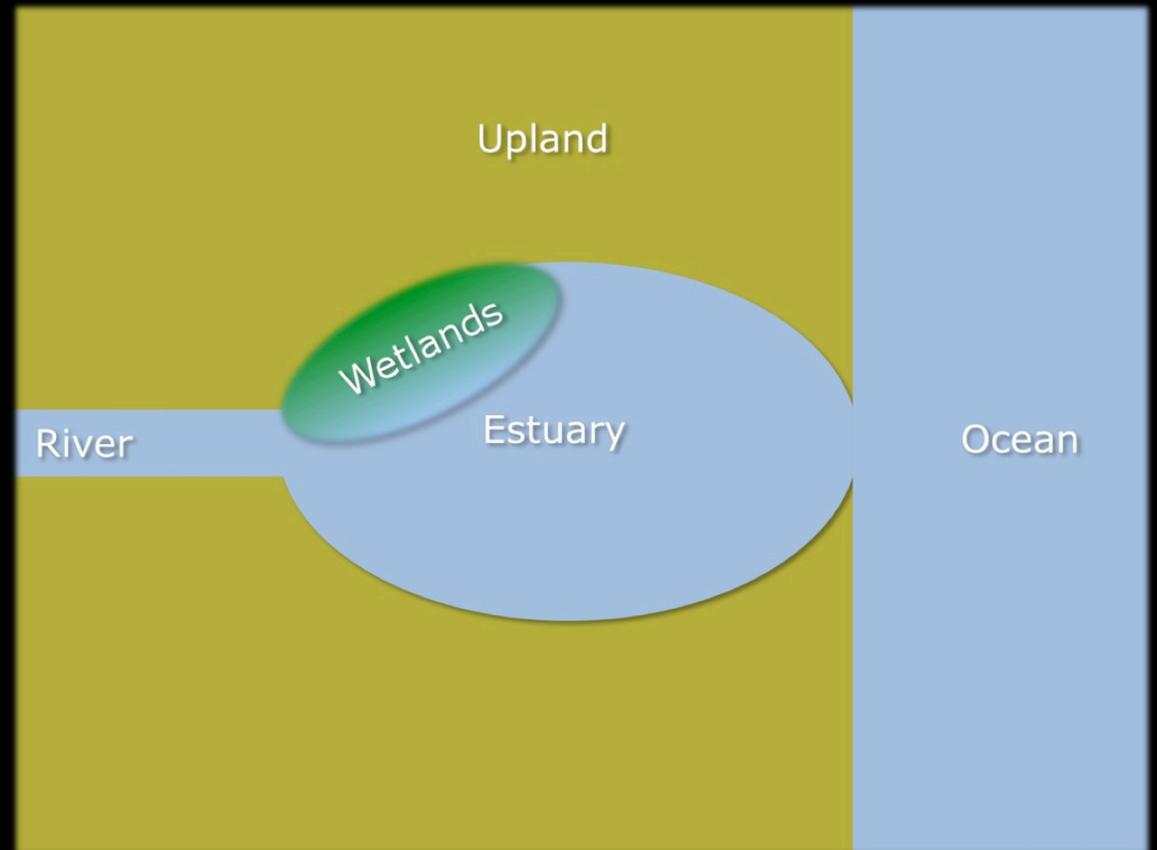
- Federal – State Partnerships, established by the Coastal Zone Management Act
- Provide protection of resources for research
- Enhance awareness and understanding of estuaries, and provide opportunities for education and interpretation
- Protect areas that contribute to the typological and biogeographical balance of the system



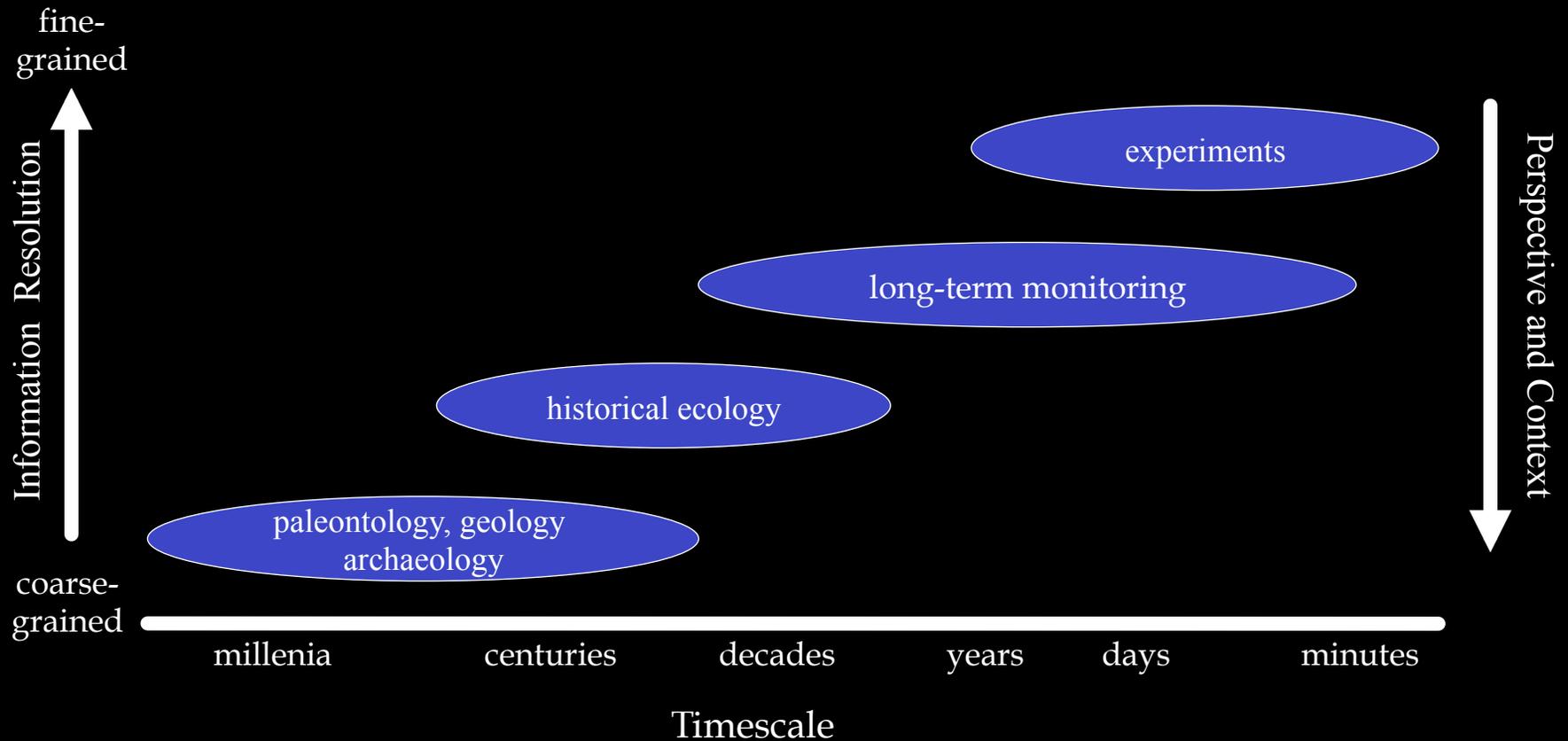


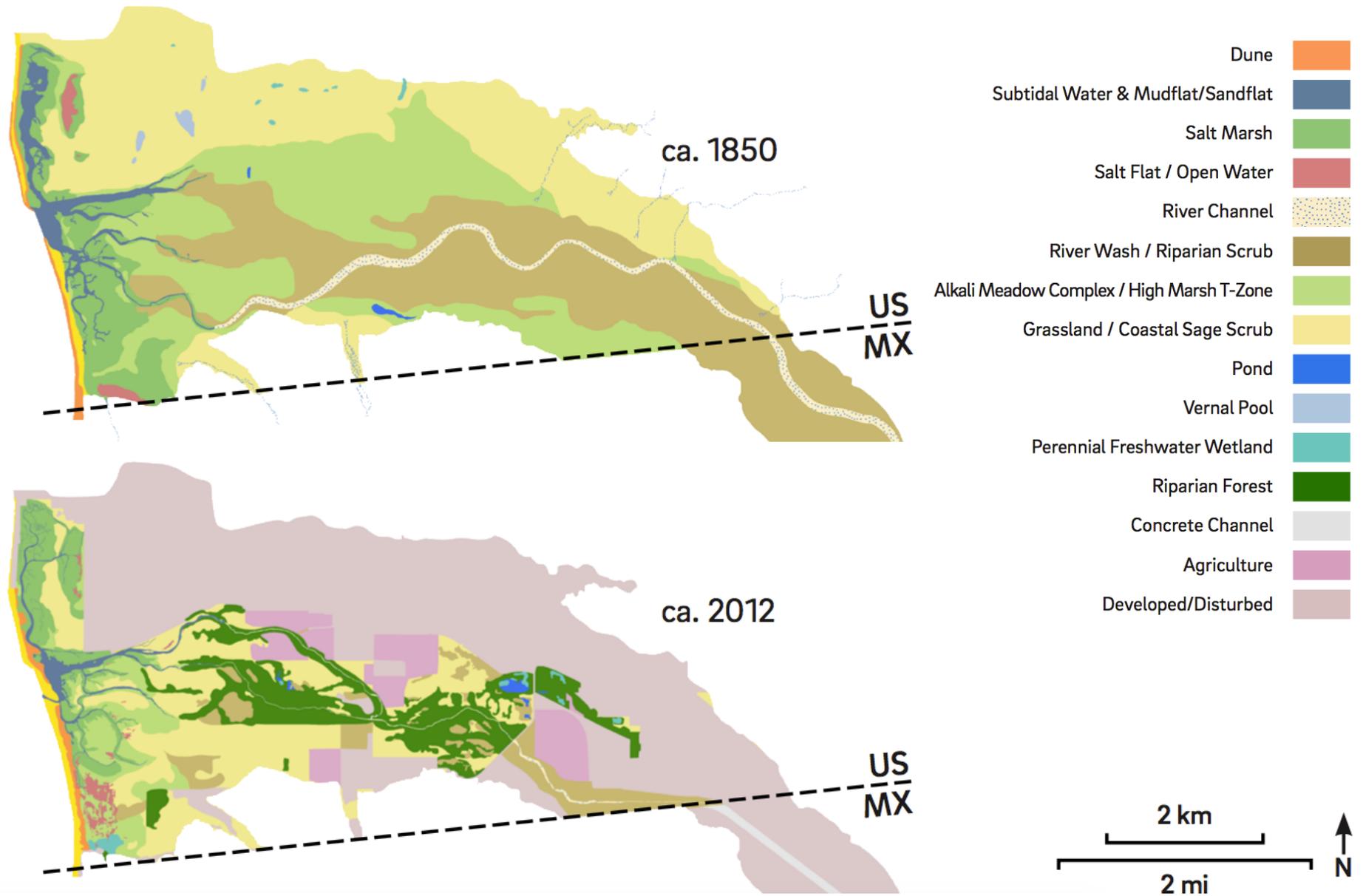
# Estuarine Wetlands

They represent the one place on earth where the three major habitat types – land, sea, and freshwater – come together

