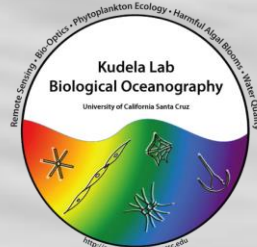
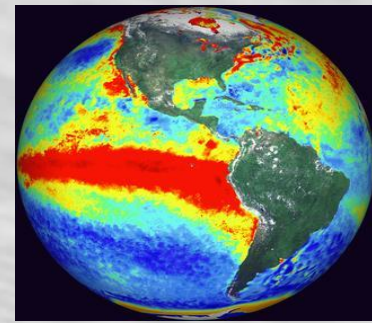


Harmful Algal Blooms and Domoic Acid: Latest Forecast and a Look Ahead to the Upcoming Season

Raphael Kudela & Clarissa Anderson
University of California Santa Cruz

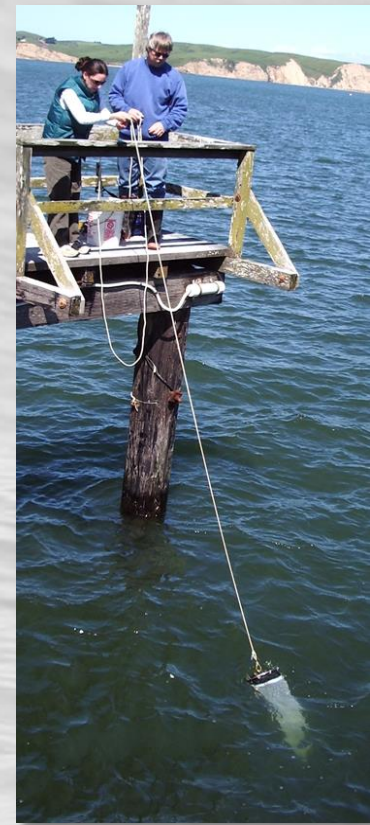


Summary of 2015

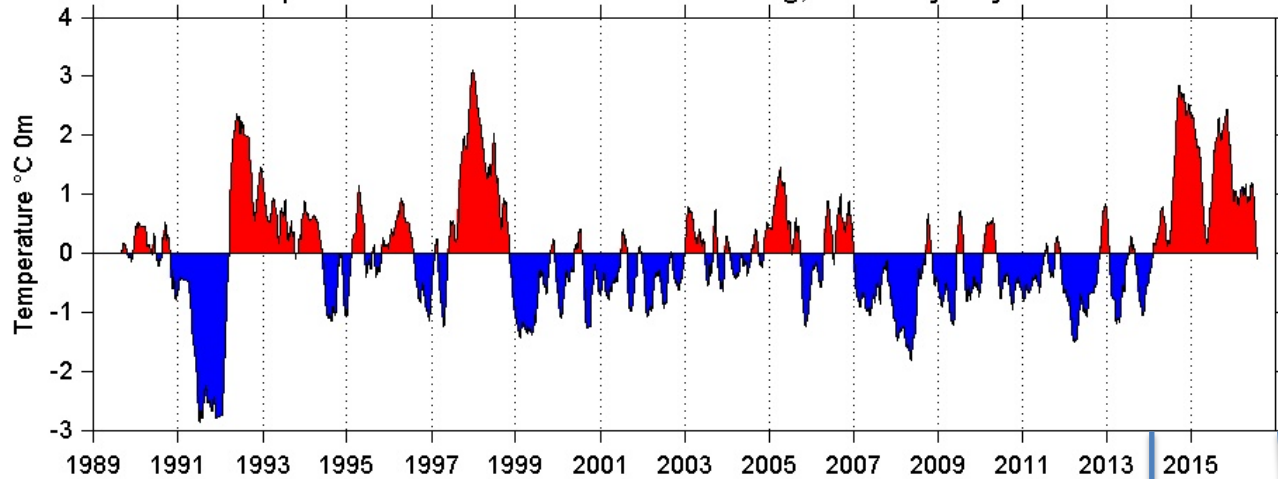


- Combination of the “blob” and El Niño resulted in very warm temperatures—transition to La Nina in 2016
- Development of a west-coast wide algal bloom dominated by the toxic diatom *P. australis*
- Linkage between warm water, algal growth, and toxicity—warm periods are highly correlated to west-coast blooms
- Toxin saturated the food web, and accumulated in the benthic environment, leading to very toxic crabs months after the bloom dissipated

