The Year of Crazy—Droughts, Blooms, Warm Blobs, and other Anomalies in the Eastern Pacific

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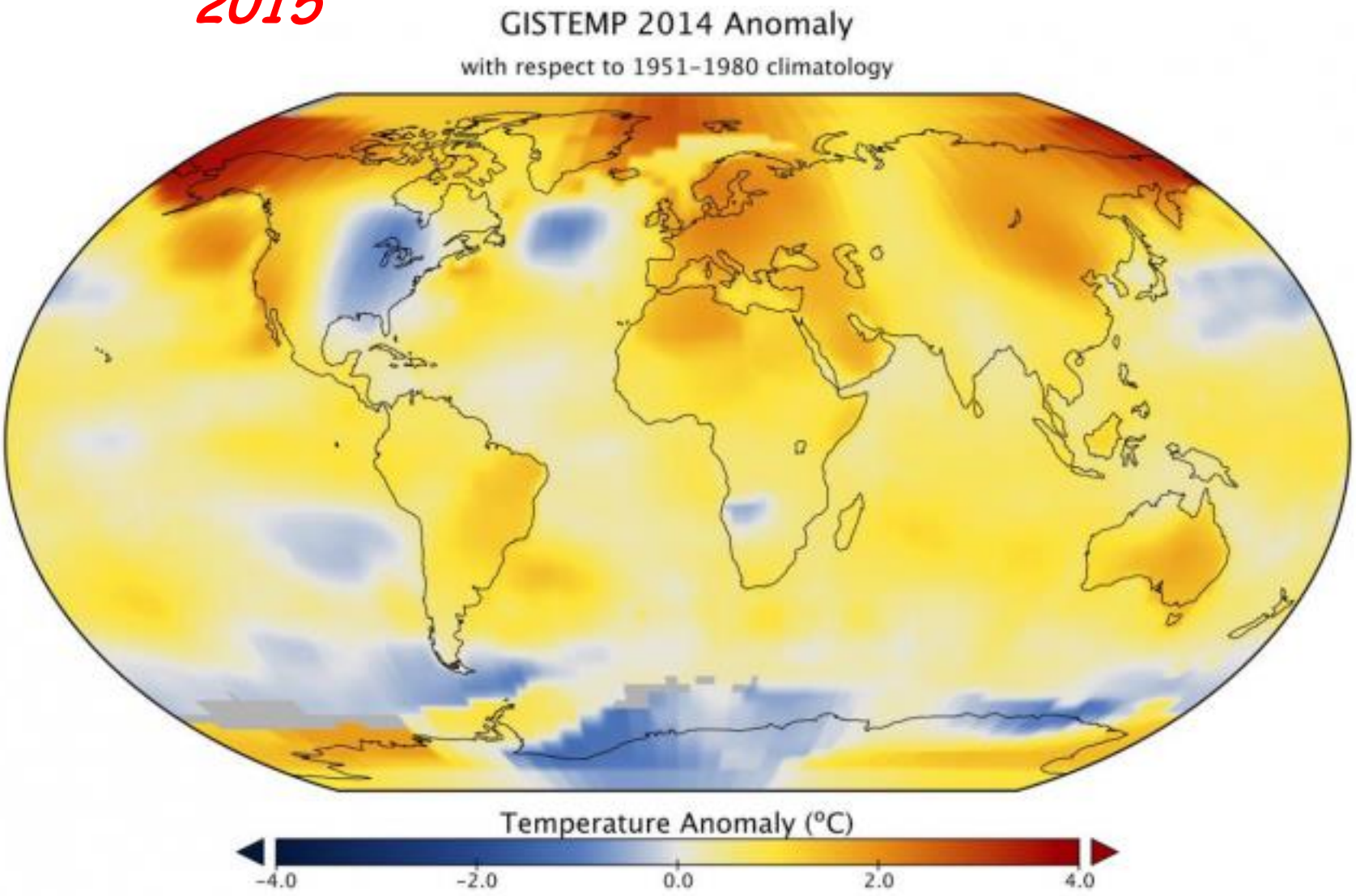
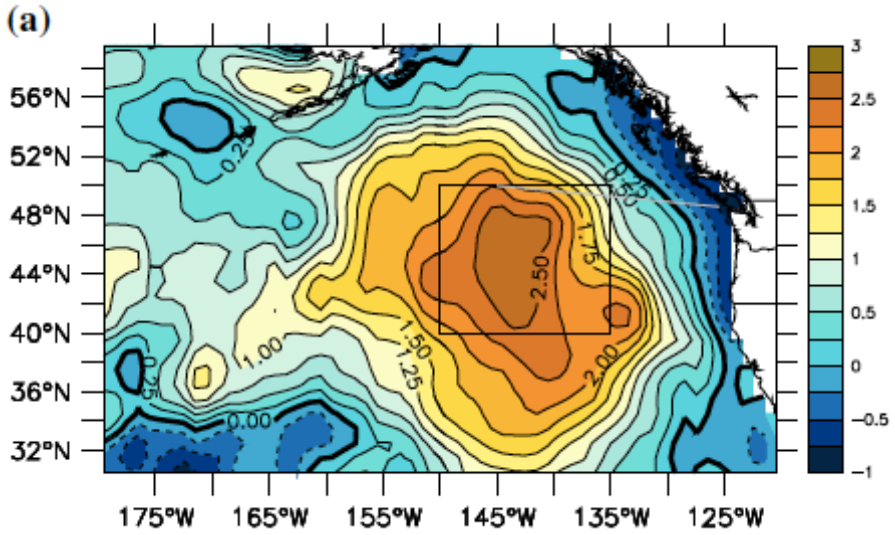
http://oceandatacenter.ucsc.edu/