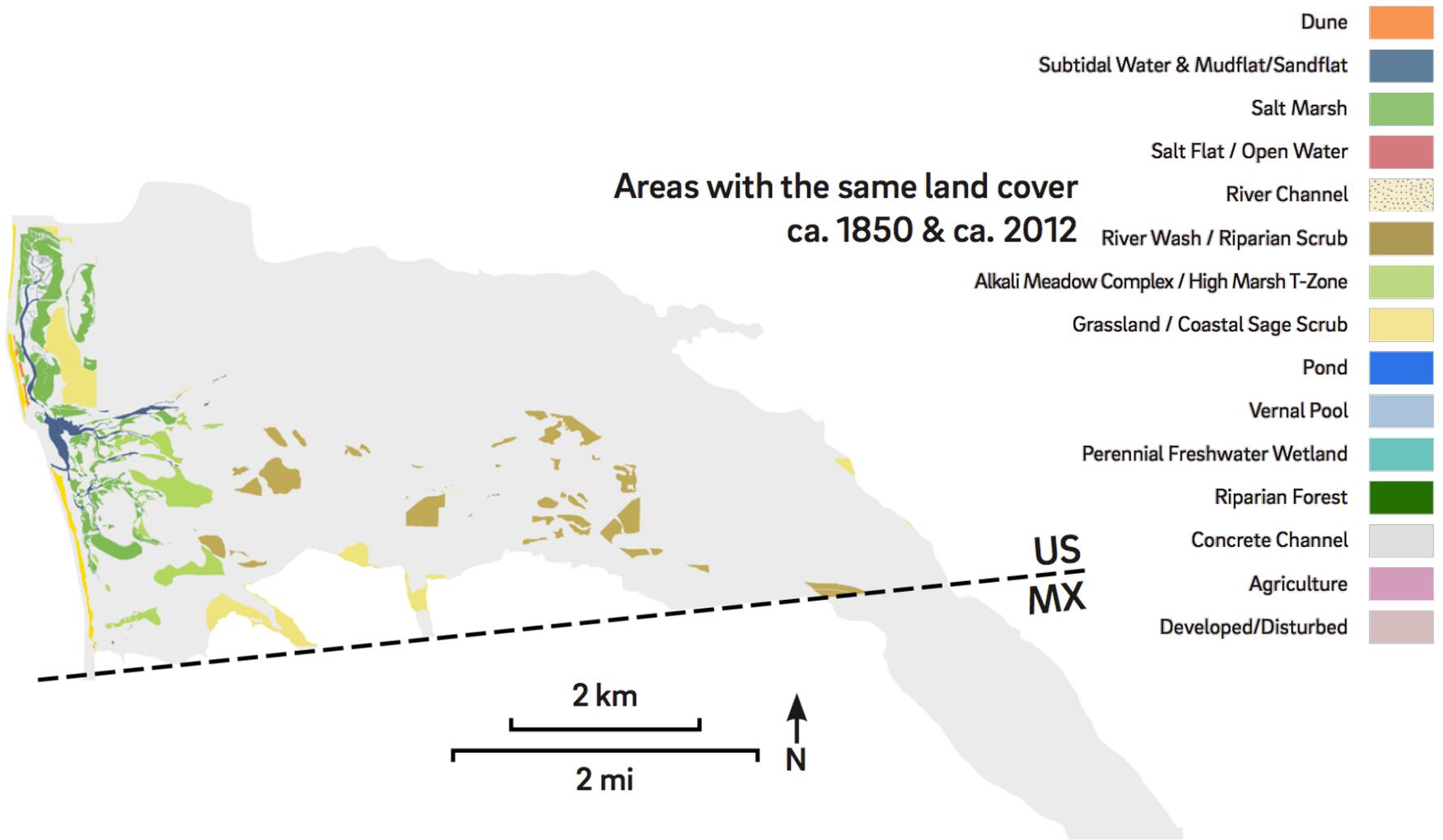


# Science-Based Ecosystem Management - Sources of Information





**Tijuana River Historical Ecology Study**  
**San Francisco Estuary Institute**



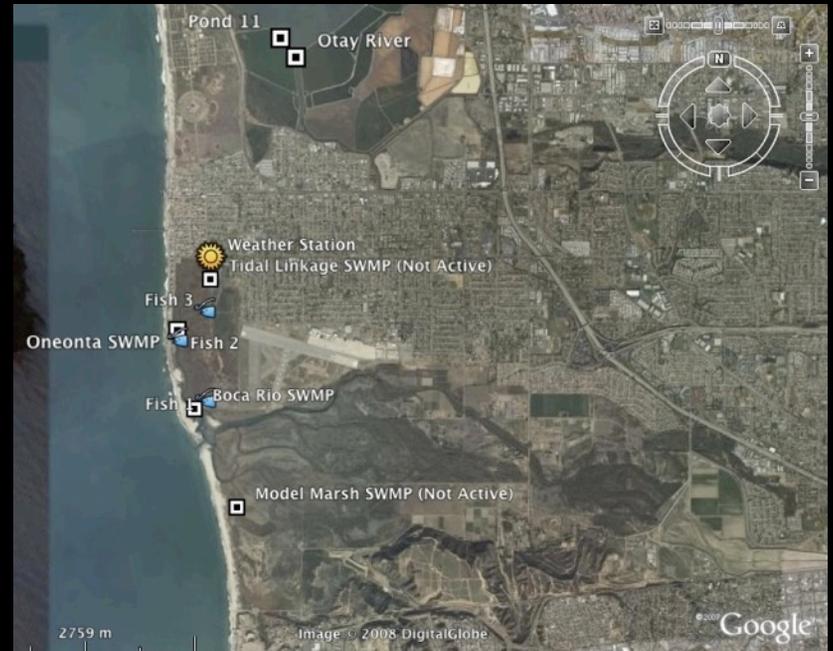
# Ecosystem Monitoring:

## Assessing “Vital Signs” and Fostering Adaptive Management

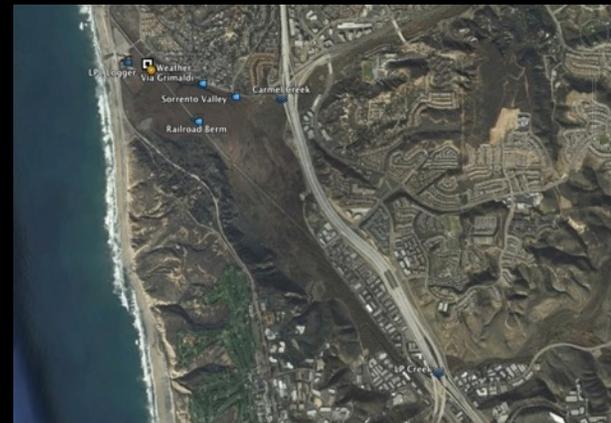
PERL and TRNERR

- Water parameters -Temperature, Salinity, Dissolved Oxygen, Turbidity, pH, depth
- Nutrients / Chlorophyll a
- Topography
- Soil
- Vegetation
- Invertebrates
- Fish
- Birds

South  
San Diego  
Bay



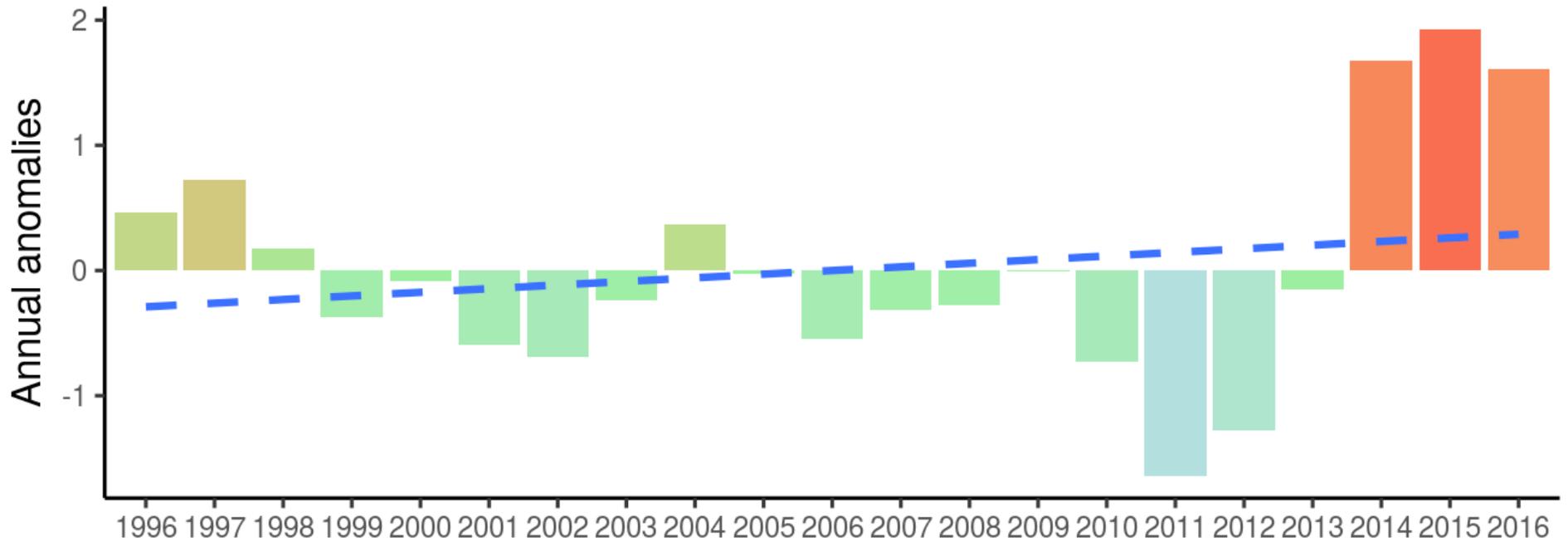
Tijuana  
River  
Estuary



Los  
Peñasquitos  
Lagoon



# Average Yearly Temperature Difference from the Long-Term Average



Oneonta Slough Datalogger Station





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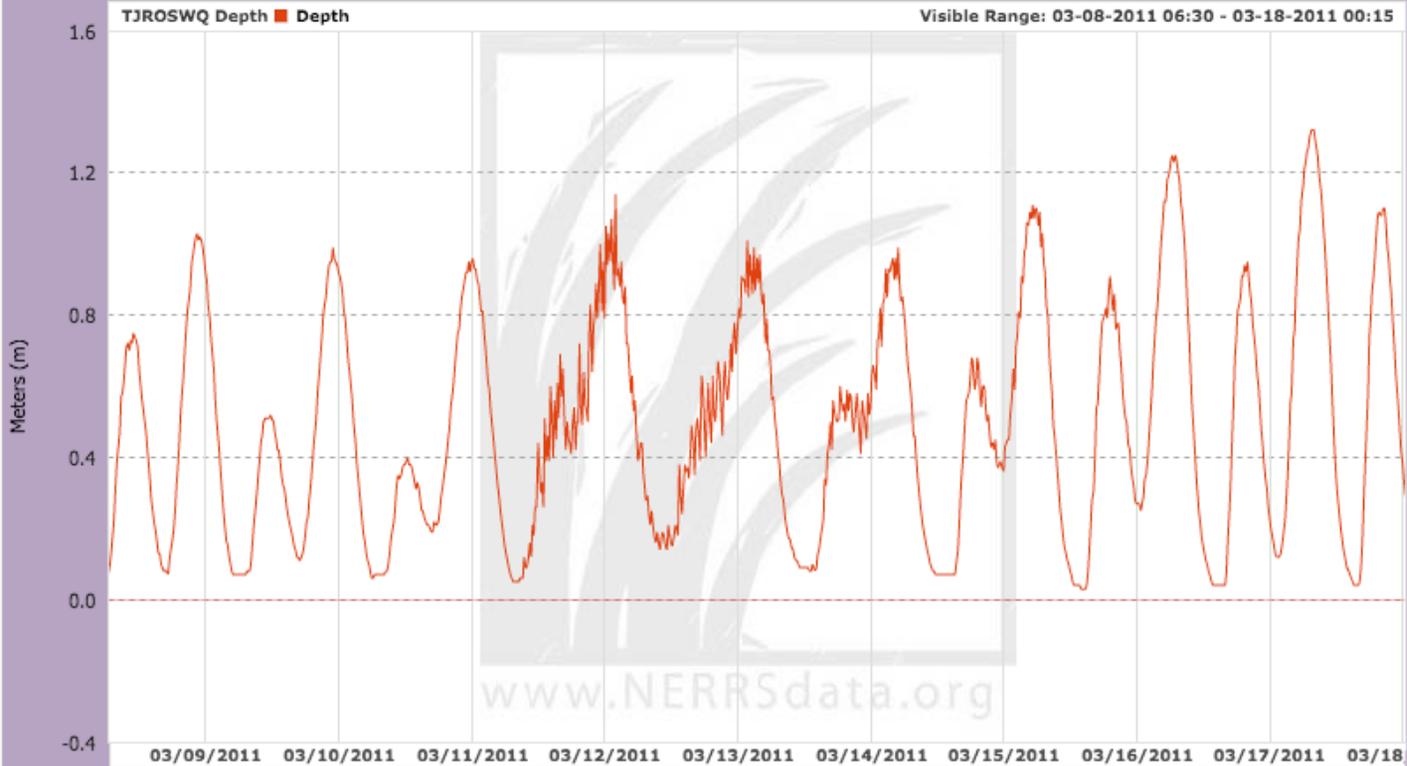
**Data Export System** Powered By The Centralized Data Management Office

[Choose Reserve](#) [Choose Sampling Station](#) [View or Download Data](#) [Submit Info](#) [Complete!](#)

Yearly Files  Export Data  Graph Data  Current Conditions

Please choose how you would like to select your dates:  Custom Dates (Enter below)  Preselected Options (24 hours, etc.)