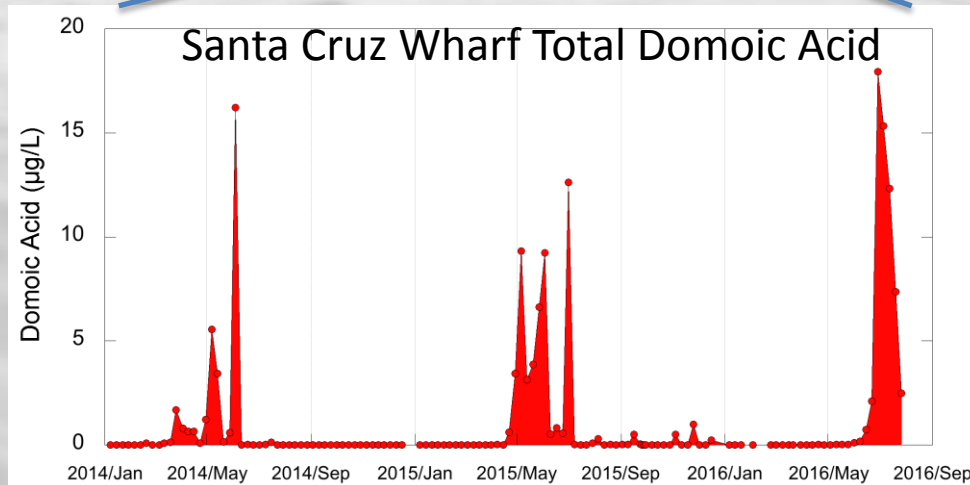
2016 is Warm & Toxic



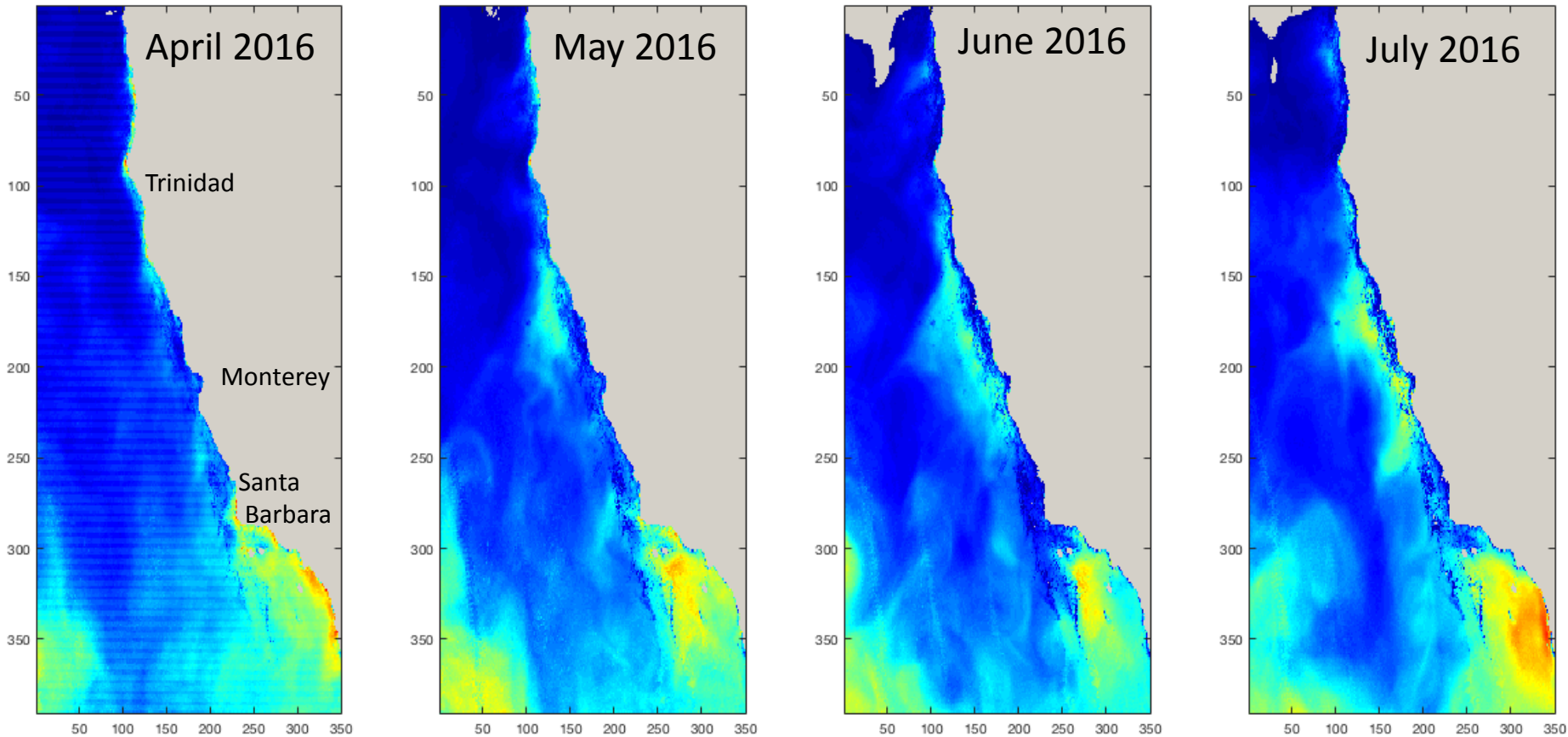
Temperature Anomalies at the M1 Mooring, Monterey Bay California