2014: The Warmest Year In the Modern Record

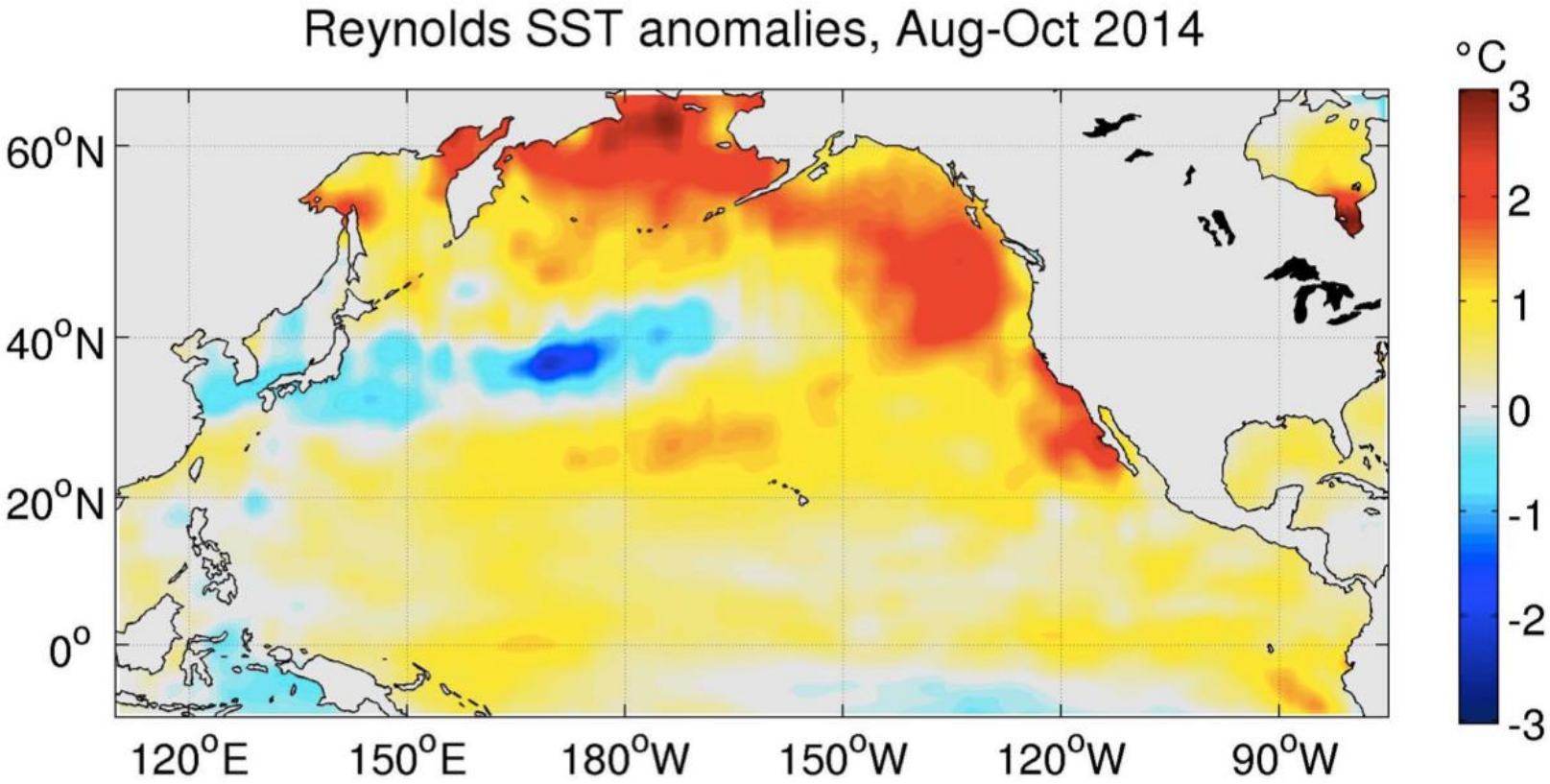
2015





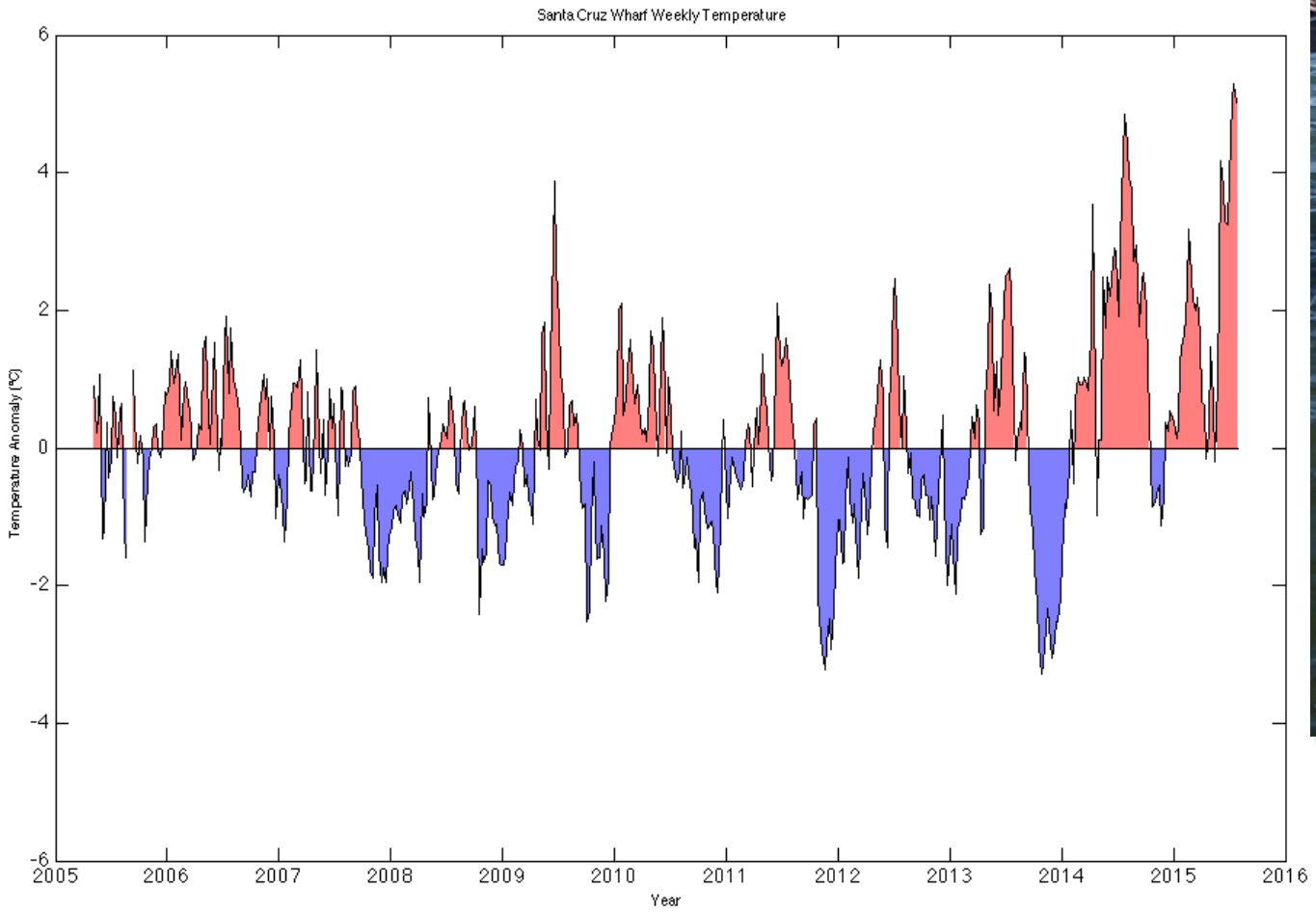
SST Anomaly, February 2014

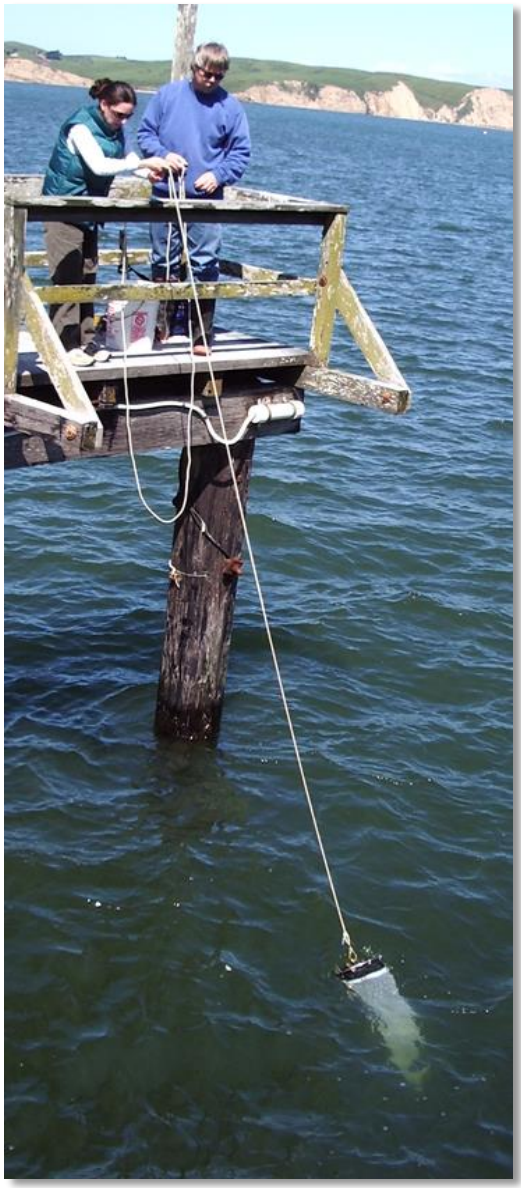
Bond et al. GRL 2015



Santa Cruz Municipal Wharf Time Series

Weekly Observations Since 2002





The Summer of Crazy

Tags: *whales* *whale watching* *humpback* *anchovies* *domoic acid* *El Nino*

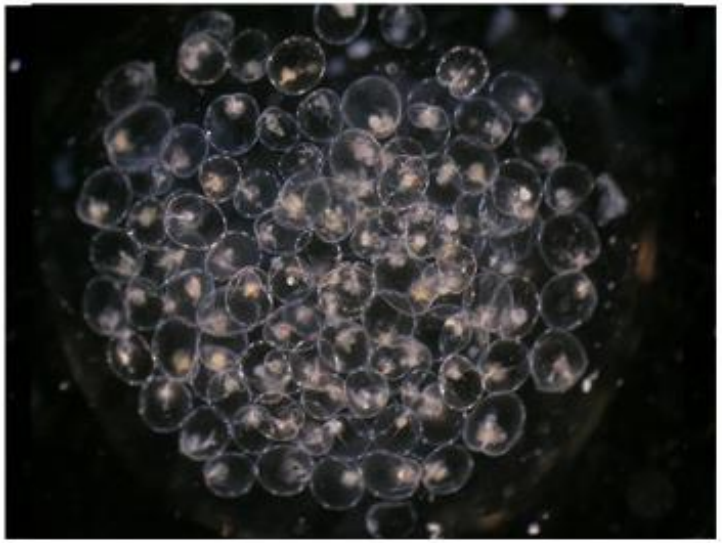
Humpback whales are crowding close to shore this summer in search of food. Photo courtesy Surfrider Foundation/Amber Jones.

http://www.hilltromper.com/article/monterey-bay-weird-summer-2014-whales-anchovies-algae