From: 03/01/2011 To: 03/31/2011 Parameter(s): Depth Optional 2nd Parameter [Graph!](#)



Zoom: [1D](#) [1M](#) [1Y](#) [5Y](#) [MAX](#)

Units:  Metric  English

[About Data](#)

[Save this graph as an image](#)



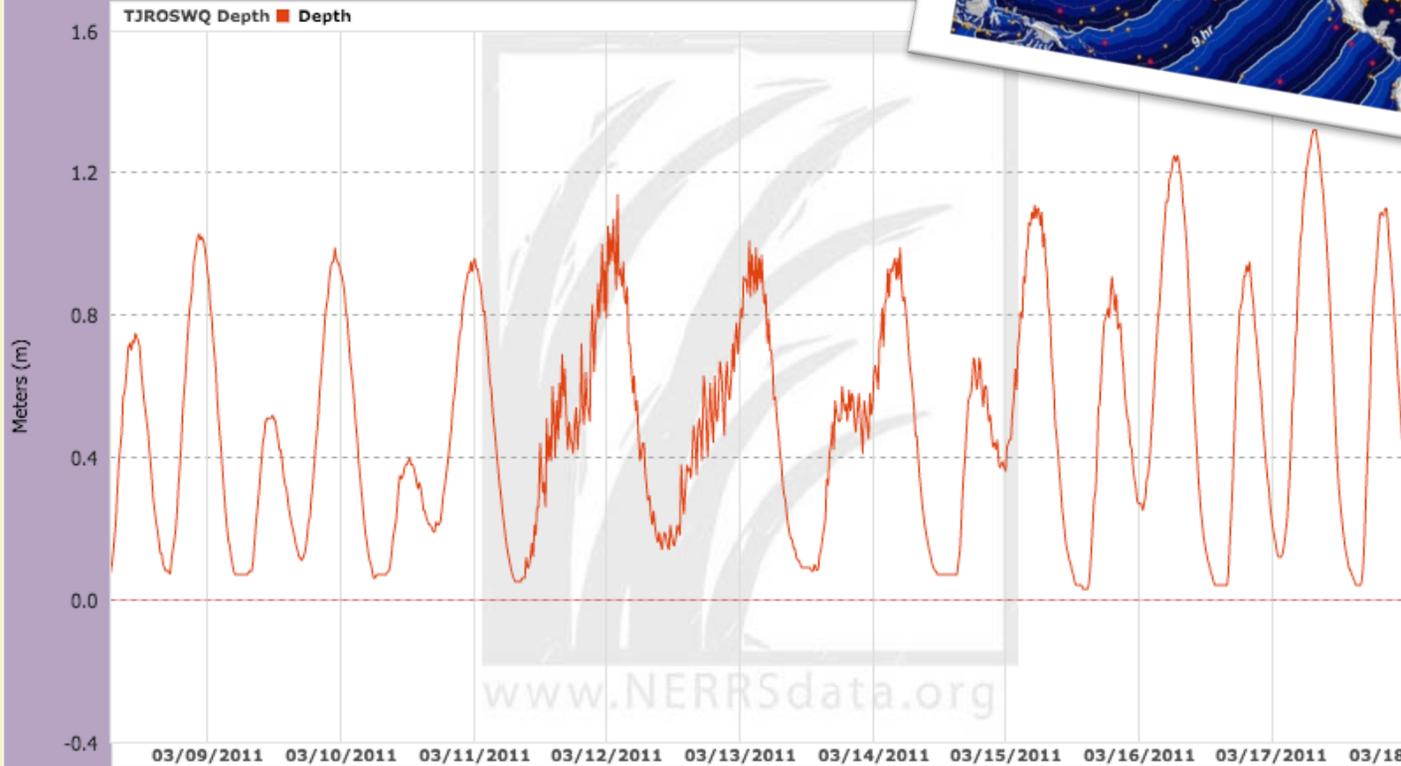
**Data Export System** Powered By The Centralized Data Management Office

[Choose Reserve](#) [Choose Sampling Station](#) [View or Download Data](#) [Submit](#)

Yearly Files  Export Data  Graph Data

Please choose how you would like to select your dates:  Custom Dates (Enter)

From:  To:  Parameter(s):



Zoom: [1D](#) [1M](#) [1Y](#) [5Y](#) [MAX](#)

Units:  Metric  English

[About Data](#)

[Save this graph as an image](#)