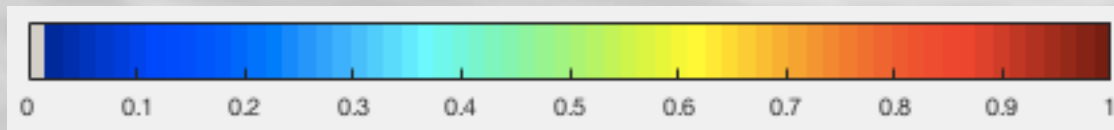
A warmer Eastern Pacific with localized upwelling would (statistically) increase the chance of more large-scale bloom events in the future



2016 Predicted Domoic Acid

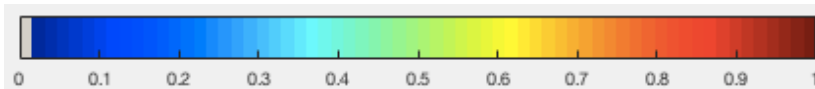
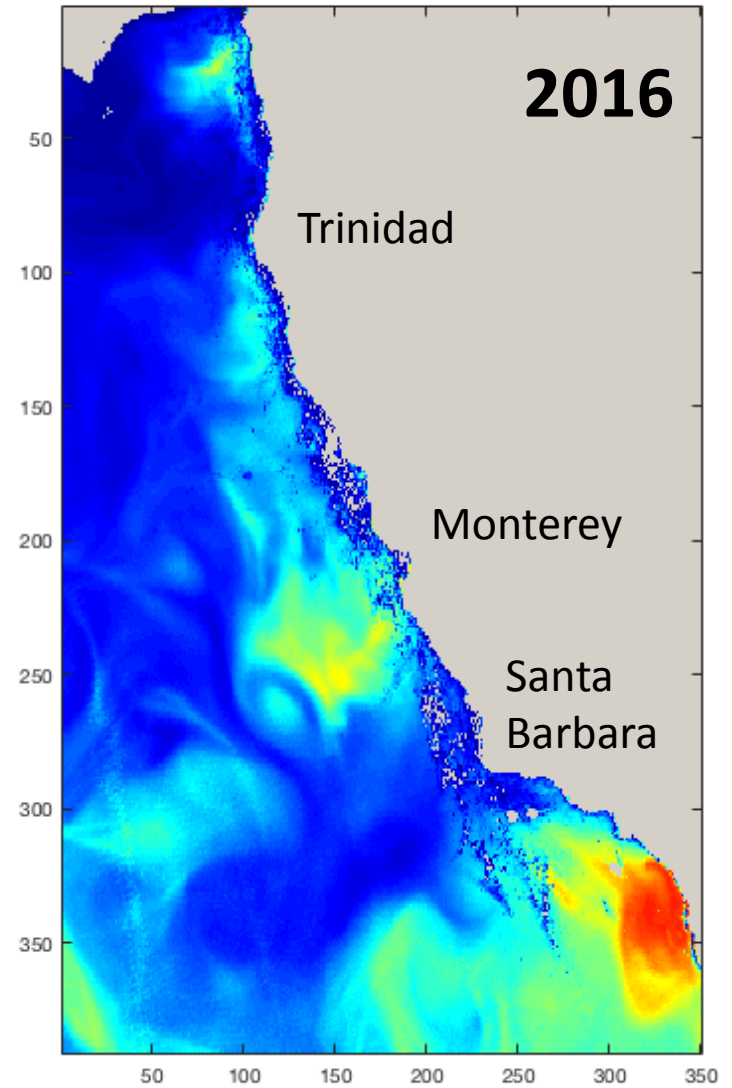
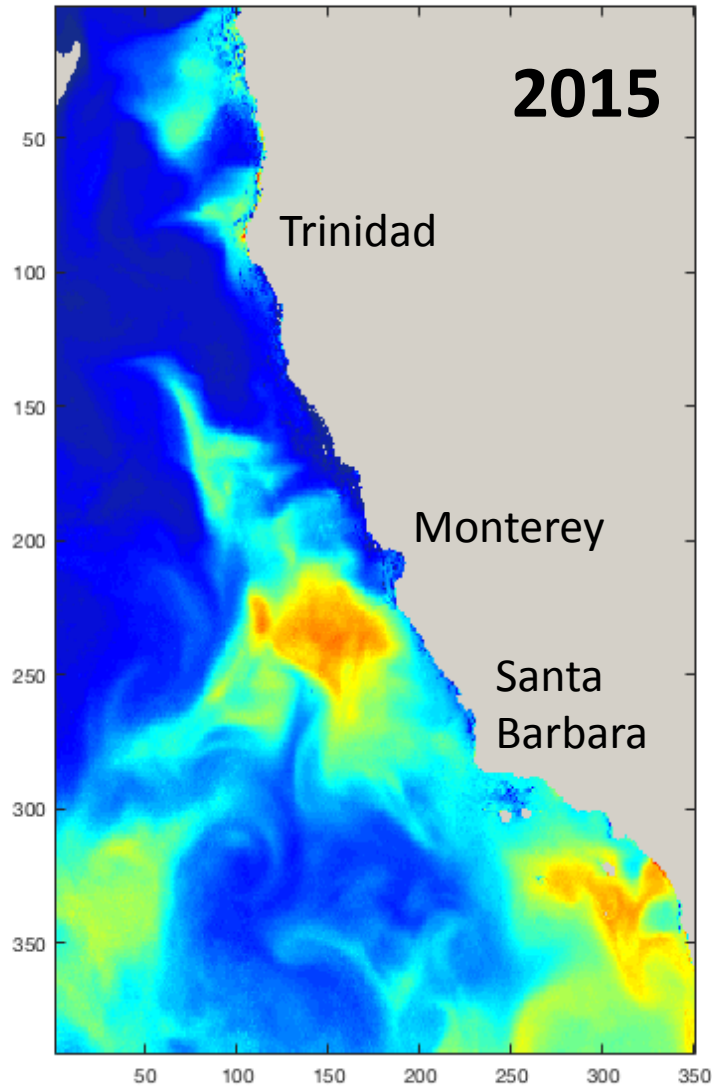


