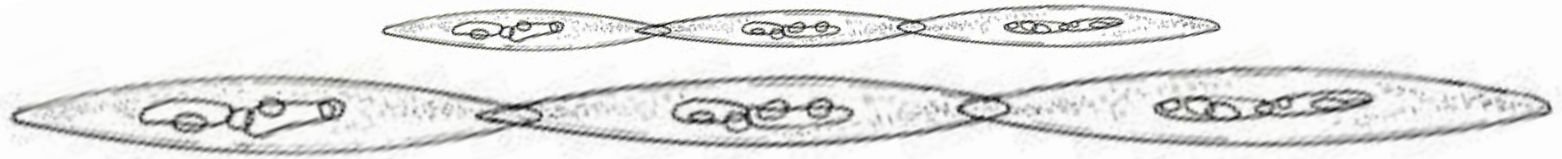


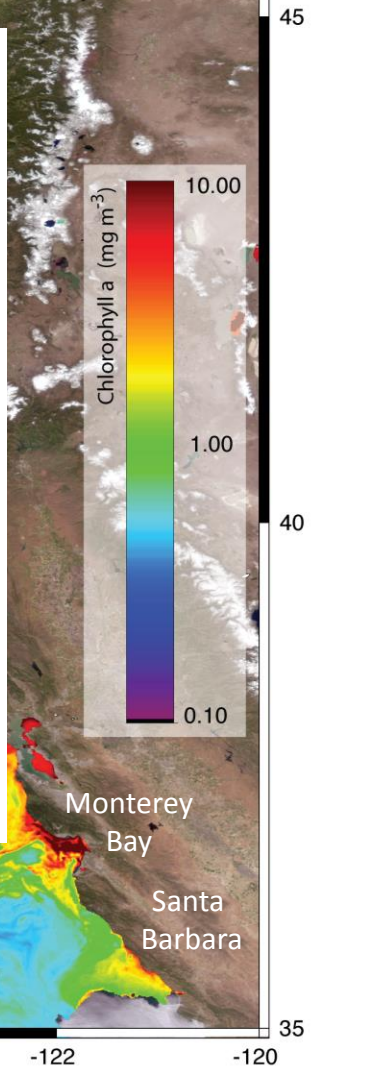
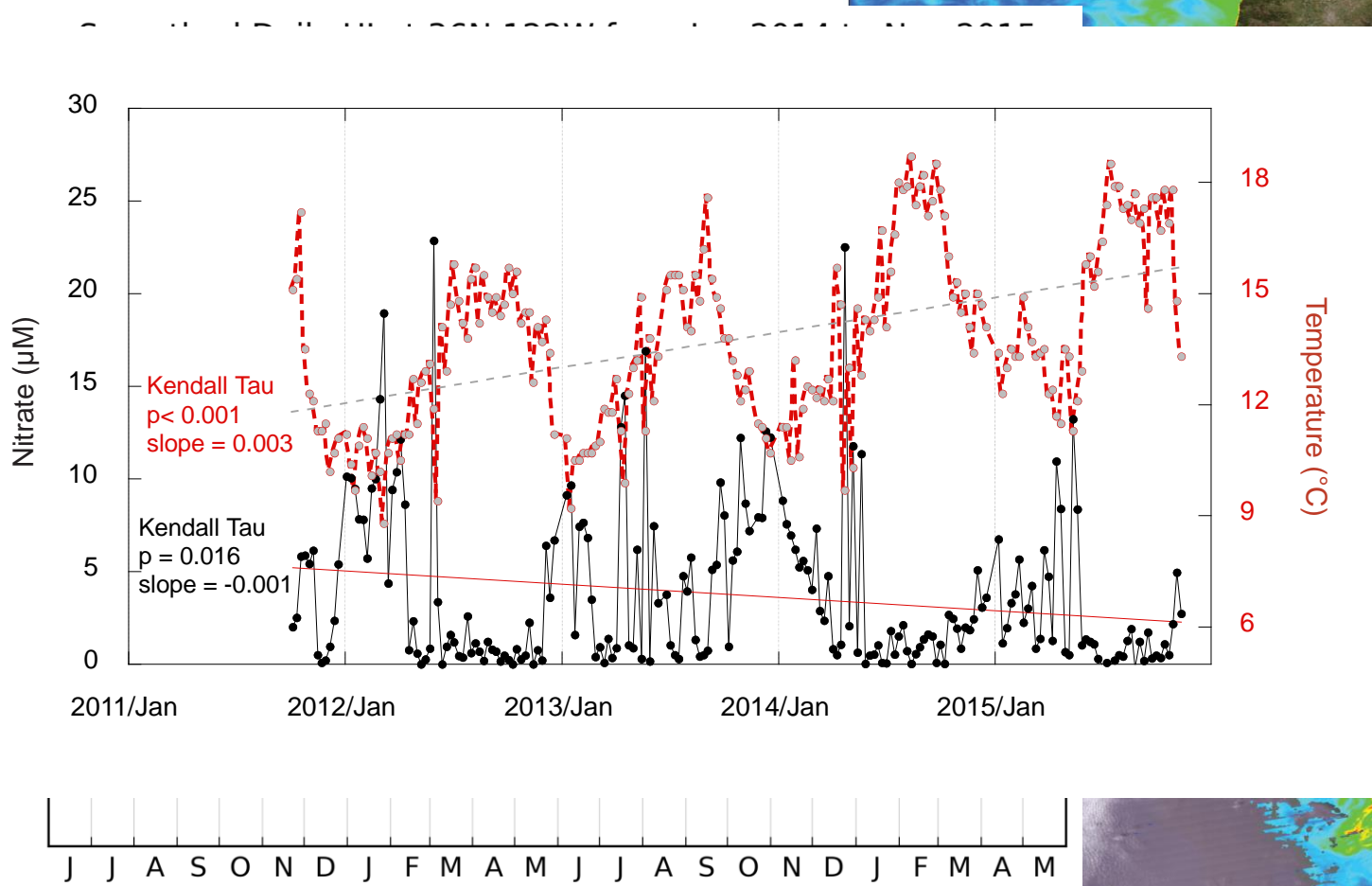
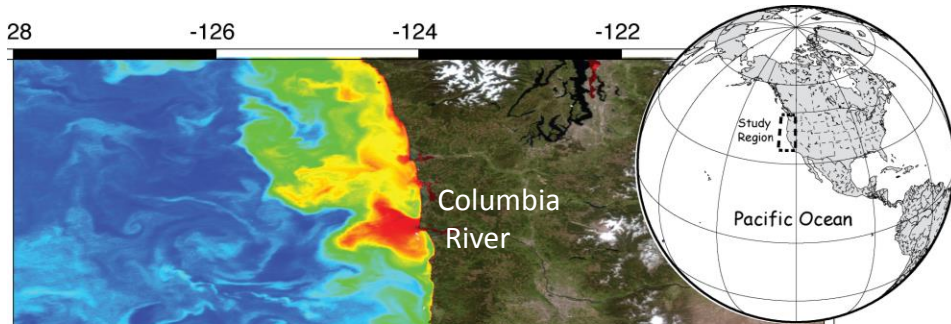
The 2015 West Coast Harmful Algal Bloom in California: What we've learned and how to mitigate impacts on fisheries in the future