haddock@mbari.org

http://lifesci.ucsb.edu/~biolum

http://jellywatch.org



Beachings of exotic blue velella tied to wind patterns

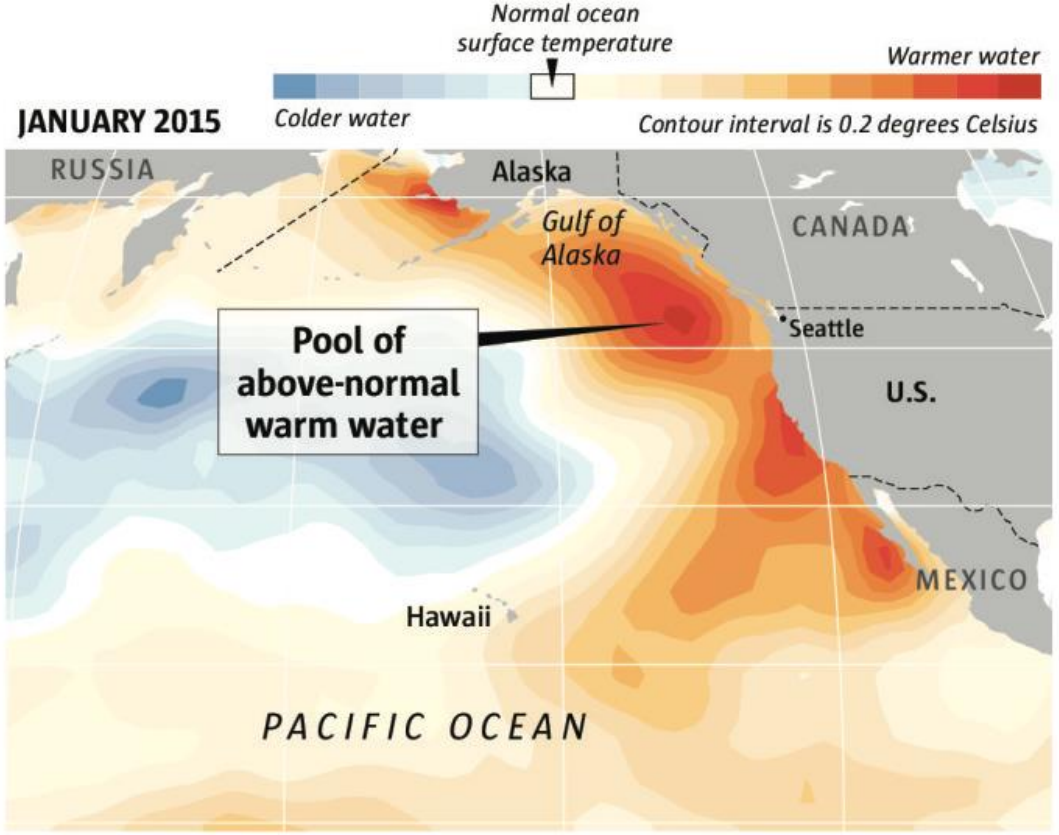
Velella, probably carried by wind, a reminder of ocean's diversity

Hamed Aleaziz Updated 7:14 pm, Thursday, July 31, 2014

Green stuff on Seaside beach probably common marine algae

The blob off our coast

Scientists say a vast pool of warm water off our coast is affecting marine life and local weather, and is part of a bigger pattern that includes California's drought and East Coast blizzards.