<http://www.cencoos.org/data/models/habs>

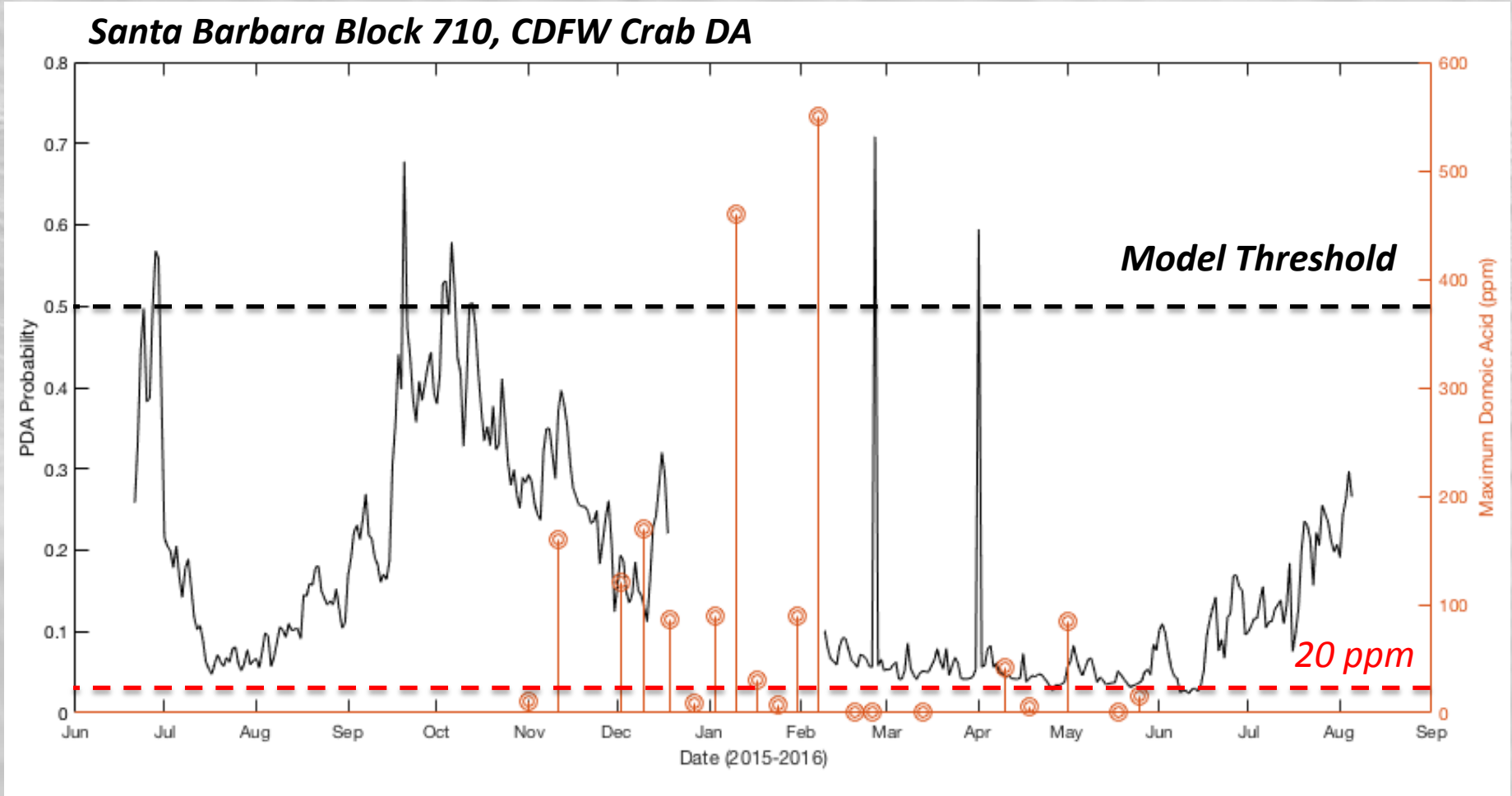


PDA Probability

August 2015 vs August 2016