### Tsunami warning issued for northern and central California and Oregon; Southern California on watch

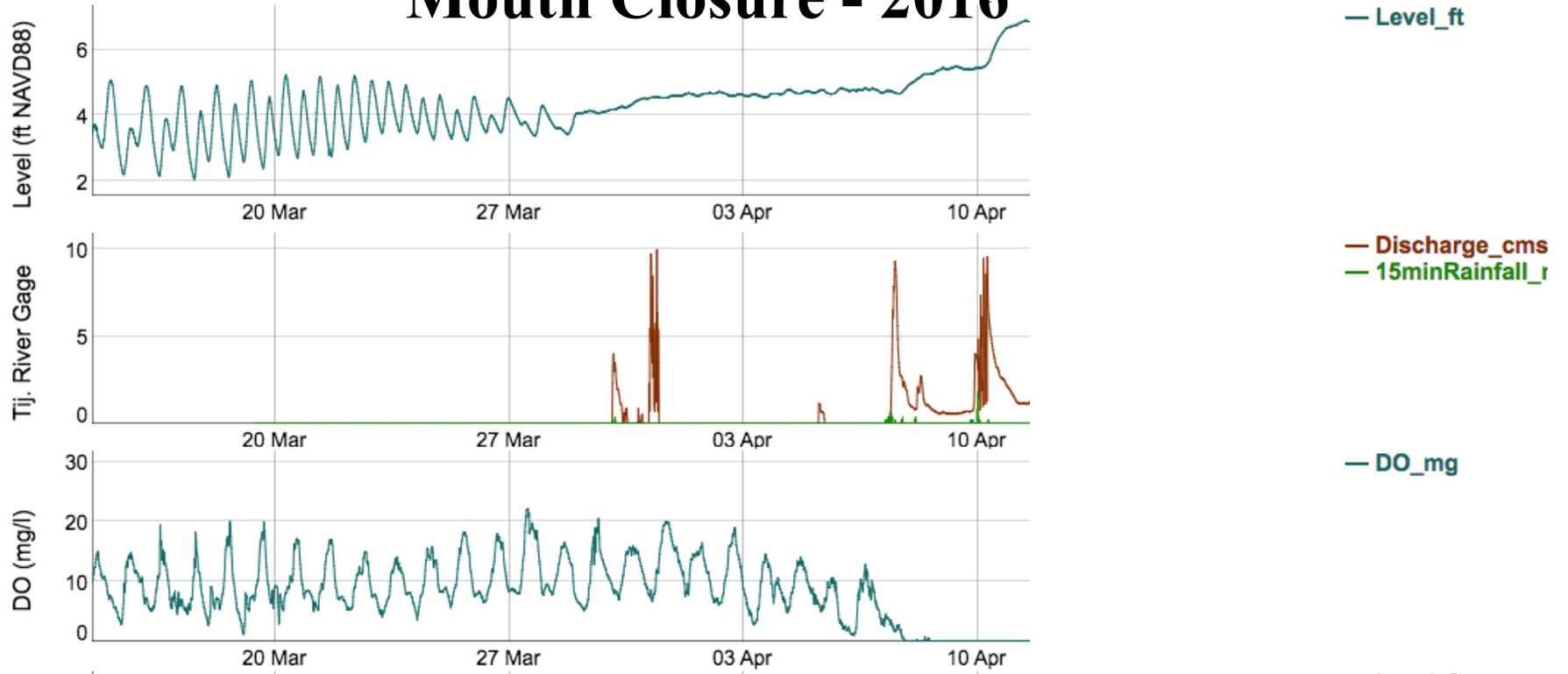
MARCH 11, 2011 | 1:50 AM



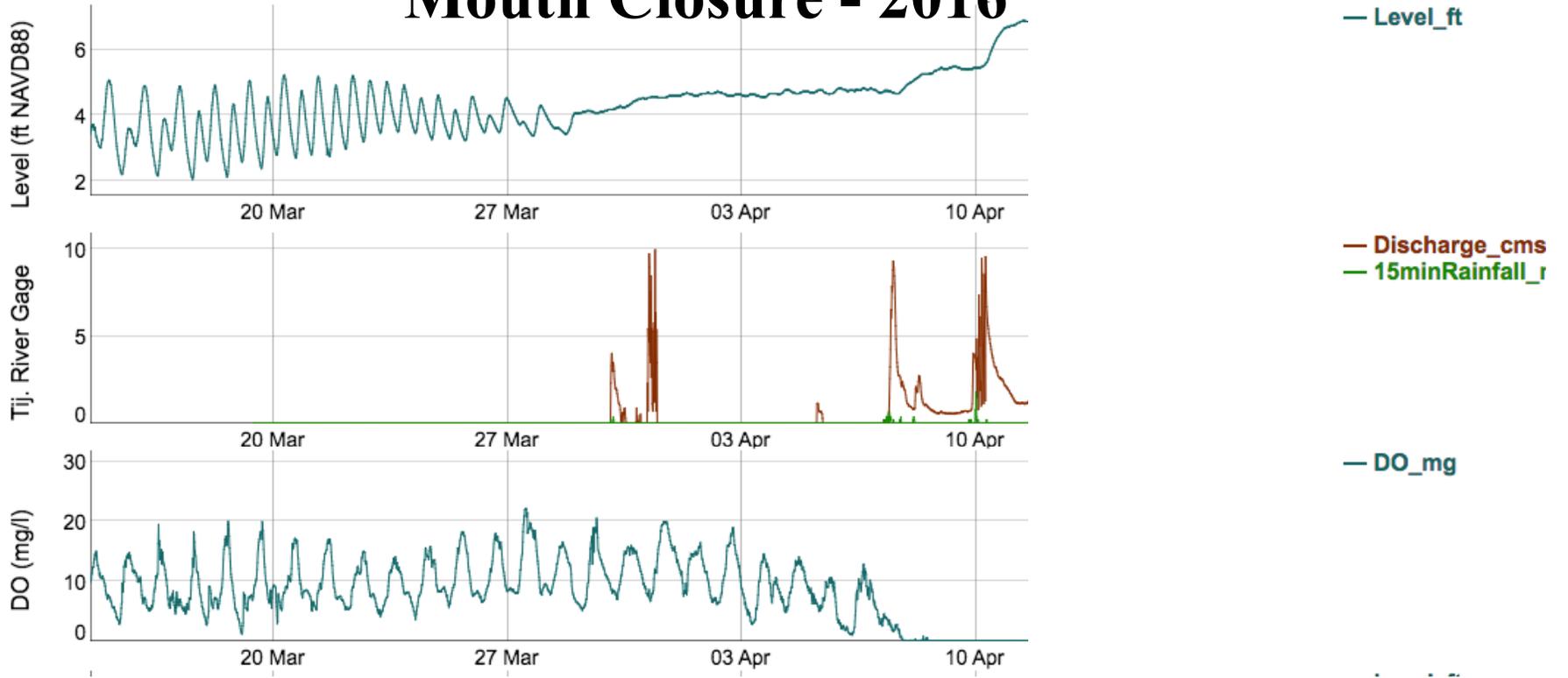


Spring 2016  
Mouth Closure

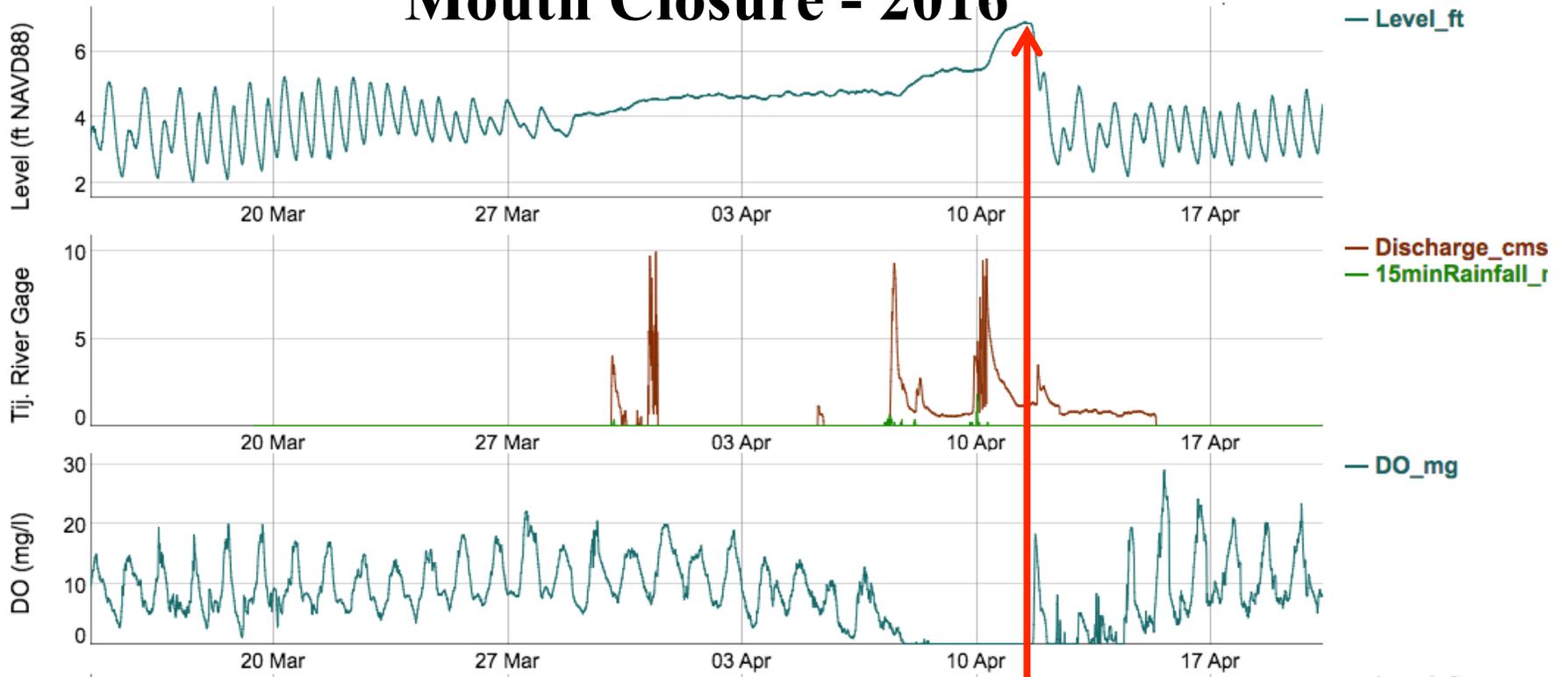
# Mouth Closure - 2016



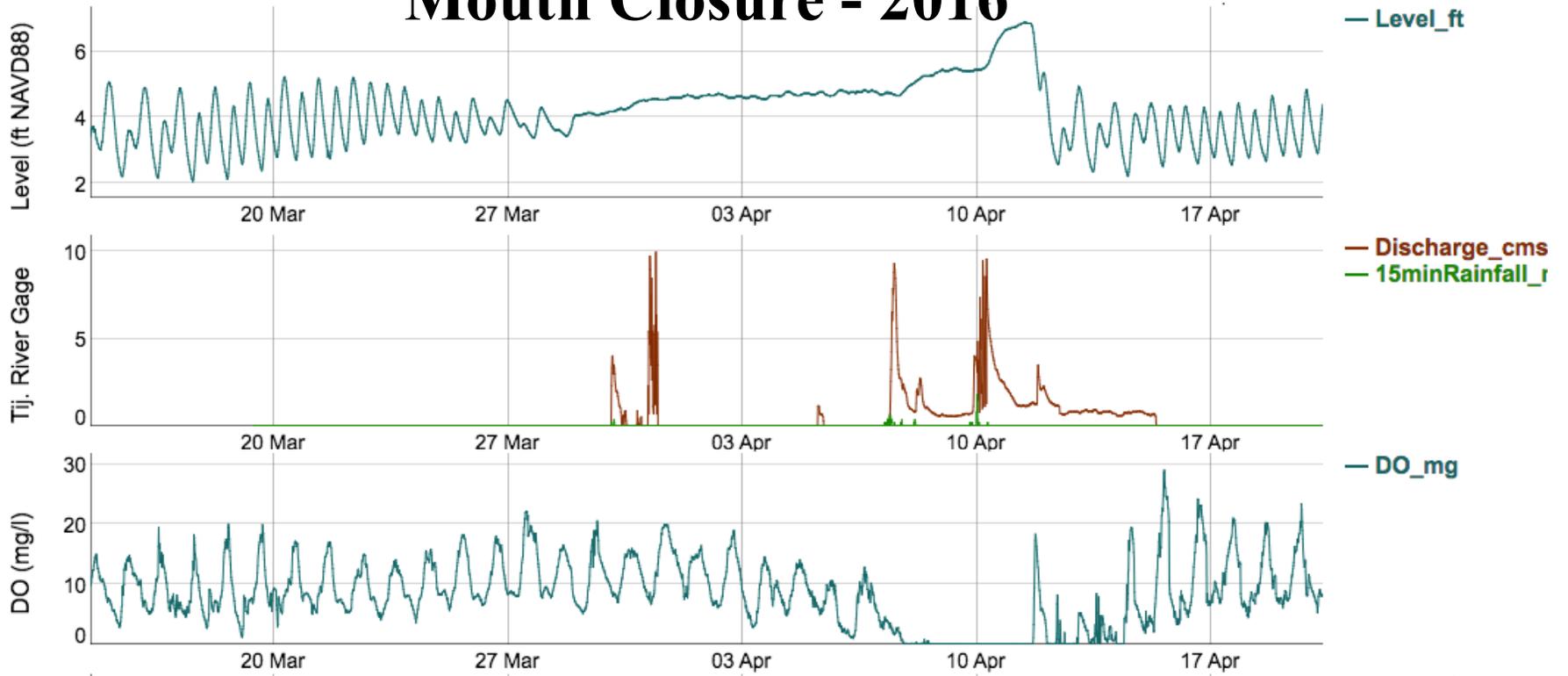
# Mouth Closure - 2016



# Mouth Closure - 2016



# Mouth Closure - 2016



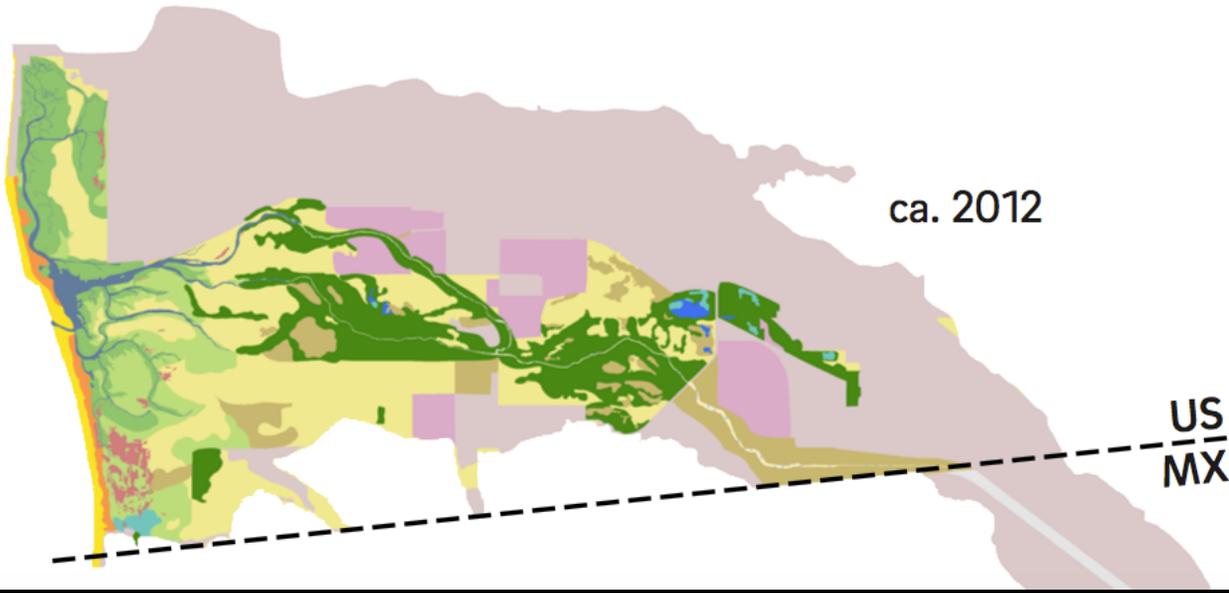
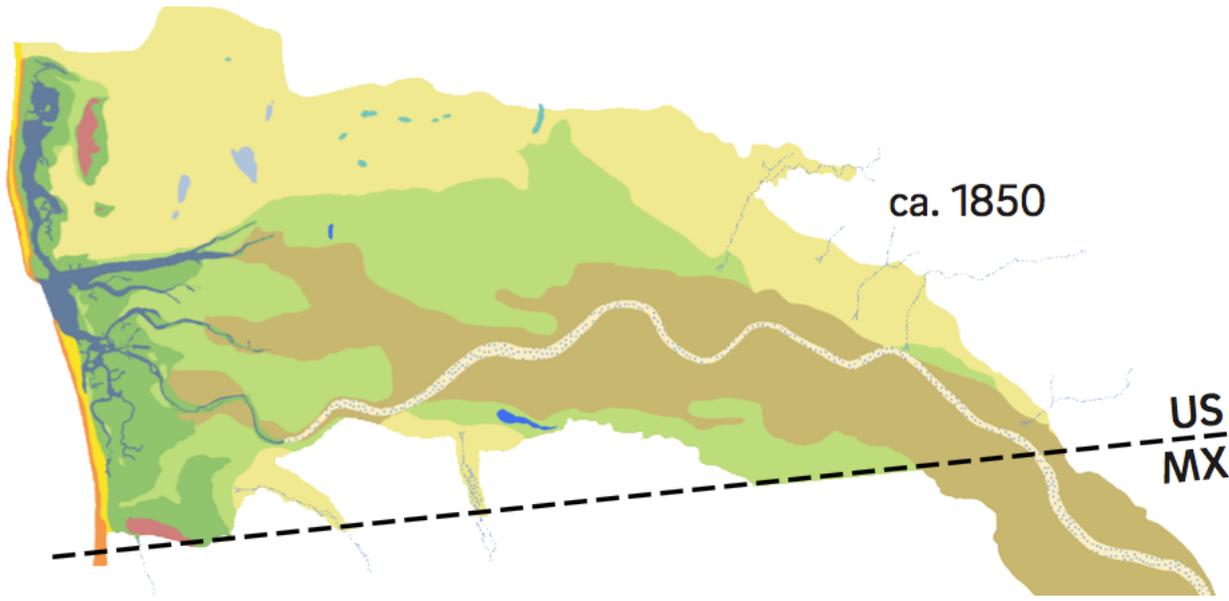
## TJ river mouth reopened after flooding, shark deaths

El Niño conditions pushed enough sand into the mouth of the Tijuana River south of Imperial Beach to close off the flow of the river to the ocean. With the weekend rains water from the closed off estuary was backing up into Imperial Beach streets, forcing an emergency opening of the river mouth with heavy equipment Monday afternoon. After the water receded it became apparent that the oxygen depleted waters had been fatal to many leopard sharks, mollusks and other species that inhabit the area.