Source: Department of Atmospheric Sciences, University of Washington

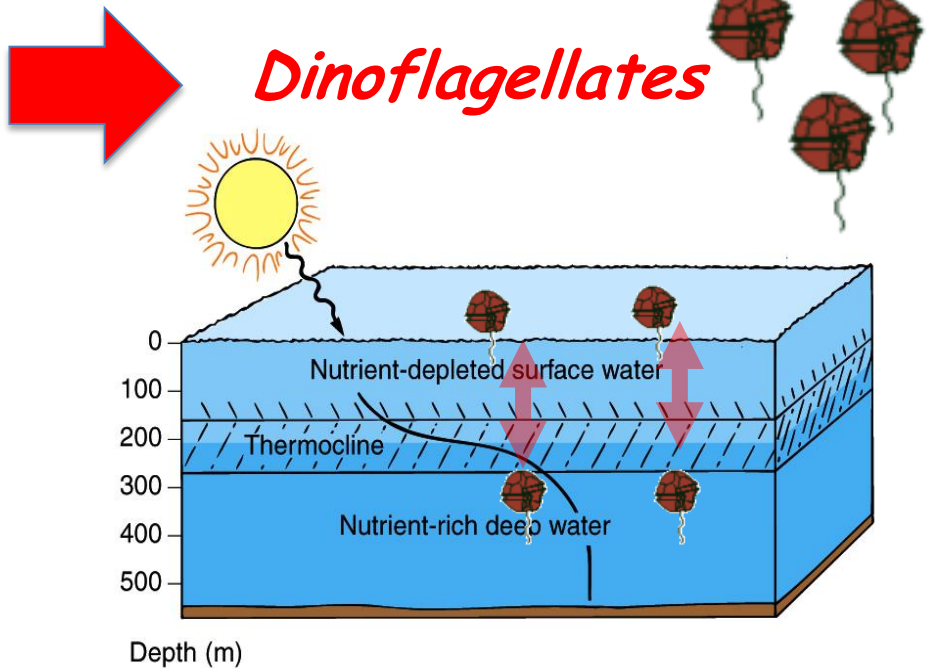
MARK NOWLIN / THE SEATTLE TIMES

DROUGHT WATCH 2015

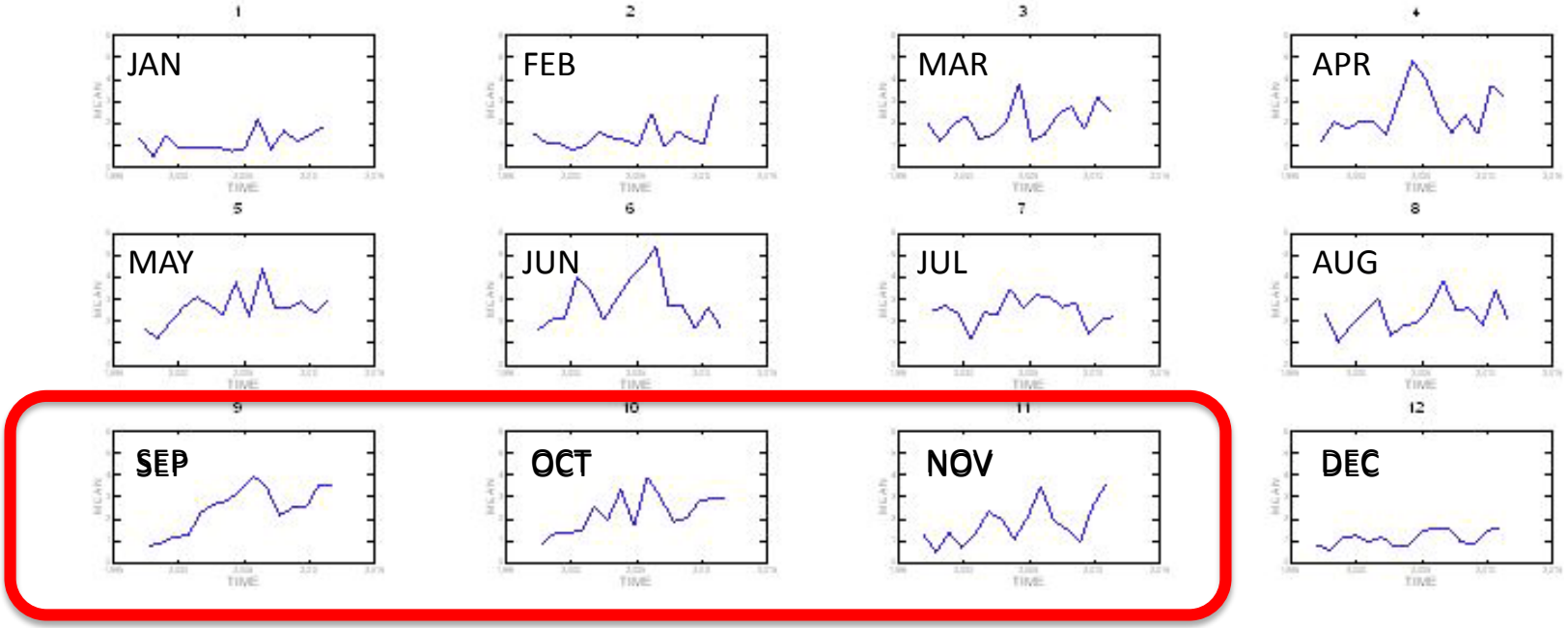
El Niño Update: California's 'Great Wet Hope' Continues to Build

Decadal Trends in the California Current:

- Mixed Layer Depth is shoaling
- Surface temperatures are increasing
- Stratification intensity is increasing
- Nutrient concentrations, ratios shifting