Dr. Clarissa Anderson
Institute of Marine Sciences
University of California Santa Cruz
clrande@ucsc.edu



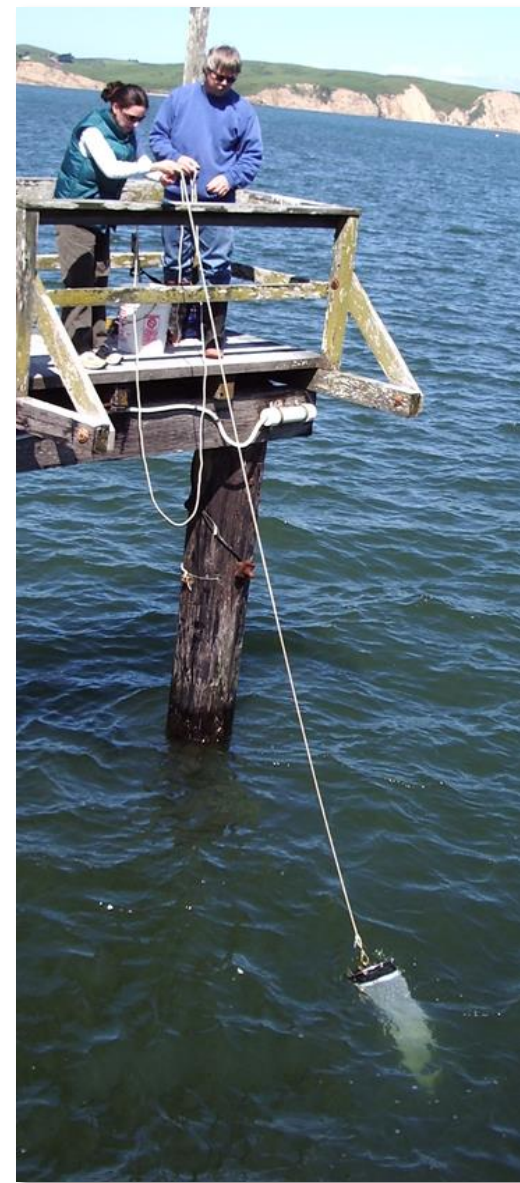
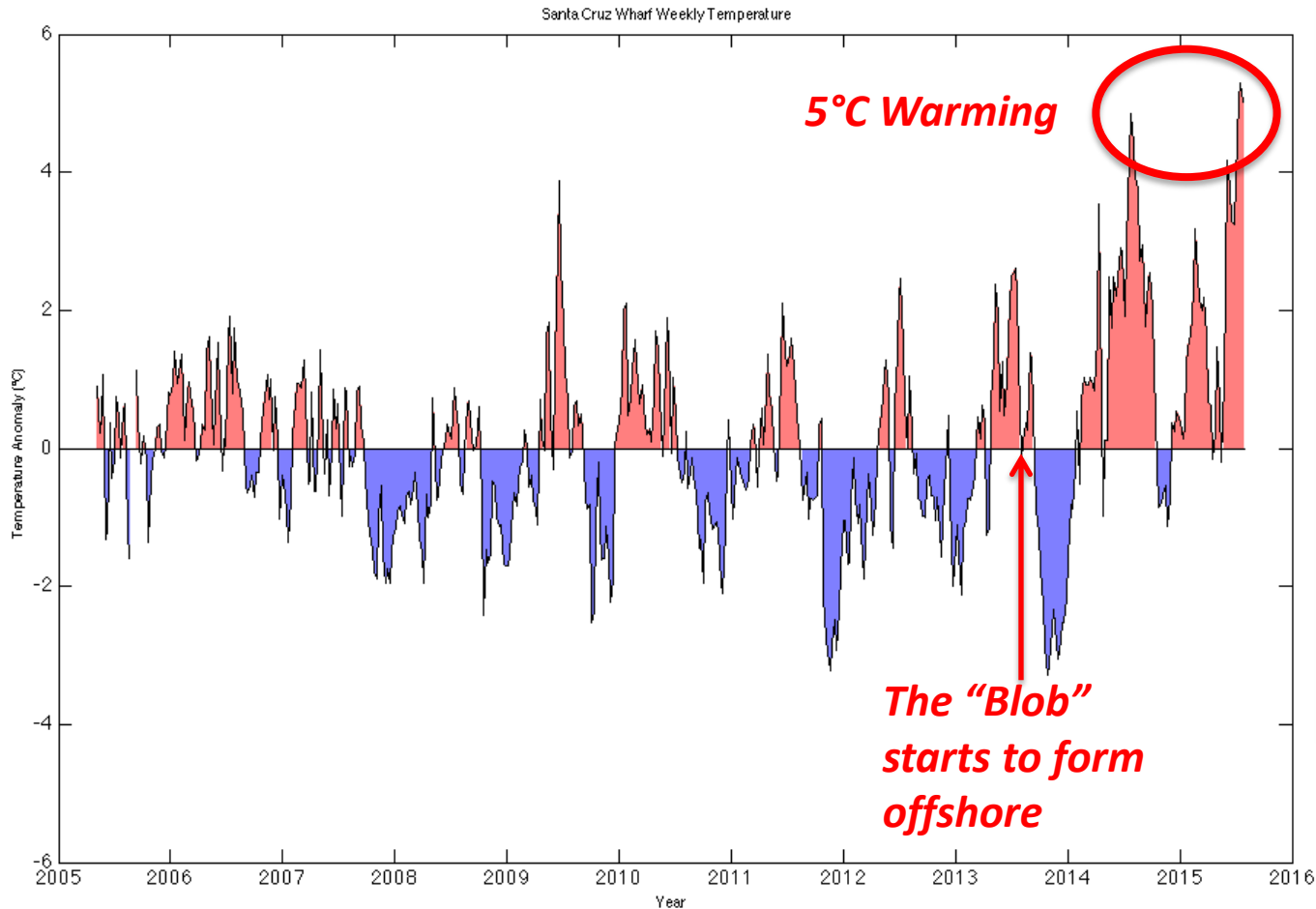
Upwelling Drives Abundance & Diversity