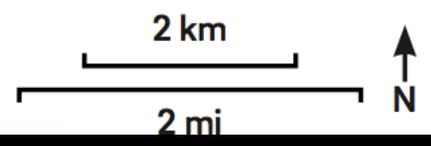


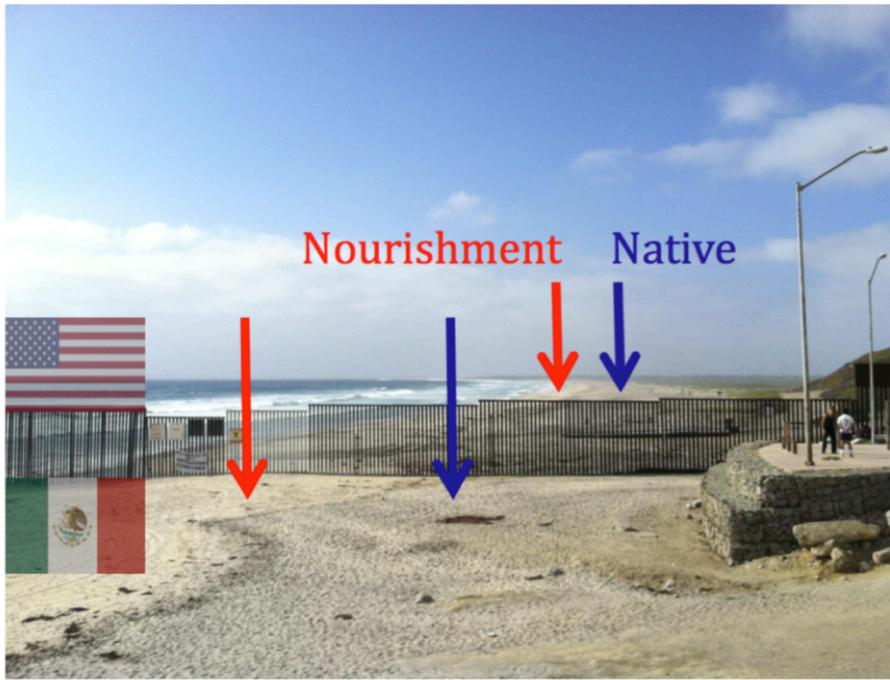
Sea gulls ate the remains of a leopard shark killed when the estuary was closed off from the ocean. -- John Gibbins / San Diego Union-Tribune

Share Gallery



- Dune 
- Subtidal Water & Mudflat/Sandflat 
- Salt Marsh 
- Salt Flat / Open Water 
- River Channel 
- River Wash / Riparian Scrub 
- Alkali Meadow Complex / High Marsh T-Zone 
- Grassland / Coastal Sage Scrub 
- Pond 
- Vernal Pool 
- Perennial Freshwater Wetland 
- Riparian Forest 
- Concrete Channel 
- Agriculture 
- Developed/Disturbed 





Ludka et al. 2013

Imperial Beach Patch



## Ecological 'Heart Attack' Feared if IB Sand Closes the Tijuana River

Experts at the Tijuana River National Estuarine Research Reserve are concerned sand from a recent replenishment project could impact flow of the Tijuana River and threaten life supported by Southern California's largest coastal wetland.

Imperial Beach, CA

Like Share 0

By KHARI JOHNSON (Patch Staff) - February 1, 2013 7:58 am ET

## New sand poses possible threat to Tijuana River

Officials at Tijuana River reserve prepare for worst in wake of replenishment project in Imperial Beach

By Katherine P. Harvey | 11:35 a.m. Feb. 6, 2013

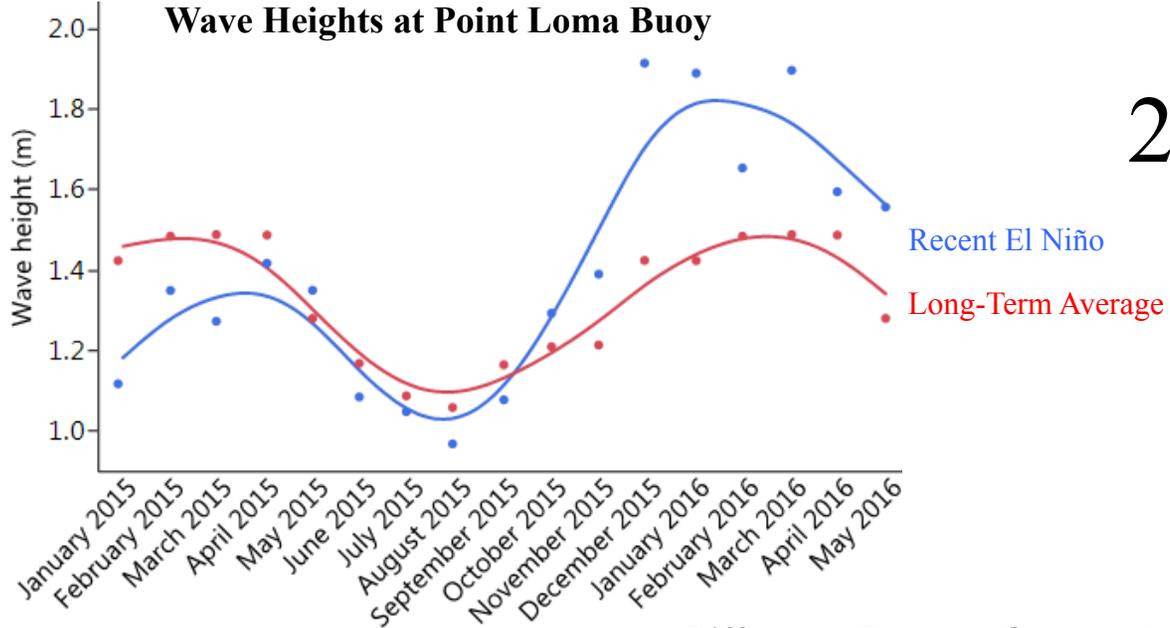


With Tijuana landmarks in the distance a man strolls beside the Tijuana Estuary near where it empties into the ocean. New sand on Imperial Beach is migrating south and threatens to close the mouth of the estuary. — Bill Wechter / UT San Diego

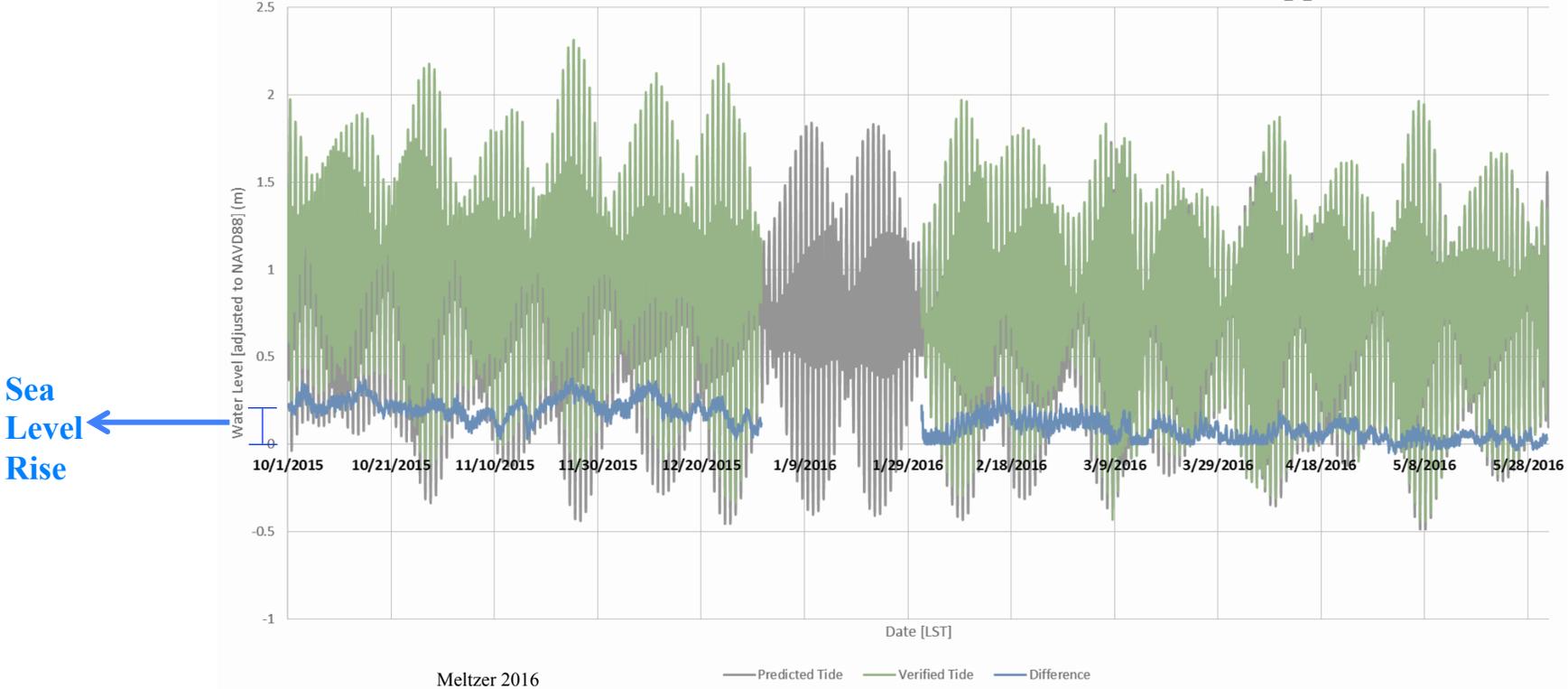
**IMPERIAL BEACH** — While some residents fight to stay afloat after a recent sand replenishment project in Imperial Beach went awry, the keepers of the Tijuana estuary prepare to keep the waters flowing at the river's mouth.

The sand has not yet closed off the estuary, and it might not ever do so, but reserve manager Brian Collins said he and his team are preparing for the worst at the Tijuana River Estuarine Research Reserve.