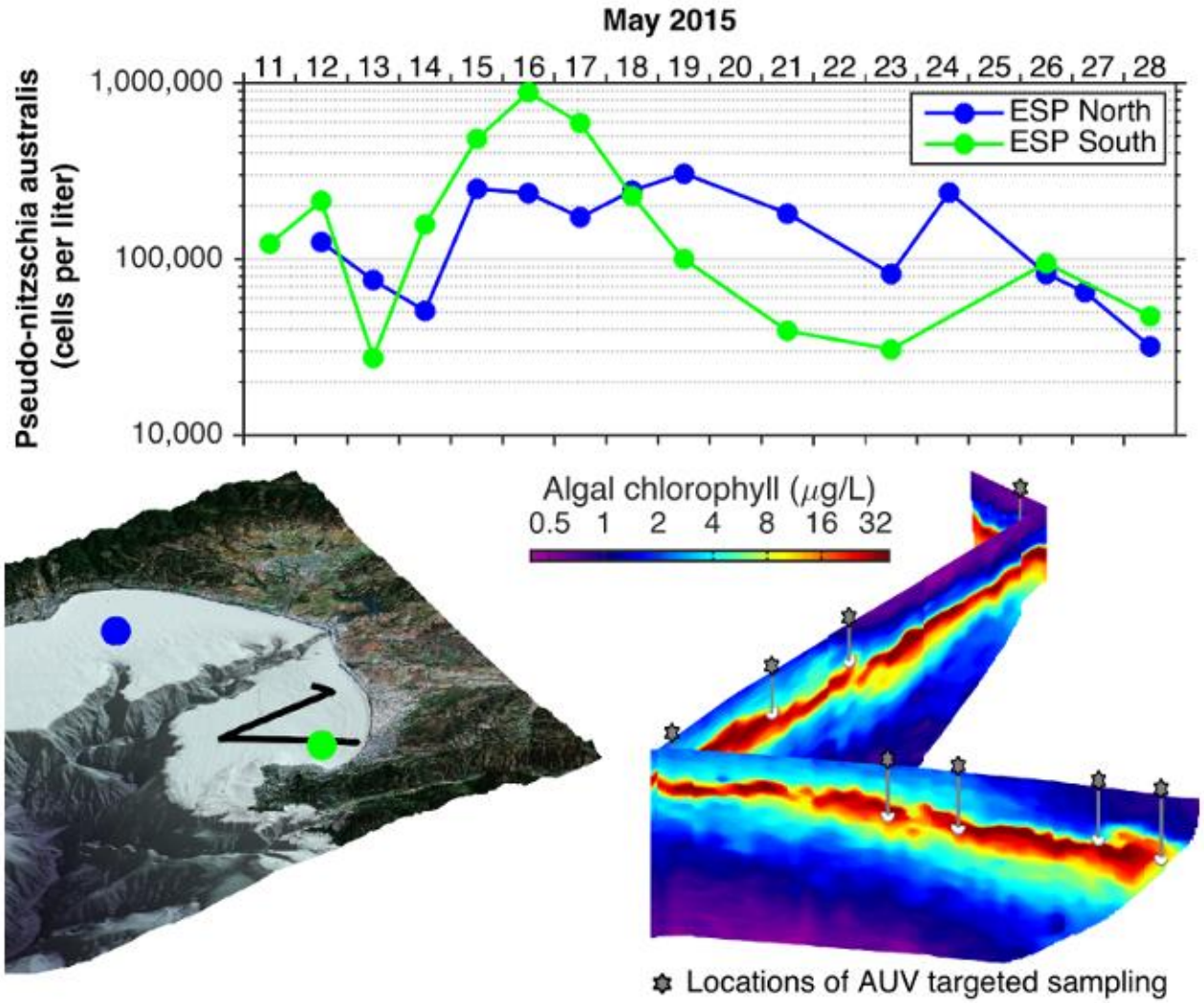
Mean Monthly Trends in Chlorophyll



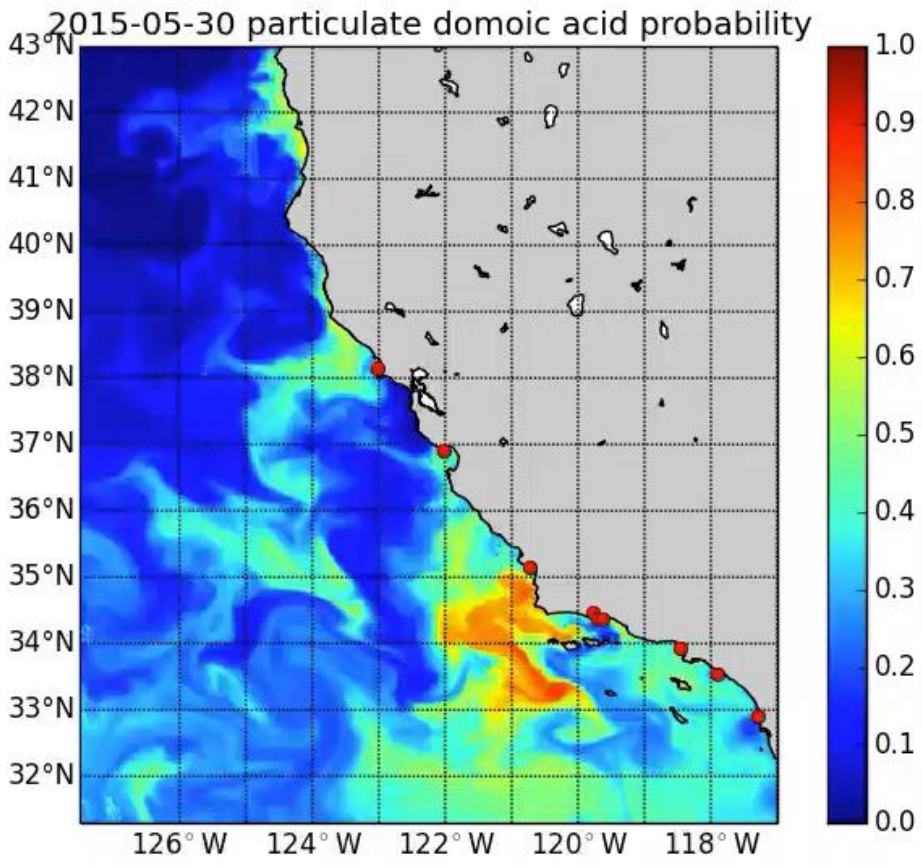
Pseudo-nitzschia has characteristics of a dinoflagellate:

- It prefers weak, pulsed upwelling/relaxation and WARM water
- It forms subsurface maxima
- It does well on anthropogenic nutrients and may be more toxic with urea
- It responds to “flush” rain events in autumn

2015 data from Monterey showing the development of a subsurface layer of *Pseudo-nitzschia* (sitting on the nutricline). Previous studies show coupling with high-Fe waters from BBL feeding these layers.