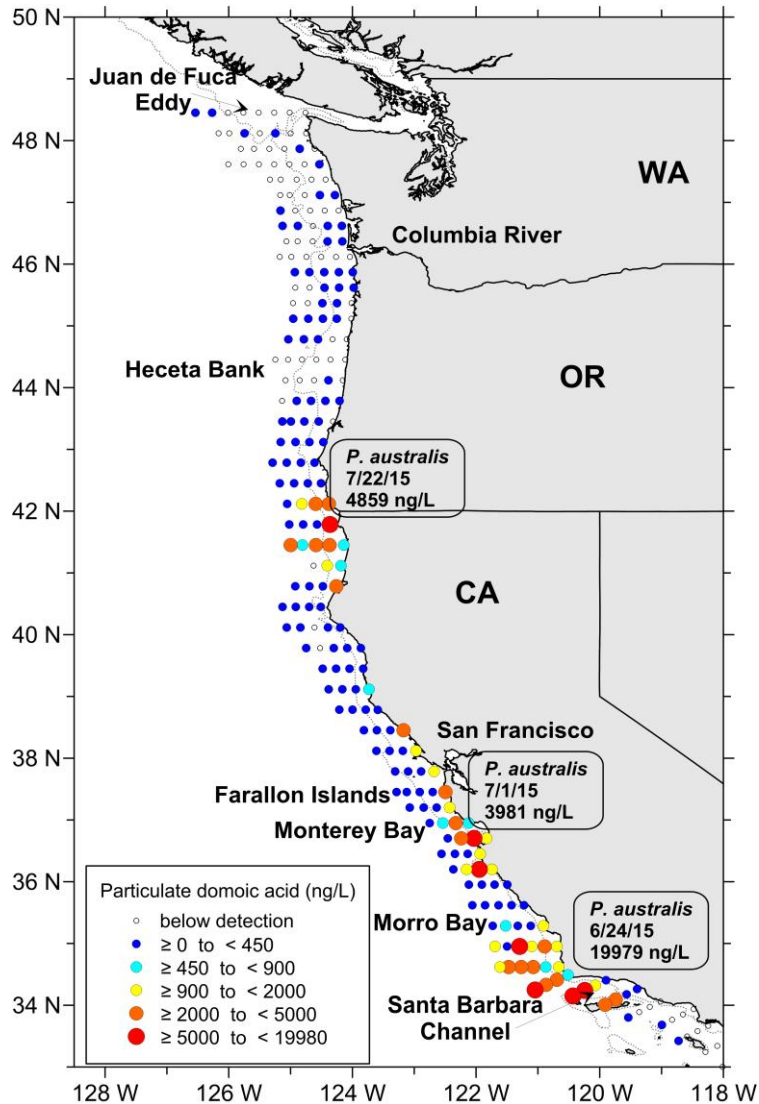
NOAA PFEL Upwelling Index

Coastal California temperatures show how warm the ocean has become

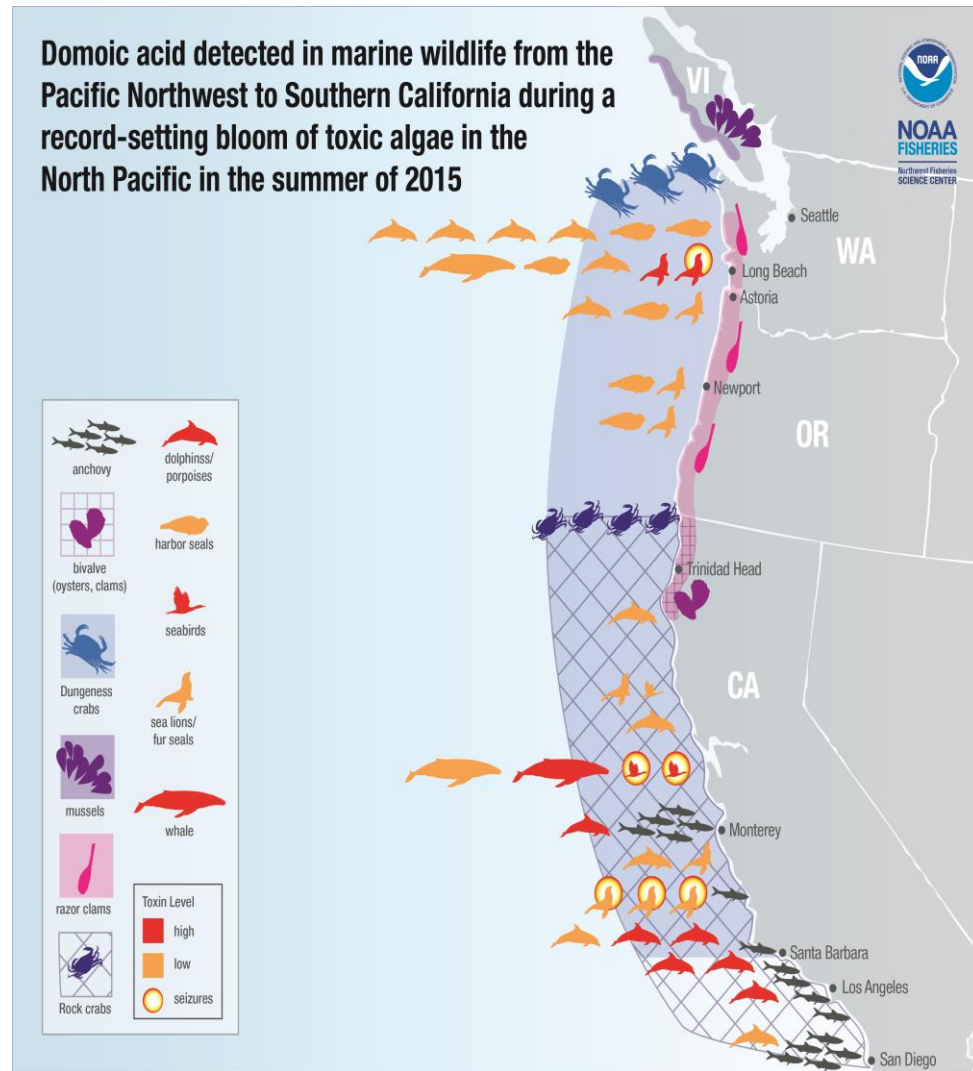
For comparison, the 1997-98 El Niño resulted in 3-4°C warming