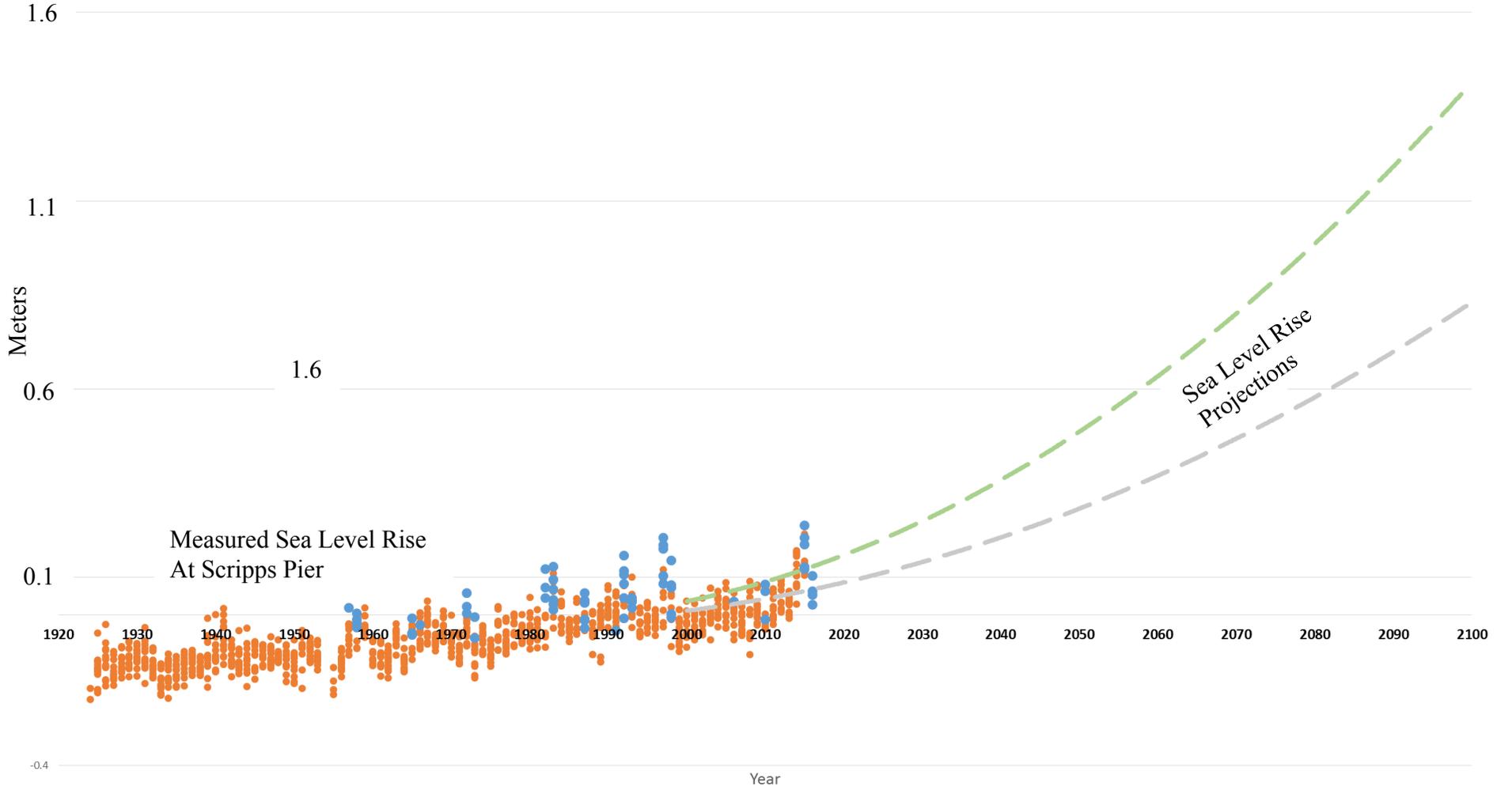
# 2015-2016 El Niño



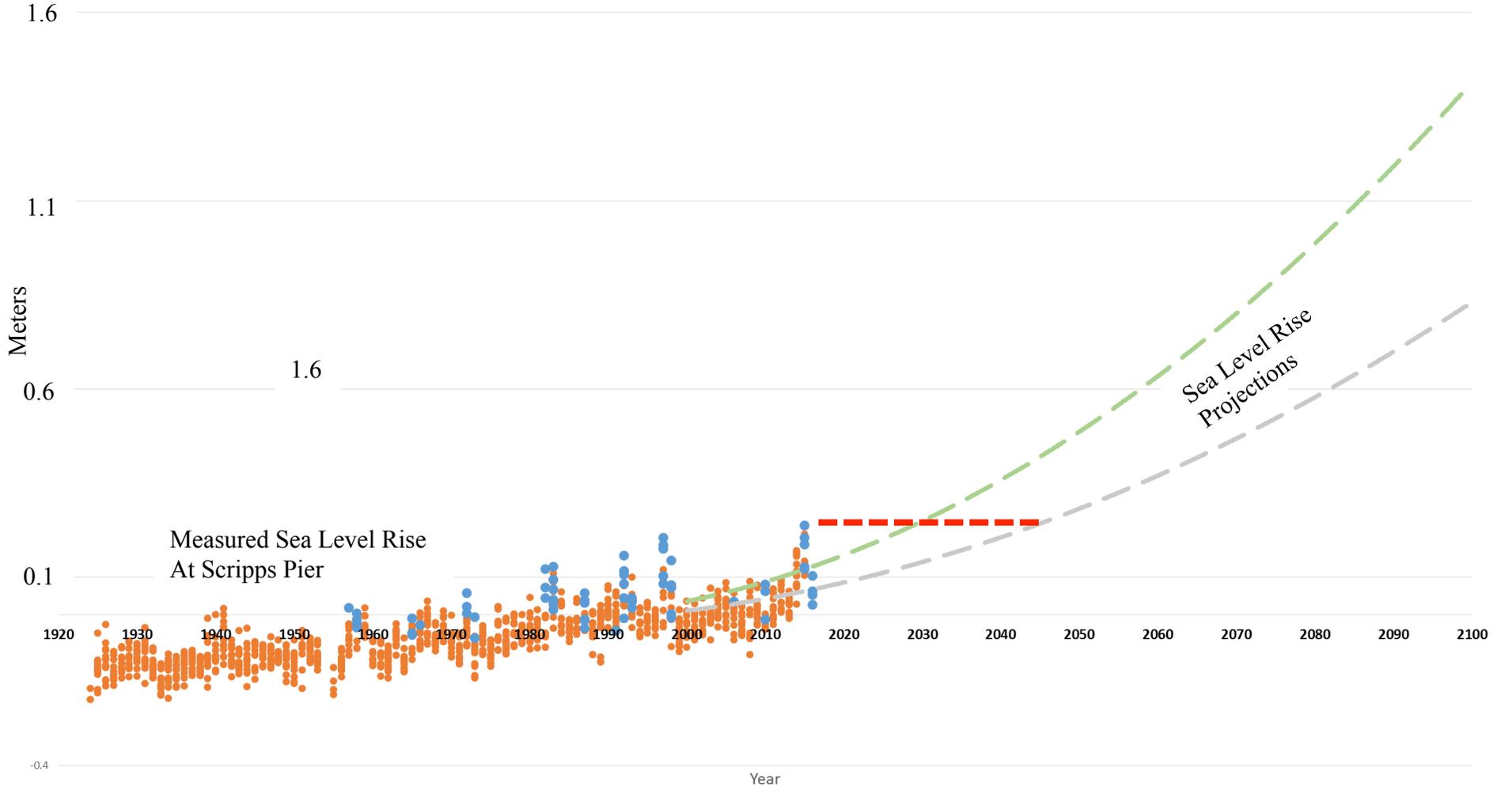
### Difference Between Observed and Predicted Tides at Scripps Pier



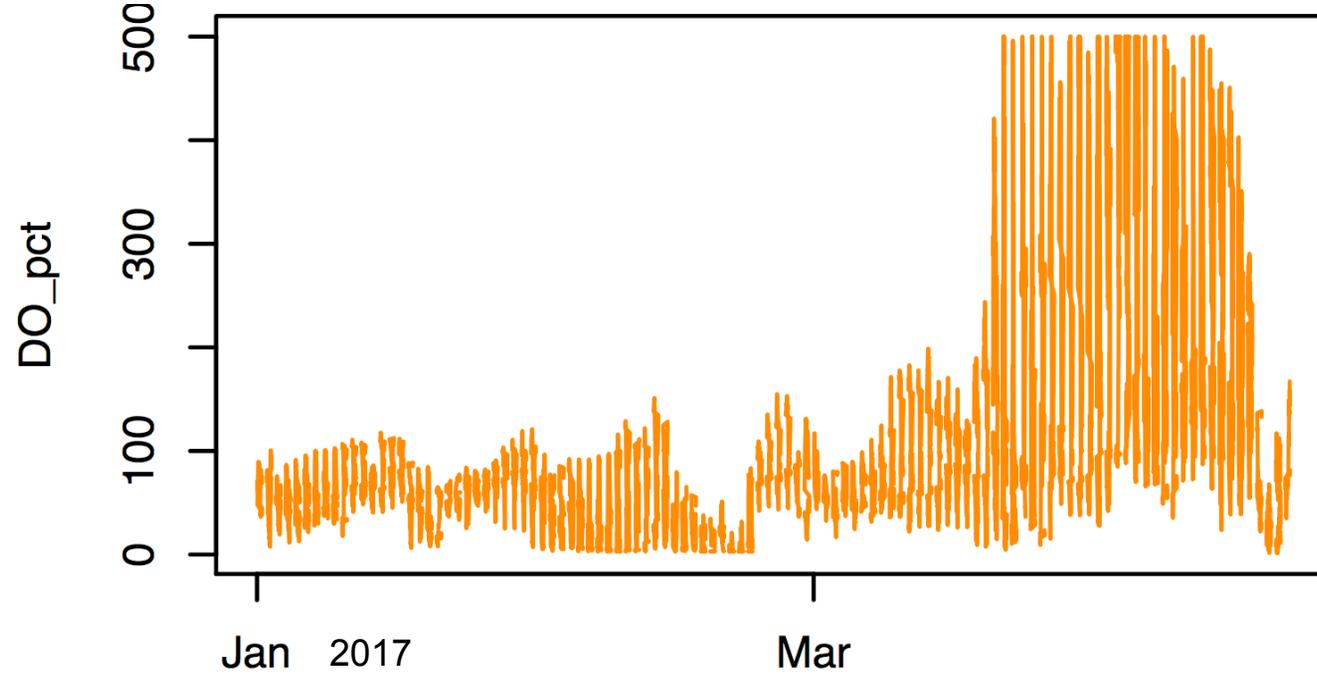
### Southern California Mean Sea Level Trends (MSL) and El Niño



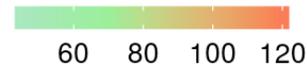
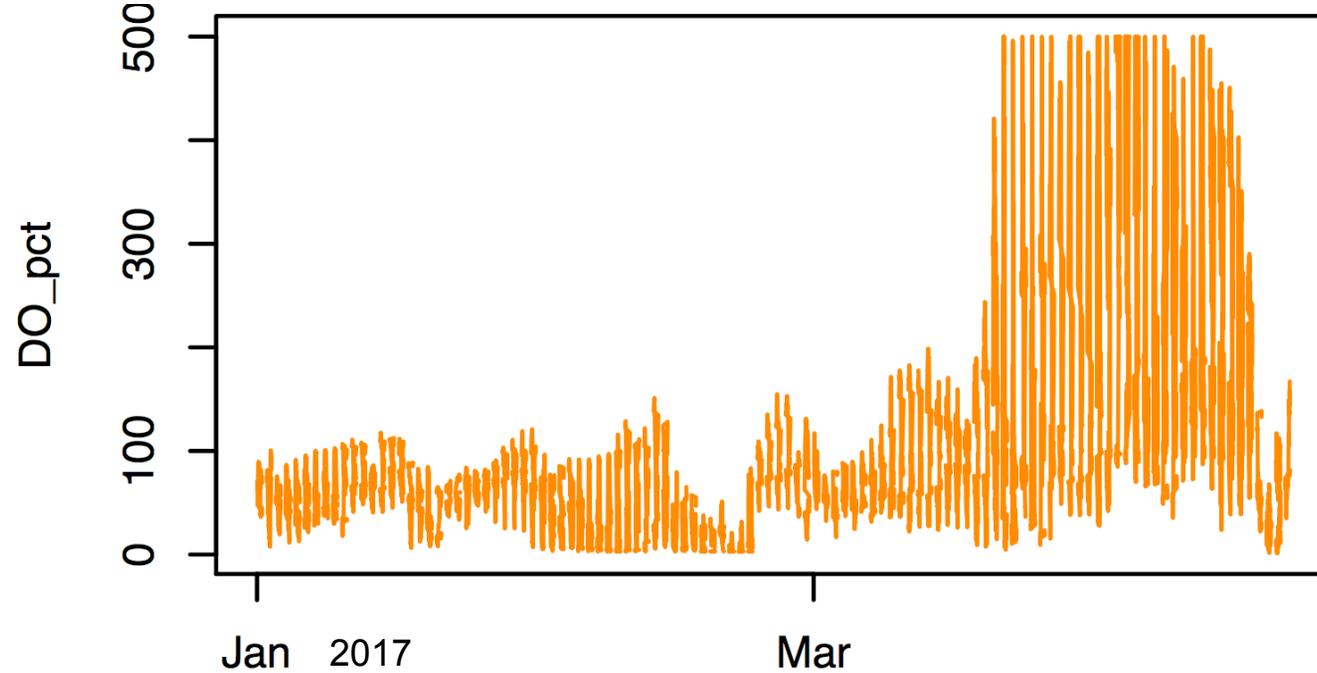
### Southern California Mean Sea Level Trends (MSL) and El Niño