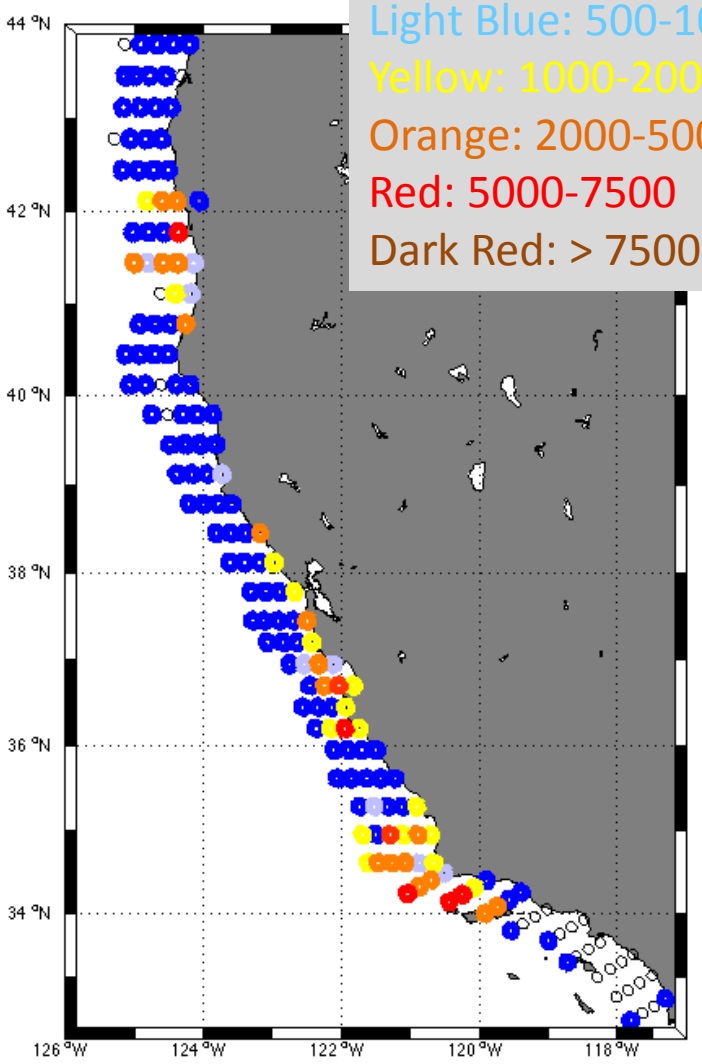


Modeled Toxin Probability



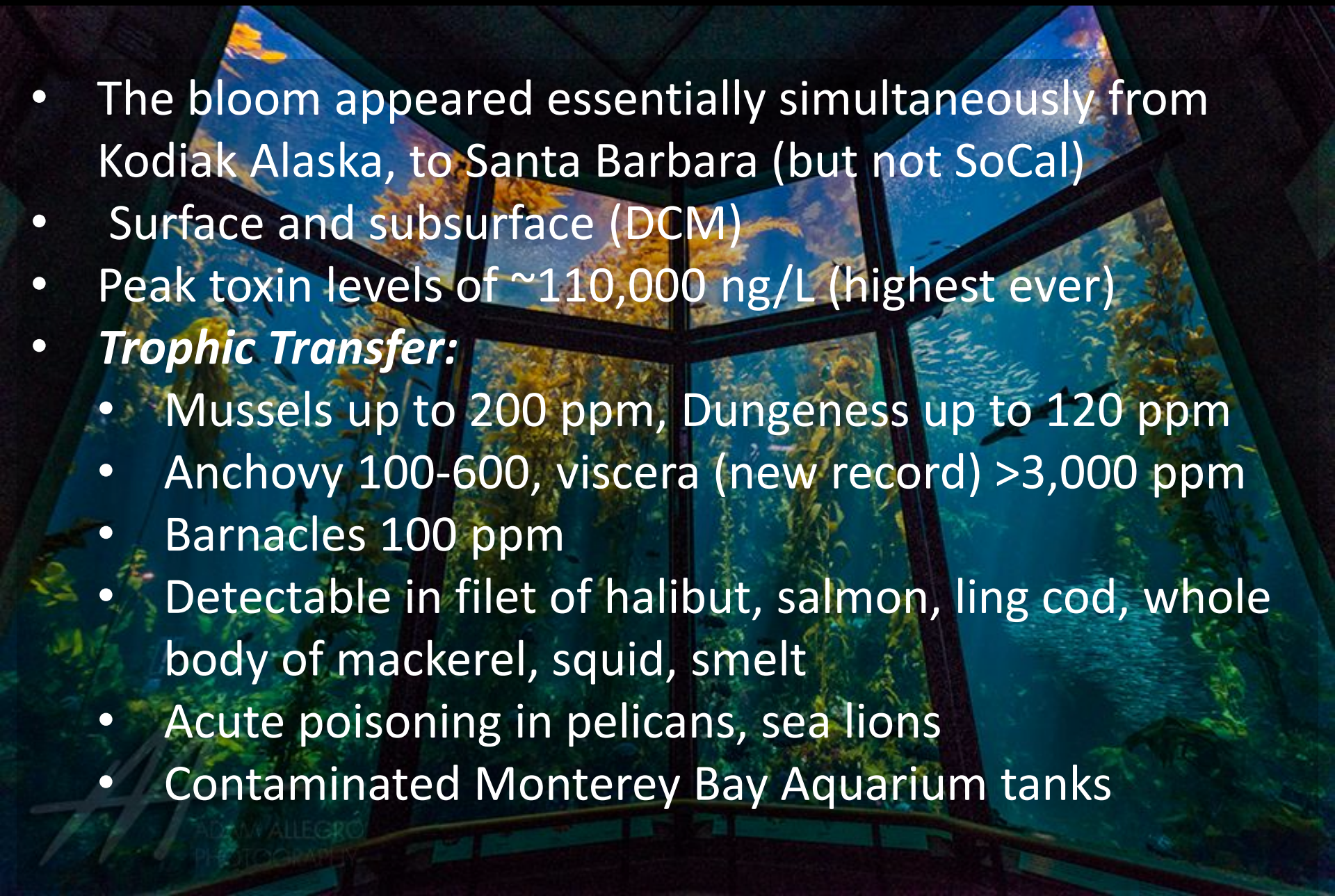
Particulate Domoic Acid (ng/L)

Blue: 1-500 ng/L
Light Blue: 500-1000
Yellow: 1000-2000
Orange: 2000-5000
Red: 5000-7500
Dark Red: > 7500



http://www.cencoos.org/data/models/habs

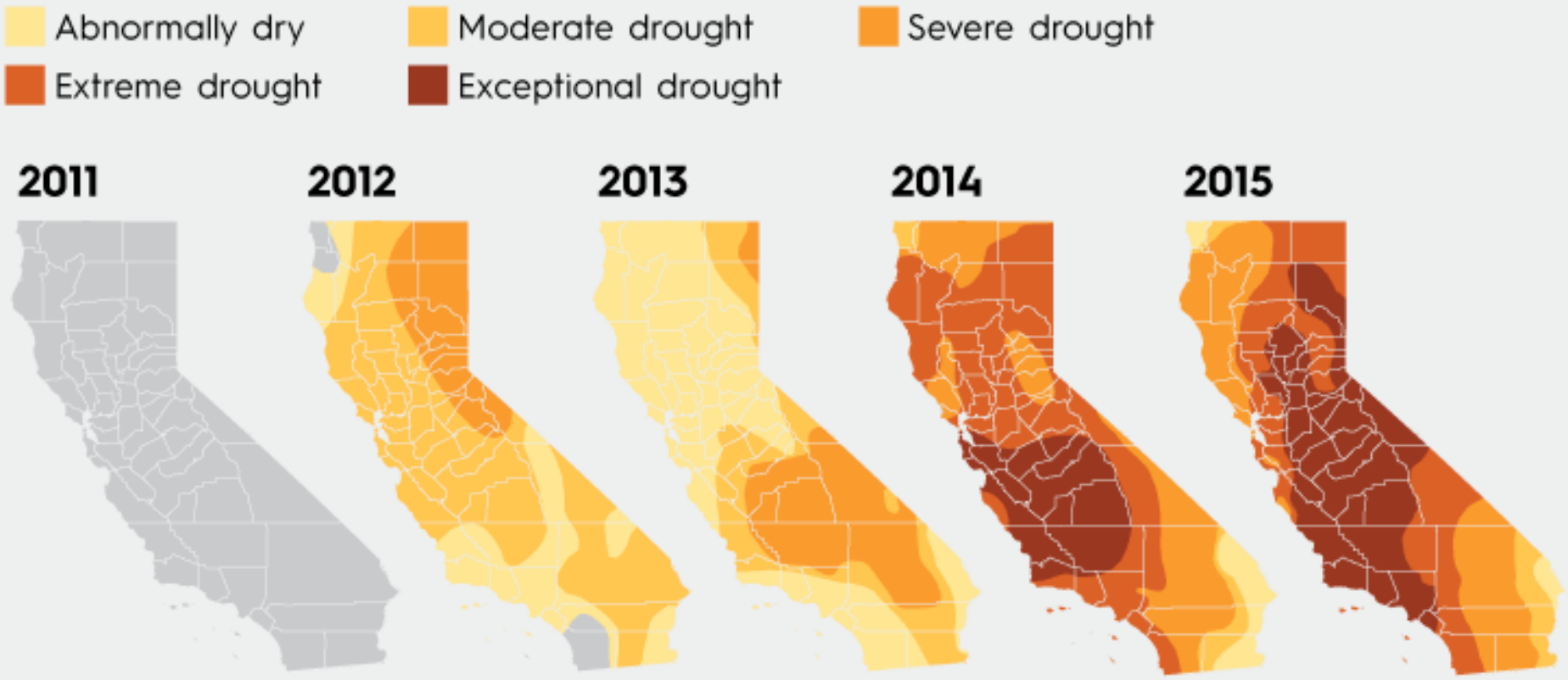
2015: An Unprecedented Year



- The bloom appeared essentially simultaneously from Kodiak Alaska, to Santa Barbara (but not SoCal)
- Surface and subsurface (DCM)
- Peak toxin levels of ~110,000 ng/L (highest ever)
- ***Trophic Transfer:***
  - Mussels up to 200 ppm, Dungeness up to 120 ppm
  - Anchovy 100-600, viscera (new record) >3,000 ppm
  - Barnacles 100 ppm
  - Detectable in filet of halibut, salmon, ling cod, whole body of mackerel, squid, smelt
  - Acute poisoning in pelicans, sea lions
  - Contaminated Monterey Bay Aquarium tanks