2015: An Unprecedented Year



Particulate Domoic Acid (ng/L)
(R/V *Shimada*, NOAA Fisheries)



Bloom Impacts, 2015
(Trainer and Kudela, unpublished)

2015: An Unprecedented Year

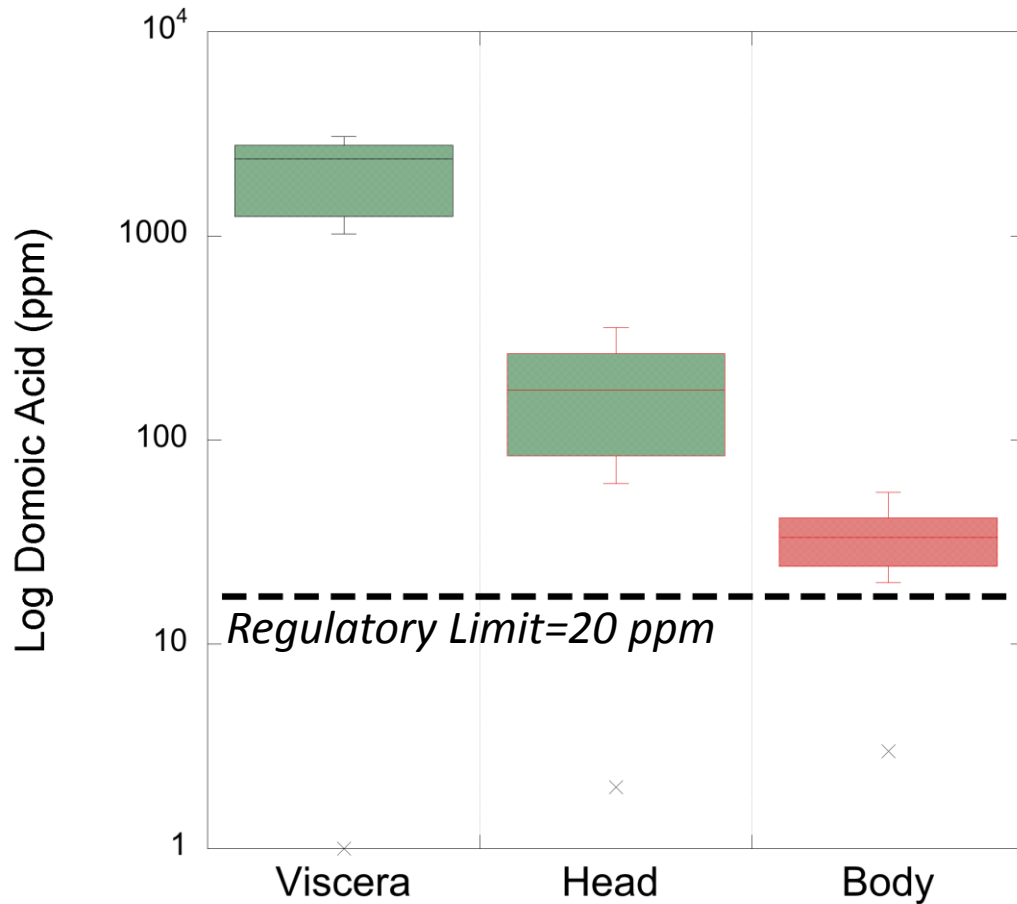
- Peak toxin levels of $>100,000$ ng/L (new record)
- **Trophic Transfer** (regulatory limit = 20 ppm)
 - Mussels up to 200 ppm
 - Anchovy = 100-600 ppm, viscera $>3,000$ ppm
 - Razor Clam = 340 ppm
 - Rock Crab = 1,000 ppm
 - Dungeness = 270 ppm
 - West Coast survey: 100% of fish contaminated
- Massive economic, ecological losses
(Gov. Brown requests federal disaster assistance)

Anchovy Contamination

- Fish caught by CDPH, frozen immediately
- Dissected frozen
 - Head, Gills, & Spine
 - Viscera
 - Body (filet & skin)
- Analyzed individually for domoic acid



Anchovy Contamination



Average Domoic Acid:

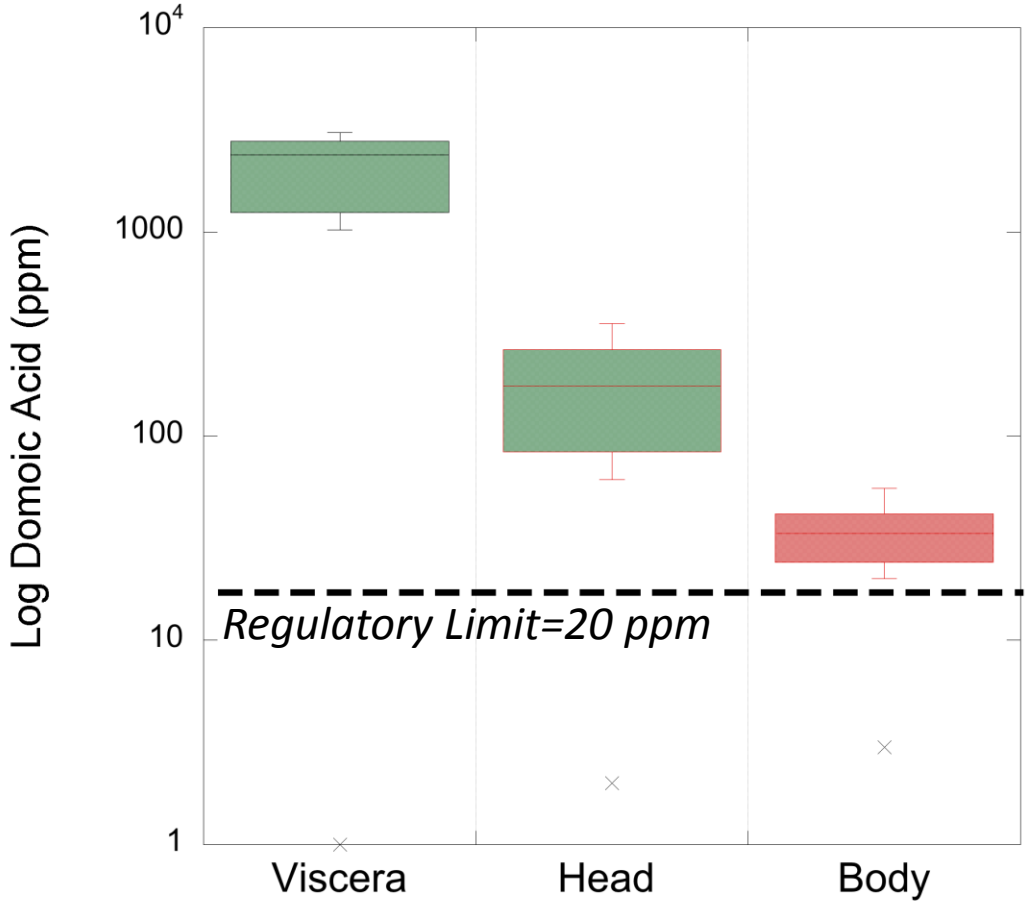
Viscera = 2076 ppm

Head = 184 ppm

Body = 35 ppm

N=10 individuals

Anchovy Contamination



Average Domoic Acid:

Viscera = 2076 ppm

Head = 184 ppm

Body = 35 ppm



CDPH Warns Not to Eat Certain Seafood Caught in Monterey and Santa Cruz Counties



News Release

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH

FOR IMMEDIATE RELEASE

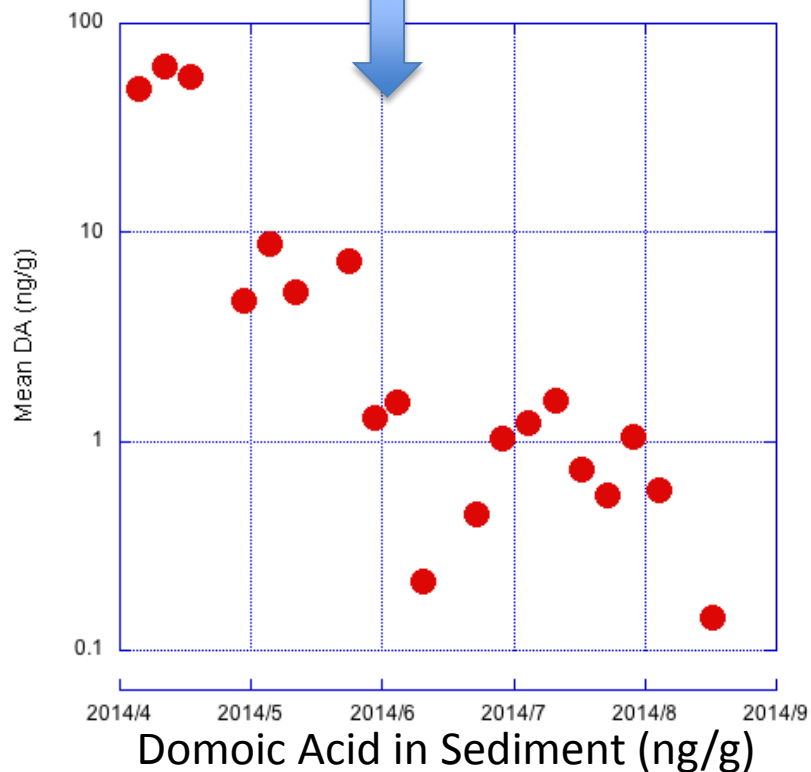
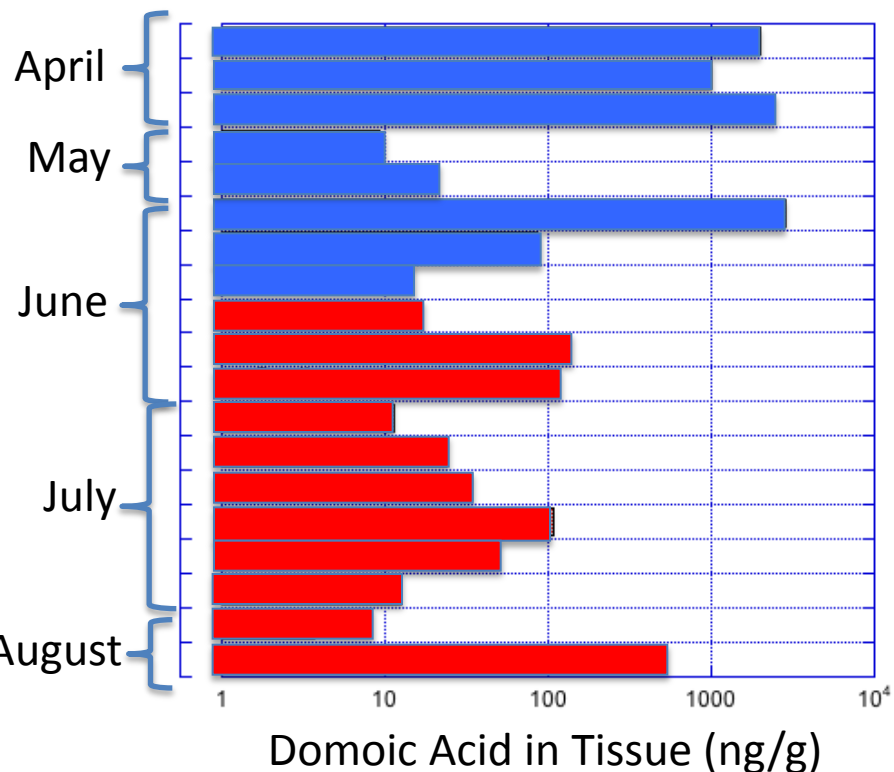
November 3, 2015
PH15-082