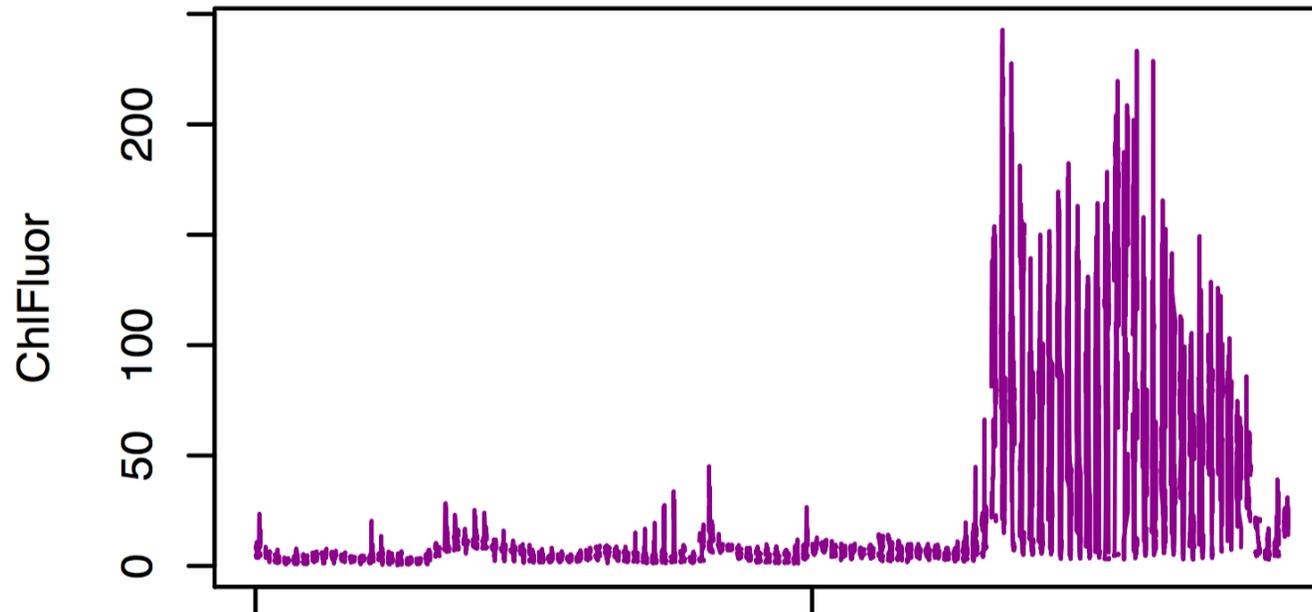
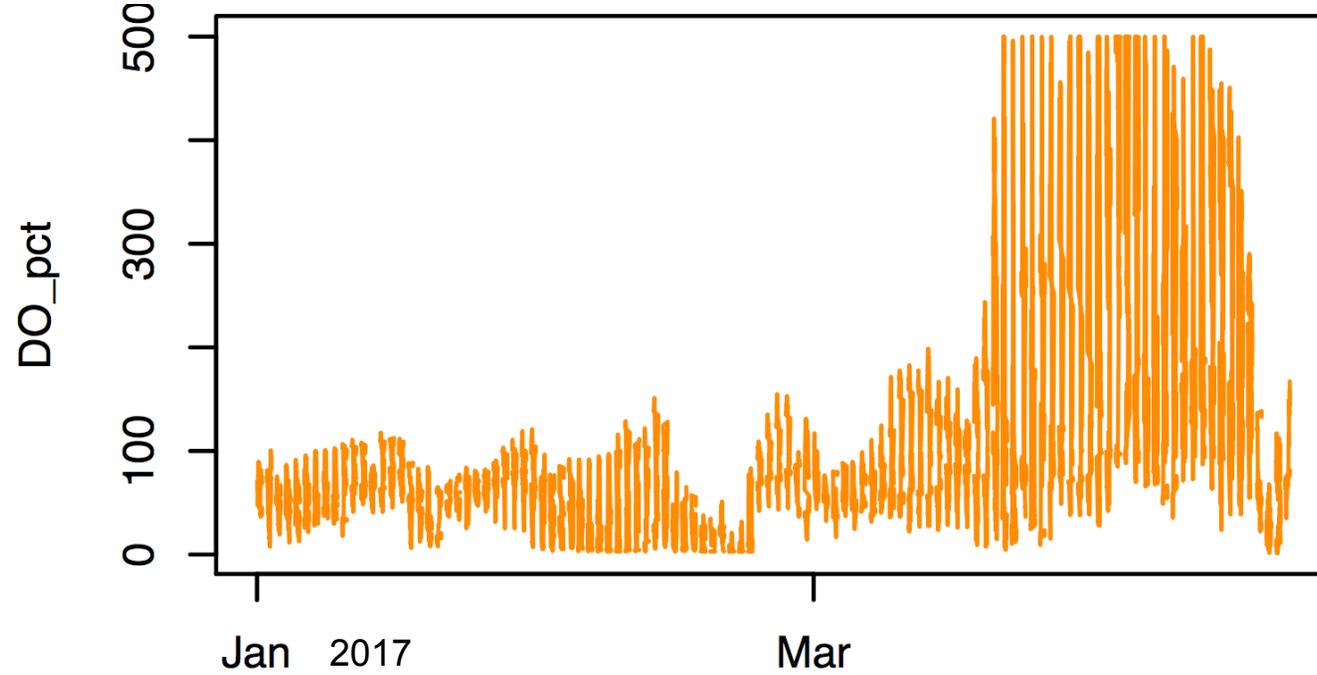
# High Dissolved Oxygen