A Record-Breaking Drought

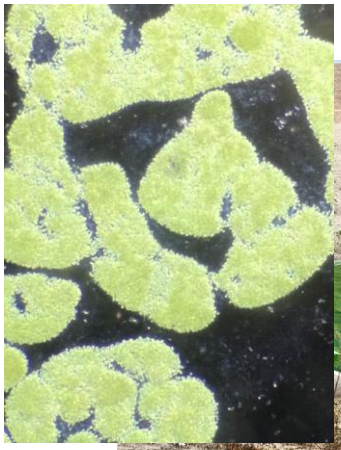
41% of the state is facing “exceptional drought” (the most severe kind).

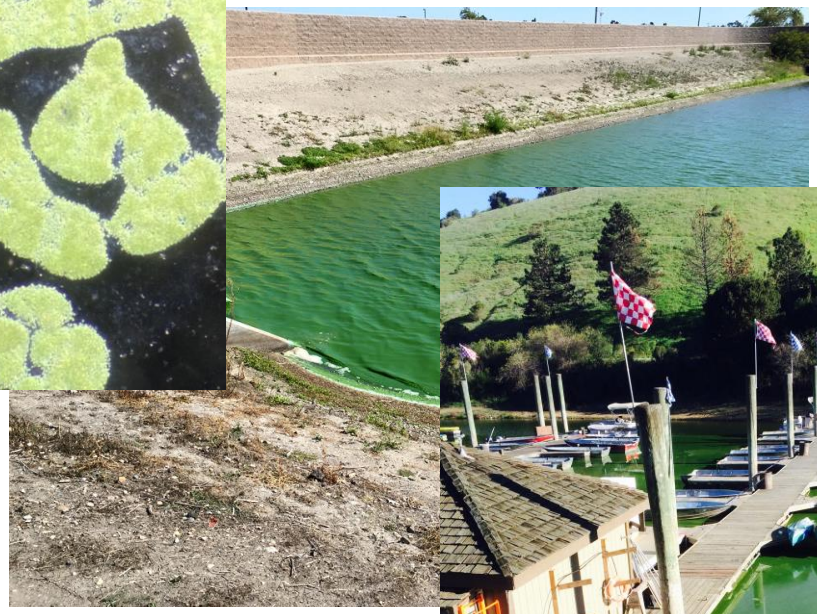


SOURCE: U.S. Drought Monitor

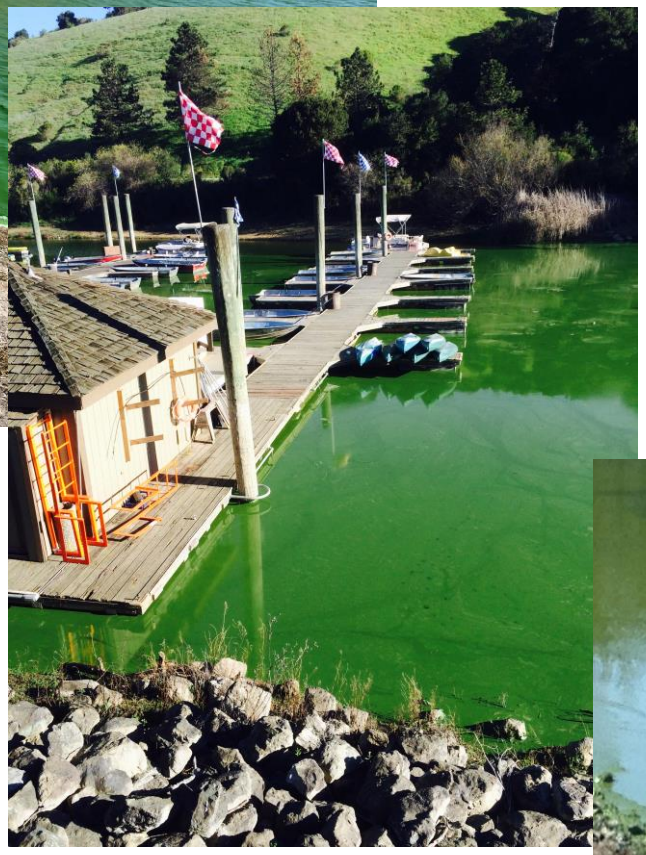
VISUAL NEWS

A Tour of California Hotspots





San Joaquin Marsh—33,500 µg/L



Lake Chabot—11,000 µg/L;
800,000 µg/L scum

Pinto Lake—1,000 µg/L annually;
2.9 million µg/L scum

A Tour of California Hotspots

<u>Wadeable Streams:</u>

Microcystin—33%

Lyngbyatoxin—21%

Saxitoxin—7%

Anatoxin-a—3%

<u>Eel River algal mats:</u>

Anatoxin-a—42%

Microcystins—15%

Both—5%

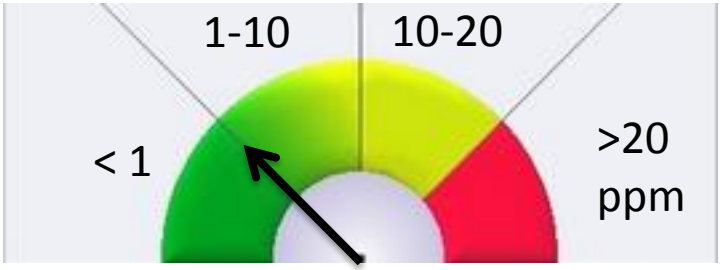
ATX ~ 10x > MCY

Data Sources: Fetscher et al. *Harmful Algae*, in press

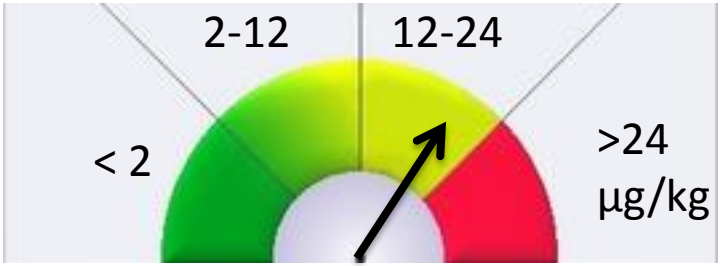
Bouma-Gregson & Higgins, Eel River Recovery Project Report 2015

San Francisco Bay: A mixing bowl for Toxins

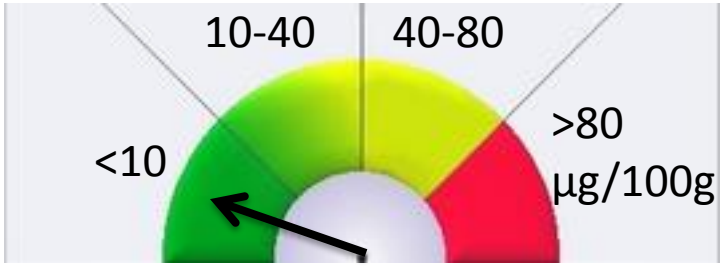
Mussels 2012, 2014, 2015: 25% of sites have all three toxins