CONTACT: [Anita Gore](#)
[Orville Thomas](#)
(916) 440-7259

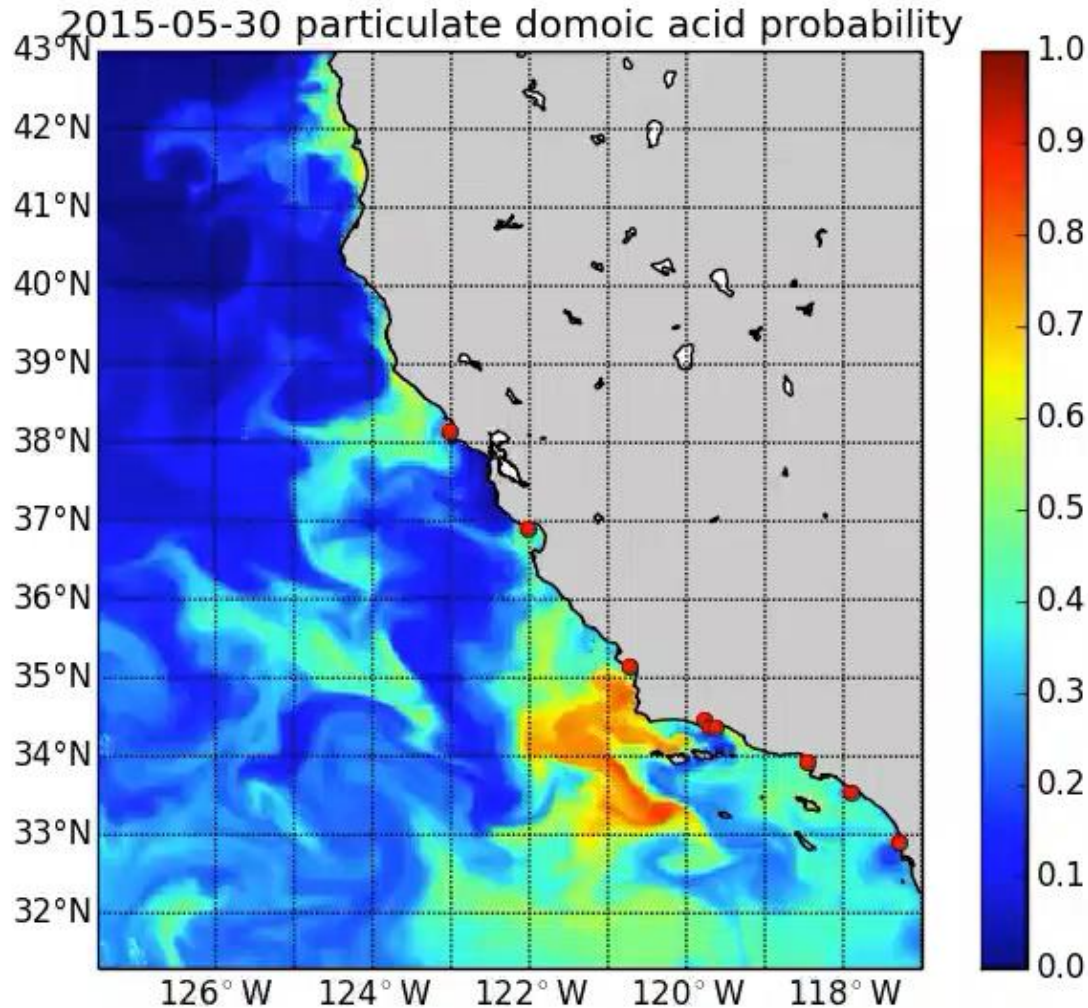


CDPH Issues Warning about Dungeness and Rock Crabs Caught in Waters Along the Central and Northern California Coast

Toxin disappears from water column



Identifying Toxic Hotspots



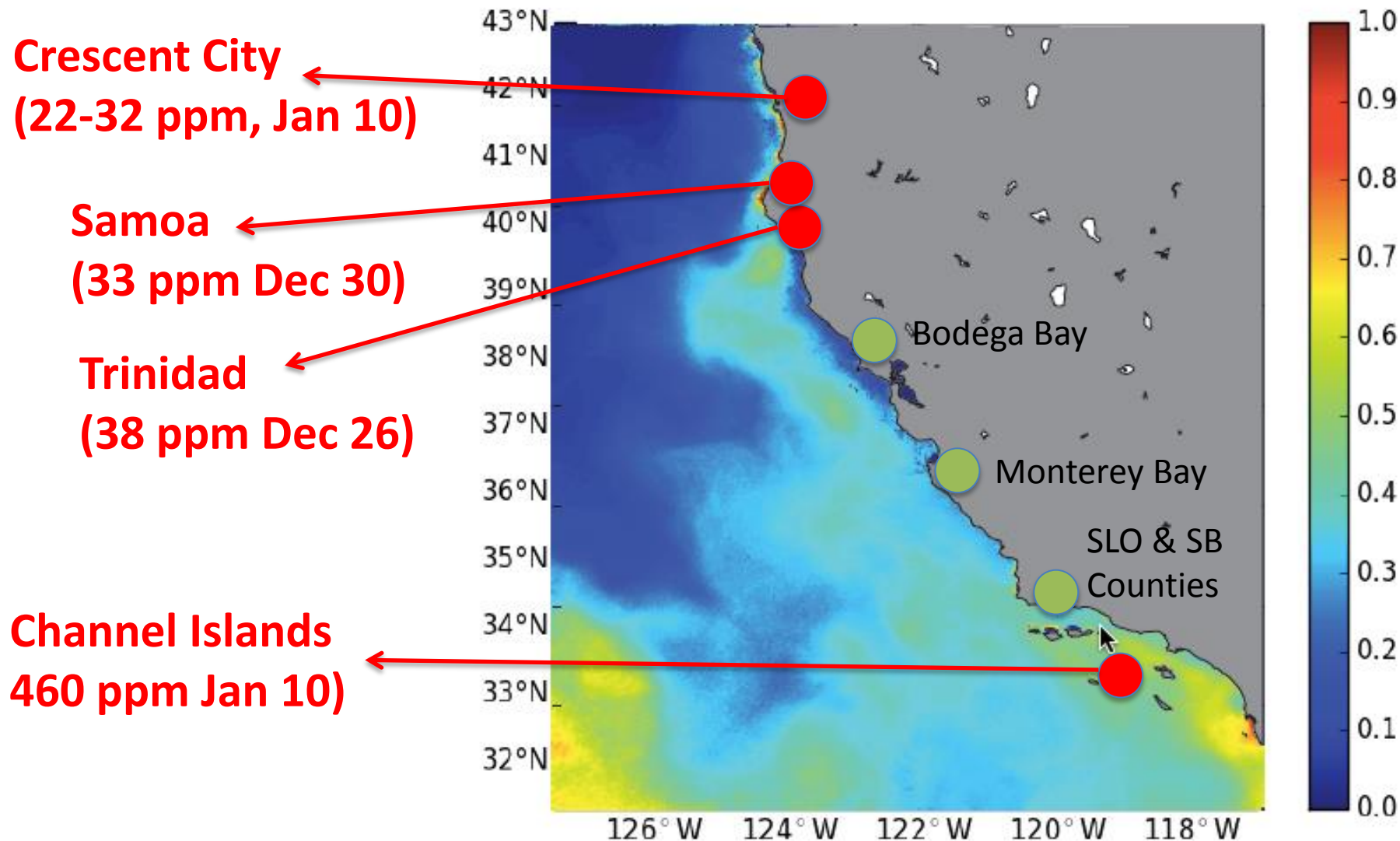
<http://www.cencoos.org/data/models/habs>