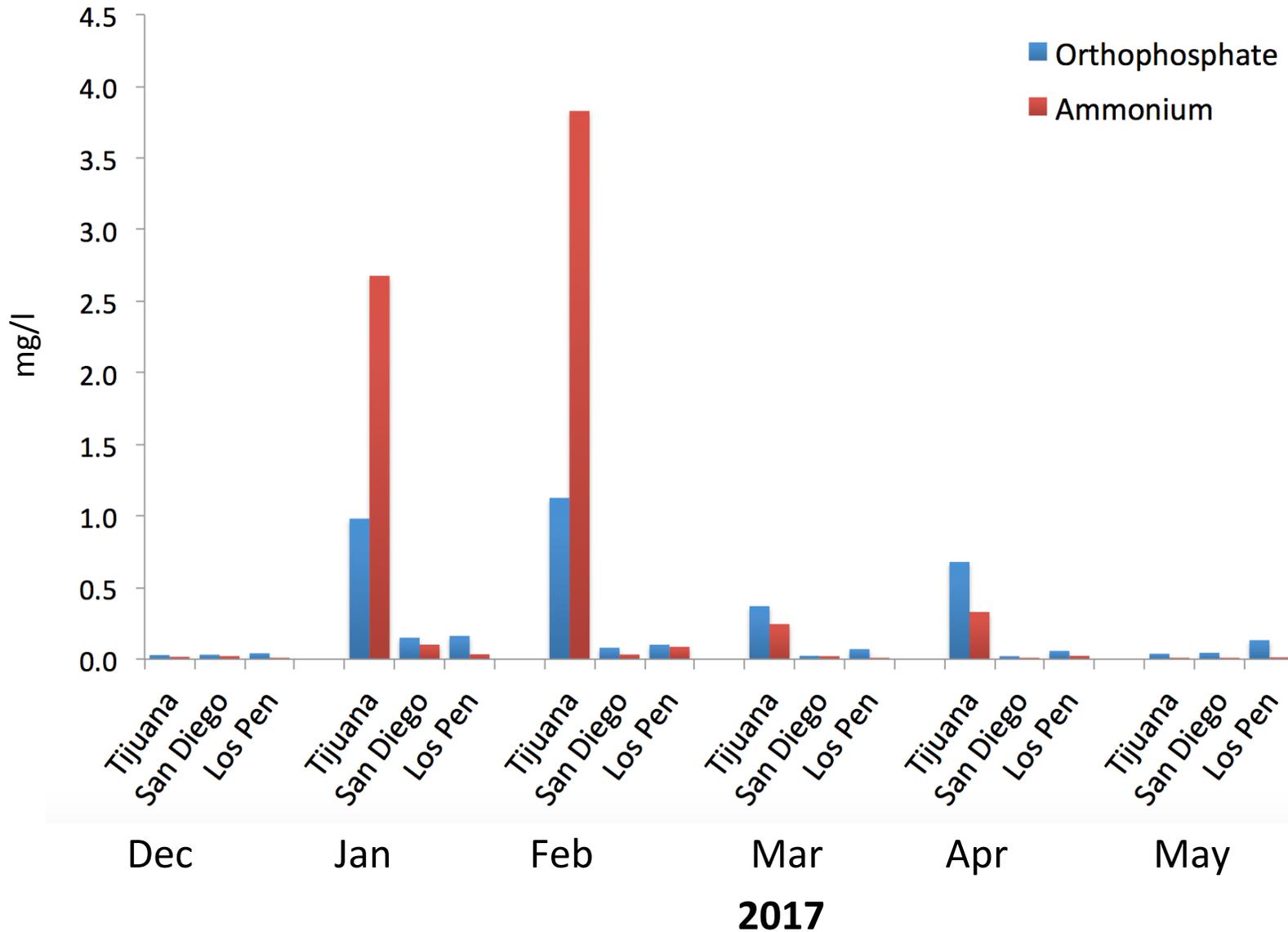
# High Dissolved Oxygen



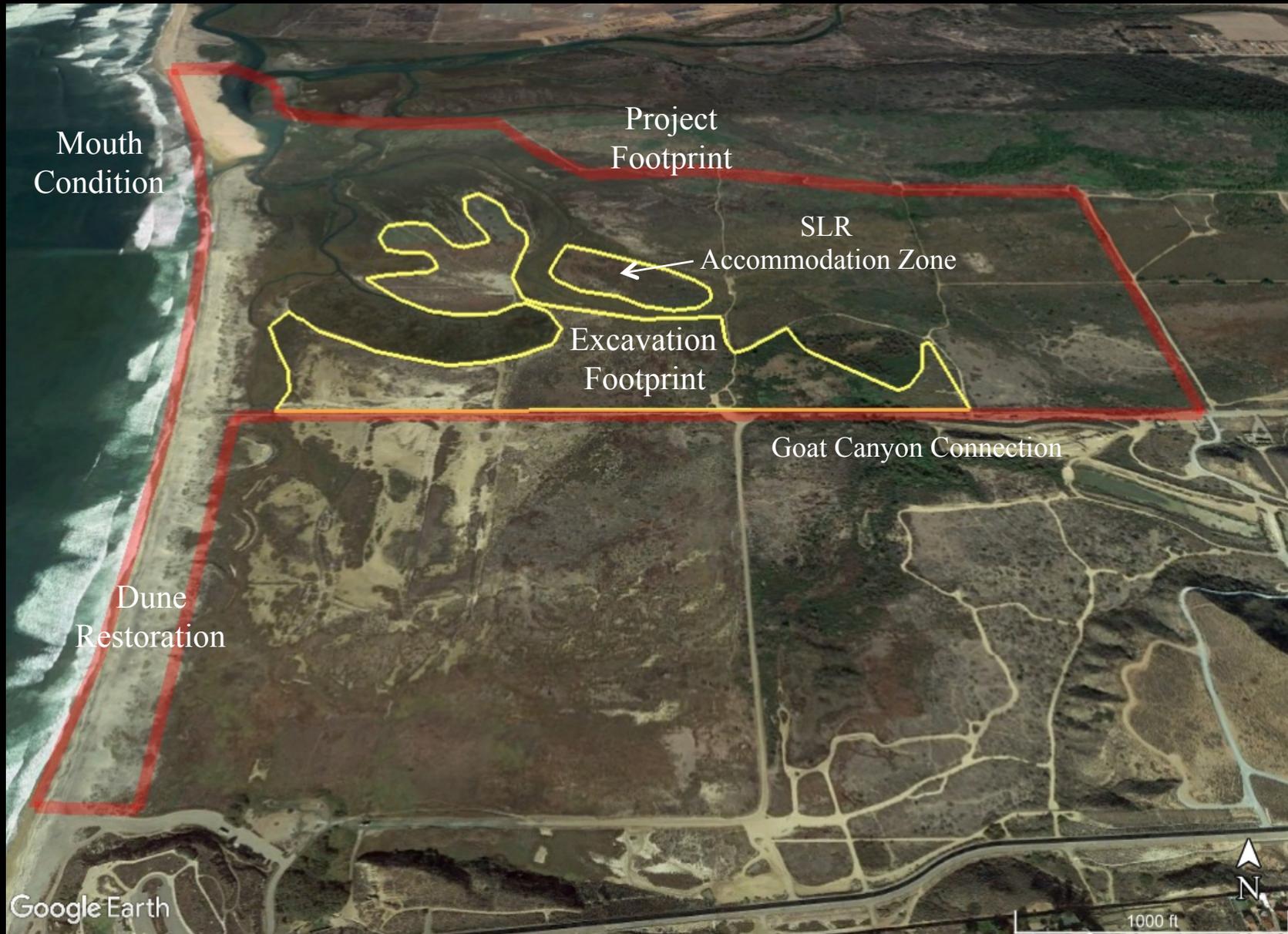
# High Dissolved Oxygen / Phytoplankton Bloom



# Very High Nutrient Loading



# TETRP (Tijuana Estuary Tidal Restoration Project)

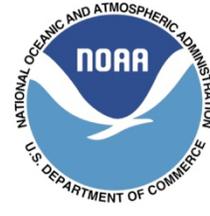


# TIJUANA RIVER NERR LONG-TERM MONITORING



- Serves as an early warning system
- Help steer management
- Track short-term variability, long-term change
- Provide background data for projects
- Stimulate new research ideas

# Partners and Funders



SAN DIEGO STATE UNIVERSITY



The Western Regional Panel  
On Aquatic Nuisance Species



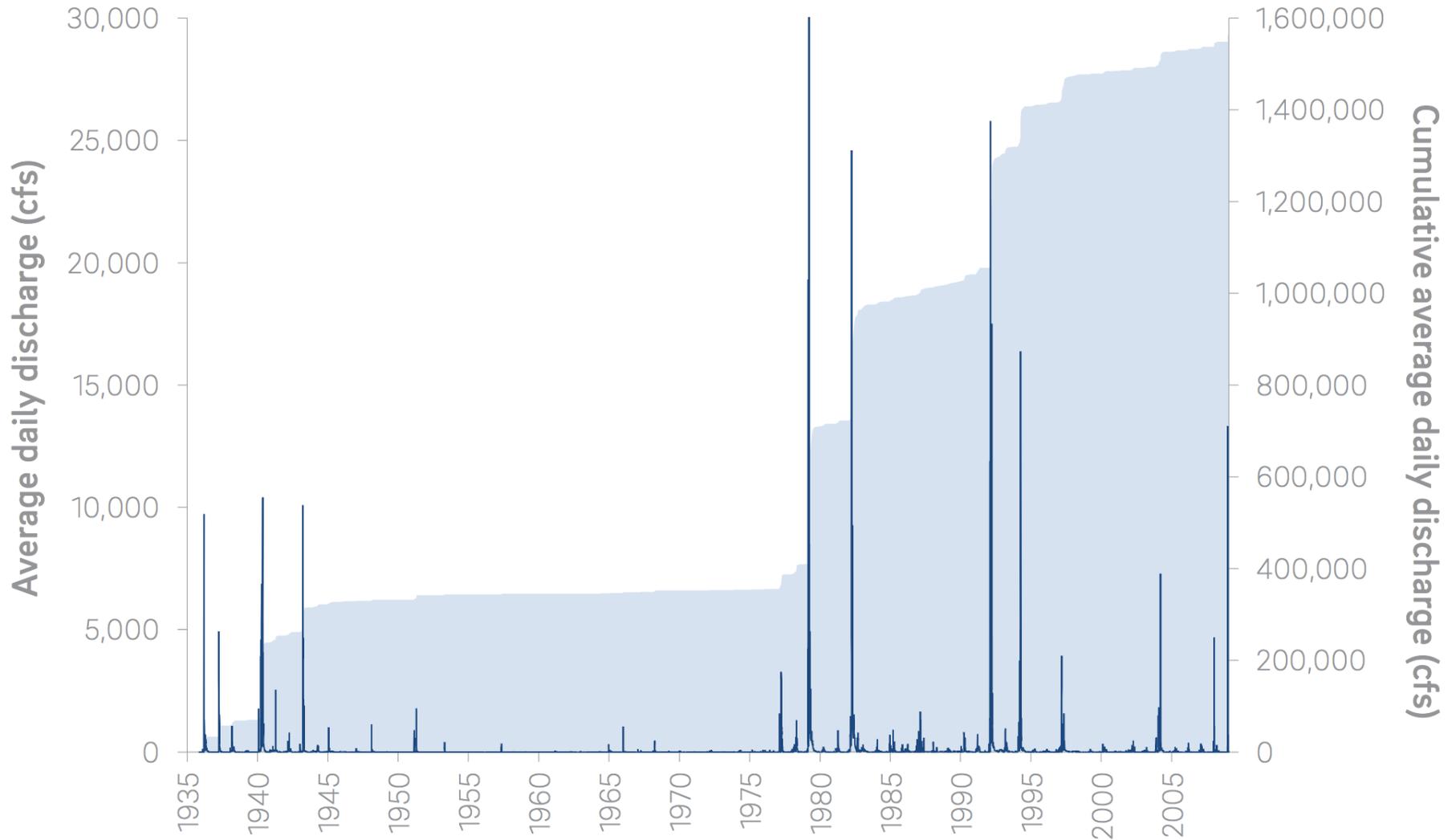
**NERRS Science Collaborative**  
Putting Science to Work in Coastal Communities



**CLIMATE PROGRAM OFFICE**  
Advancing scientific understanding of climate, improving society's ability to plan and respond



# Tijuana River Flow



# NEWS of SOUTHERN COUNTIES

## WATER AT SAN YSIDRO POLLUTED

*Schools Close and People  
Warned as Sewage Effluent  
Contaminates Wells*

SAN YSIDRO, Sept. 16.—Schools were closed temporarily, public drinking fountains were sealed and housewives warned to boil all drinking water today by County Health officials after it was learned that the water supply of this community was contaminated by Tijuana sewage effluent.



# Climate Understanding & Resilience in the River Valley

Conduct Vulnerability Assessment

Develop Climate Adaptation Strategy

Focus on:

- **Sea Level Rise / Effects on Tidal Prism**
- **Riverine Flooding**



More extreme  
river flow events

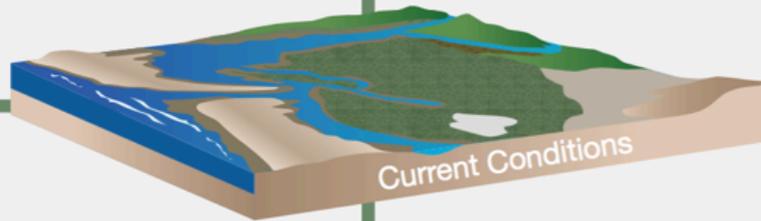


Scenario A: Lake Tijuana



Scenario B: The Sea Around Us

Decreased  
tidal prism

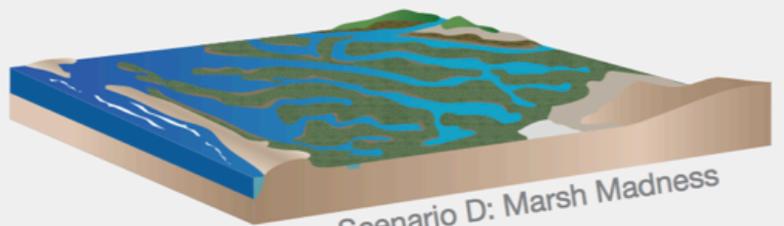


Current Conditions

Increased  
tidal prism



Scenario C: Salt of the Earth



Scenario D: Marsh Madness

Fewer extreme  
river flow events

# Scenario A: Lake Tijuana

Increased extreme river flow events  
Decreased tidal prism

A river mouth that remains mostly closed limits the exchange of water between the river and the sea, and tends to form a large lake in the lower valley. With nowhere to go, water and sediment entering from upstream collects and can cause severe flooding in the upper valley. Extreme events temporarily open the mouth and flush the collected water. Sea level rise impacts are limited as sedimentation helps the land rise quicker than the sea. However, beachfront areas are still affected, and when sea level rise is coupled with riverine flooding the results can be extremely destructive.

## Changes to the Physical Environment

### River-Ocean Connection & Water Residence Time

The river mouth is mostly closed, trapping water in the system for long periods of time. The mouth is opened periodically during storm events that create extreme river flows and flush the system.

### Flooding, Inundation, & Sediment Dynamics

Severe riverine flooding impacts the entire valley as extreme river flow events increase freshwater inputs and water ponds behind the closed river mouth. There is potential for dramatic restructuring of the valley as new river channels are created during storms and other channels filled in due to sedimentation.

### Surface- & Ground-Water Salinity

There is an increased freshwater influence with variable conditions experienced during periods of mouth closure.

## Example Management Challenges

Relating to Increased Extreme River Flow Events

### Transportation

Access in the valley is frequently impaired by excess sediment and flooding, obstructing emergency evacuation routes, roads, bridges, and trails. This may lead to a need for more resources for emergency rescue operations.

### Sediment Management

Large amount of sediment transport during extreme river flow events possibly overwhelming current sediment management Best Management Practices.

## Changes to the Natural Environment

Beaches, Sand Dunes, & Salt Flats  
Slight increase.

### Open Tidal Channels & Mudflats

Limited saltwater influence and rising elevations due to sediment aggradation result in large decreases in habitat.

### Salt Marsh

Limited saltwater influence and an increase in freshwater inputs result in large decreases in habitat area.

### Wetland-Upland Transition

Increased freshwater inputs cause a large decrease in these habitats as they transition into fresh and brackish marsh.

### Fresh and Brackish Marsh

As freshwater collects behind the closed mouth, fresh and brackish marsh areas increase in size.

### Upland

Sediment aggradation outpaces sea level rise causing a large increase of upland areas in the lower valley.

### Riparian

Increased freshwater inputs from extreme river events in the upper valley result in large increases in riparian areas.

Scenarios are not predictions but are alternative representations of how the future may unfold in response to potential climate and environmental changes. For more details visit: <http://www.tnerr.com/curr/>.