Domoic Acid
(100% of mussels contaminated)



Microcystins
(82% of mussels contaminated)



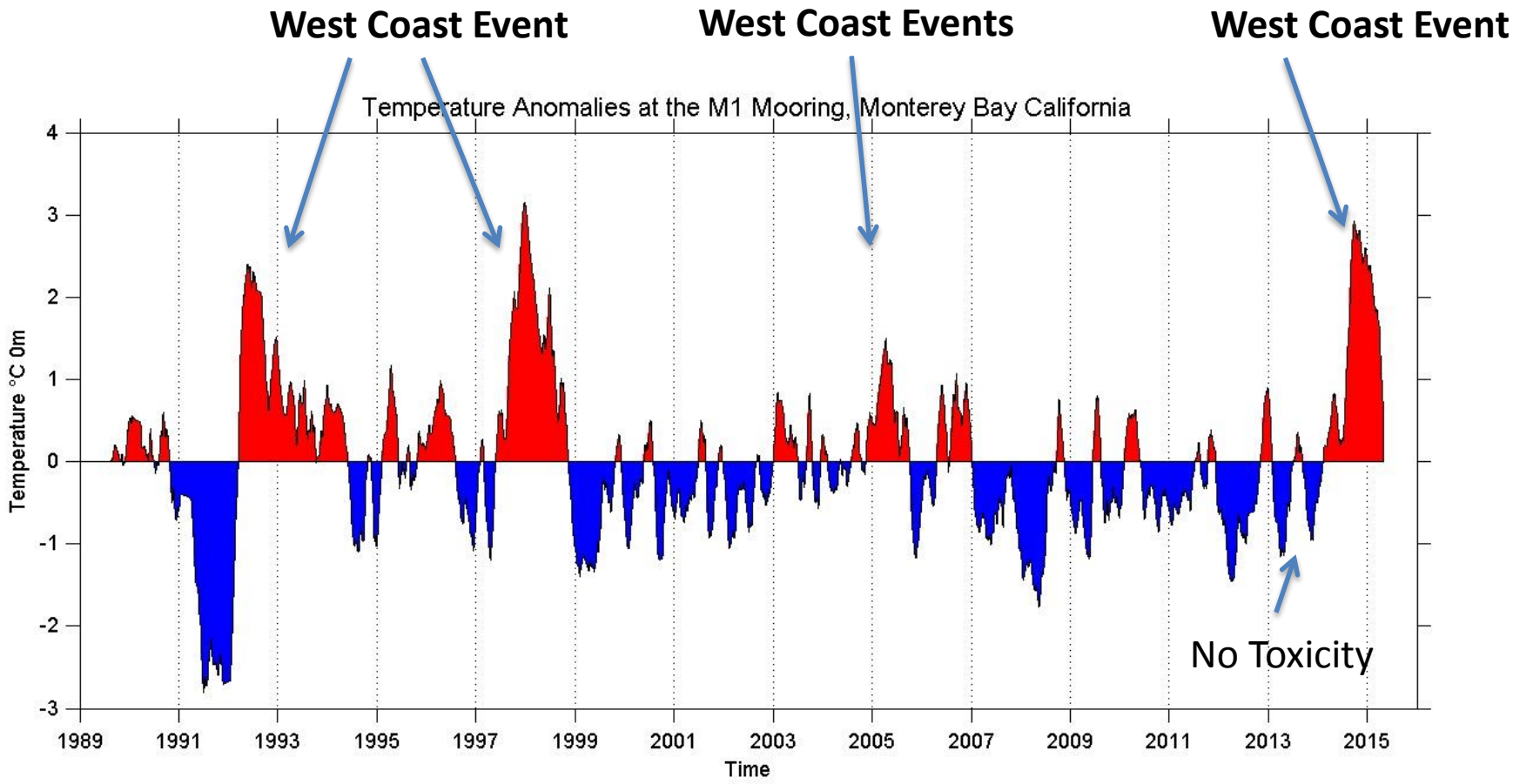
Paralytic Shellfish Toxins
(25% of mussels contaminated)

CLIMATE

Blooms Like It Hot

A link exists between global warming and the worldwide proliferation of harmful cyanobacterial blooms.

Hans W. Paerl[1] and Jef Huisman[2]

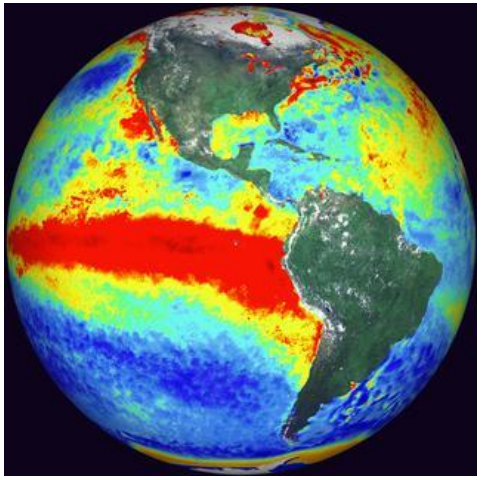


Note: 60 point moving average applied to daily averaged values.

Monterey Bay Aquarium Research Institute

Updated:20-Jul-2015

2014-2016: From Bad to Worse? Or Will El Niño Save Us?

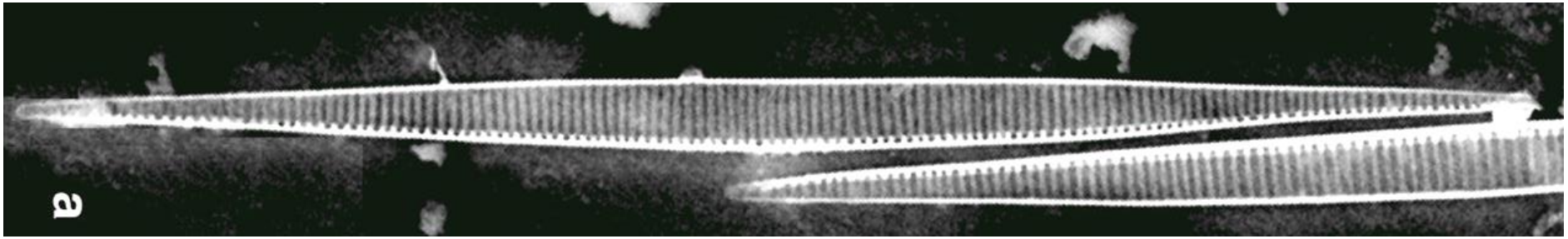


- Historically, more toxic marine HABs during El Niño

- More rainfall may alleviate cyanobacterial problems…

…but rainfall may also flush everything into the ocean

- ***Good News:*** we have operational HAB forecasts, and greatly improved monitoring in both the watersheds and coastal ocean. Fantastic opportunity to test theories!



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Data Access

Southern California Coastal Ocean Observing System
Central and Northern California Ocean Observing Systems
California Harmful Algal Bloom Monitoring and Alert Network (Cal-HABMAP)