Modeled Toxin Probability
(CeNCOOS/NOAA/NASA)

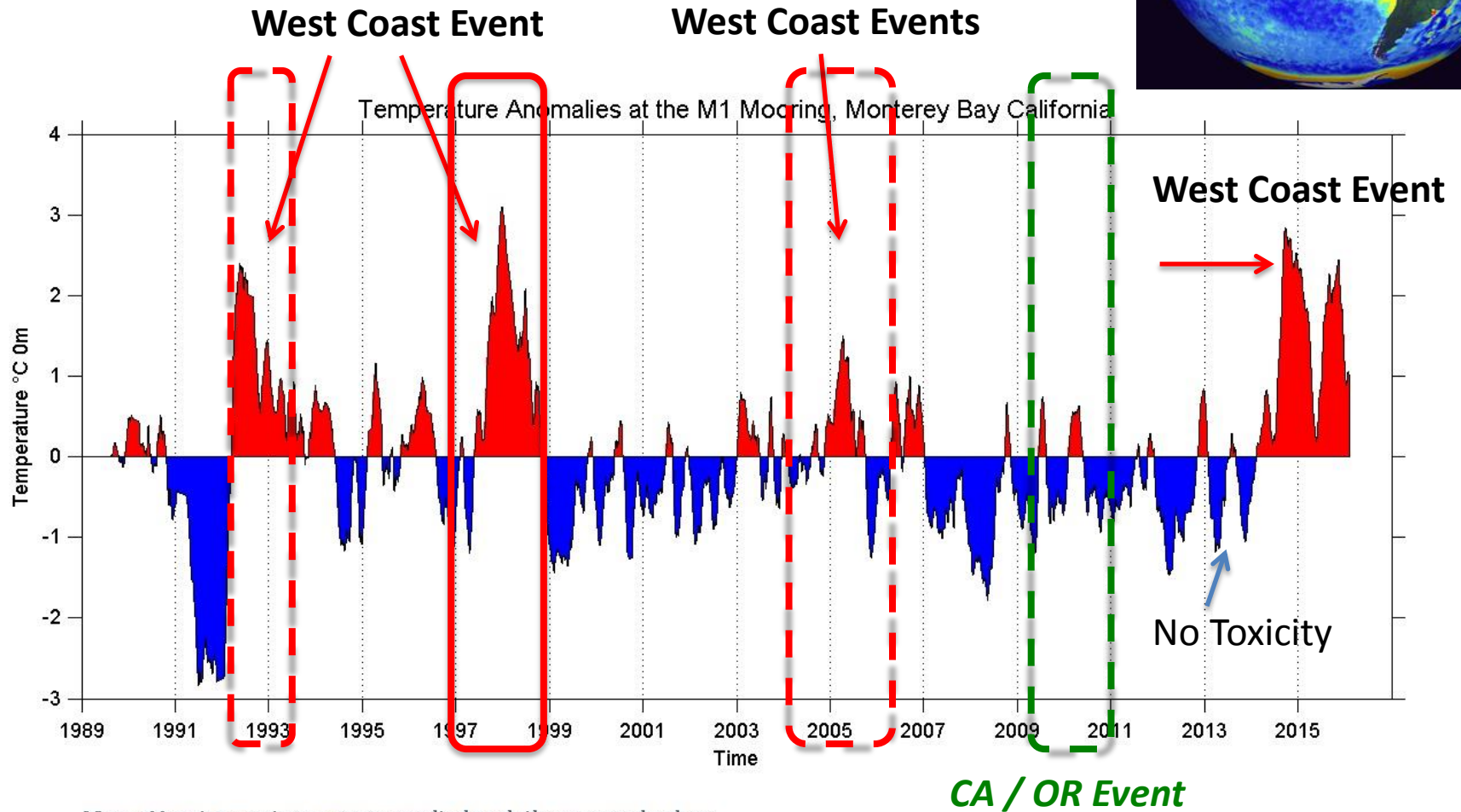
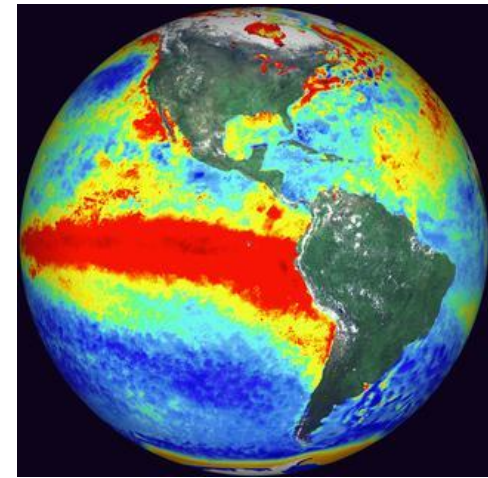


The model provides ~seasonal prediction of trophic transfer

Toxin Probability, Oct-Nov 2015



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

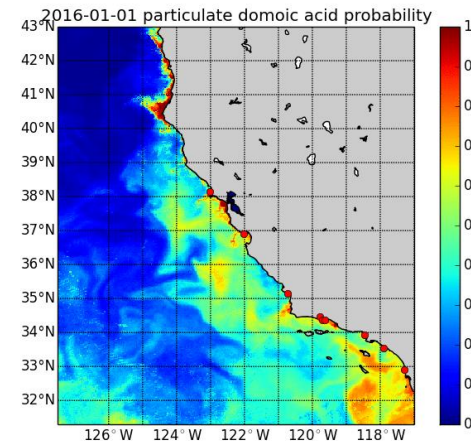


Note: 60 point moving average applied to daily averaged values.

Monterey Bay Aquarium Research Institute

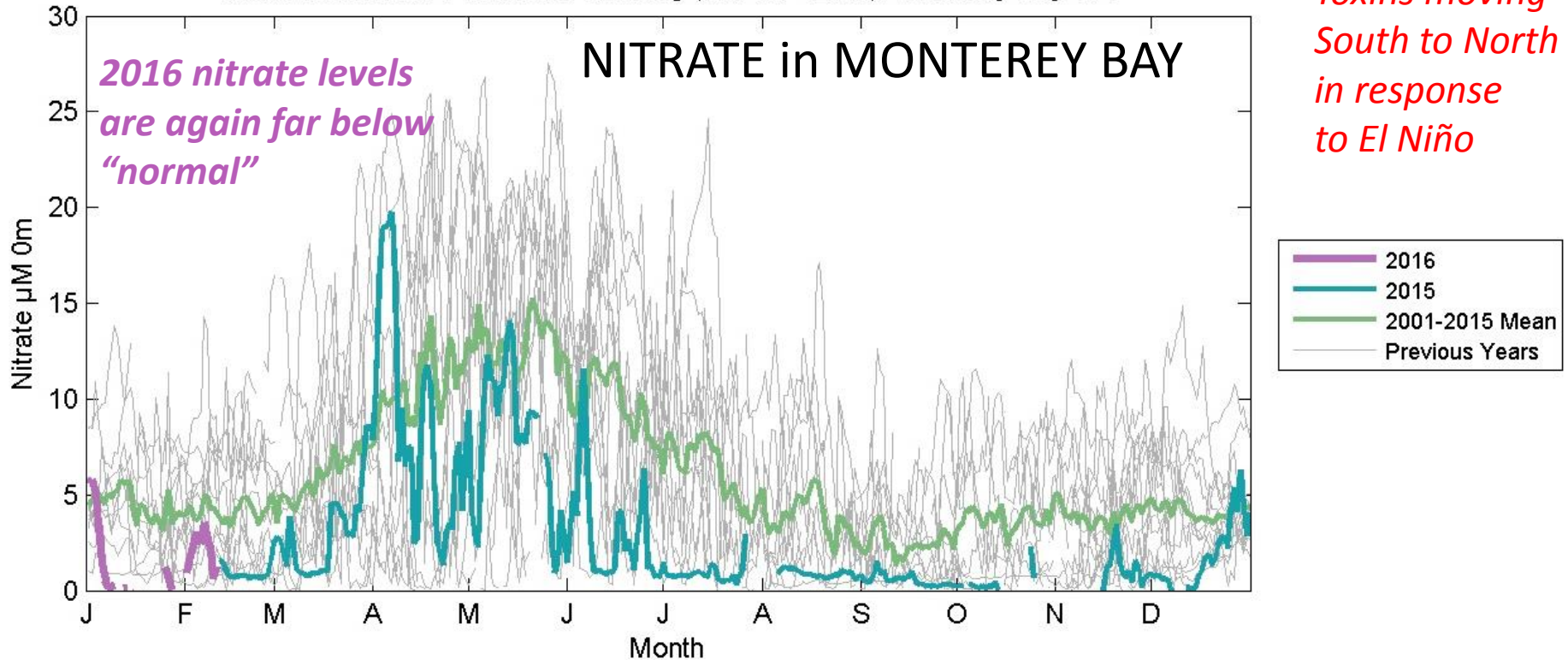
Updated: 10-Feb-2016

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



Toxins moving South to North in response to El Niño

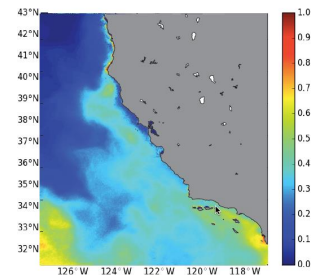
Surface ISUS NO₃ at the M1 Mooring (36.7N, -122W), Monterey Bay CA



Climatology Minimum on 08-Mar-2010, 0.01µM; Maximum on 25-May-2013, 27.52µM
2016 YTD Minimum on Jan-15, 0.05667µM; Maximum on Jan-02, 5.78µM



Tools for Future Mitigation



- Toxin forecasting system is being transitioned to operations at NOAA with NASA support. **Provides a 3-day warning.** Can be visualized for specific fishing regions in California.
- Seasonal averages point to **hotspots of toxin activity** – these are places for fisheries to avoid and for managers to target
- We can **predict toxins far offshore**, but have very little “seatruth” data— opportunities to collaborate with NOAA Fisheries cruises
- **Toxic blooms lead to sediment contamination** and likelihood for crab exposure — we need to be prepared for this after large blooms (*sediment sampling should be added to state monitoring*)
- **CDPH needs more assistance with biotoxin monitoring** — we need more labs processing samples quickly to help fisheries adapt
- Next generation models focus on **seasonal forecasts** to give a longer lead time for planning and mitigation!