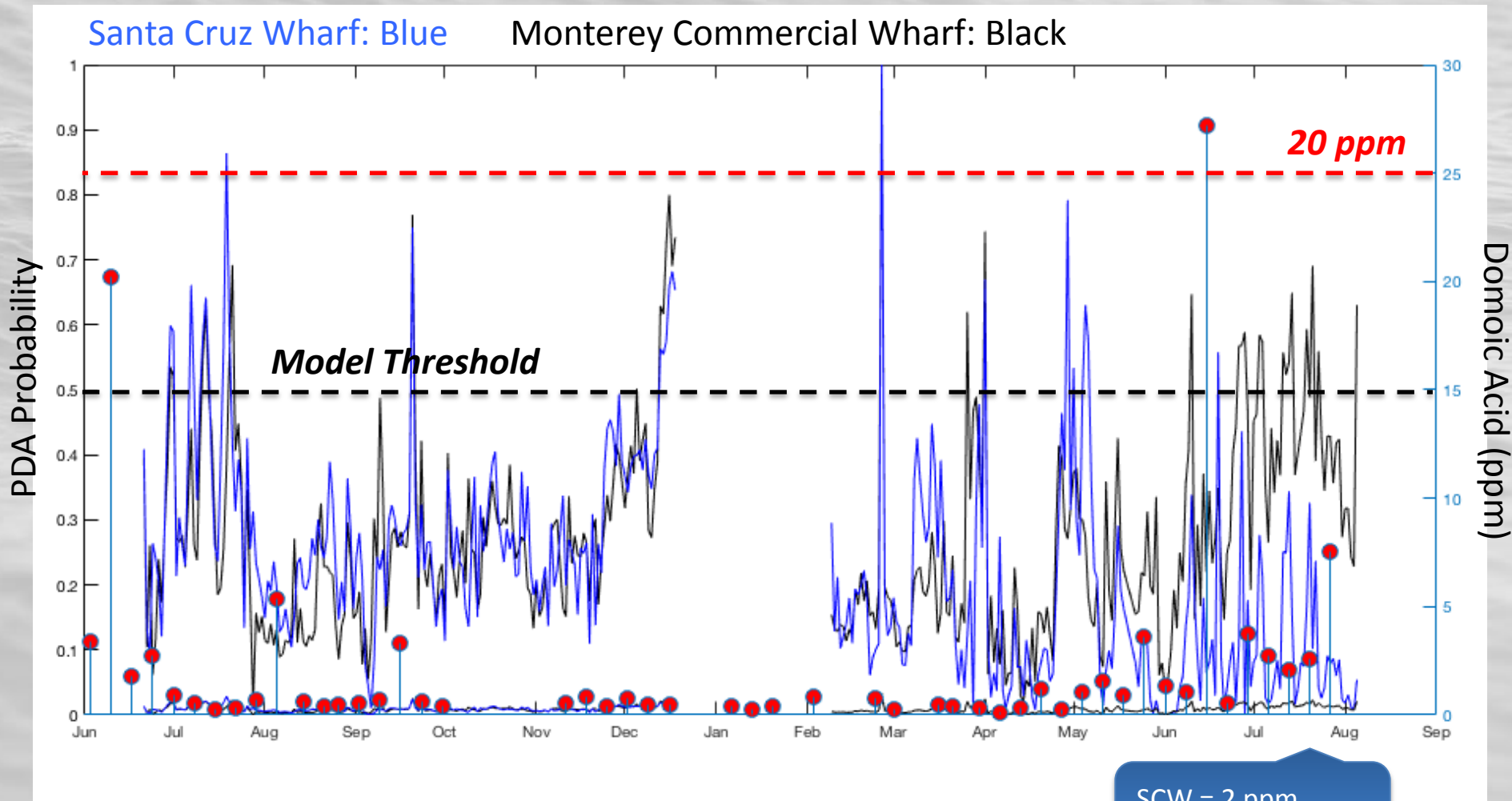


PDA Model Tracks Crab Toxicity



The Water-column model leads crab toxicity by about one month

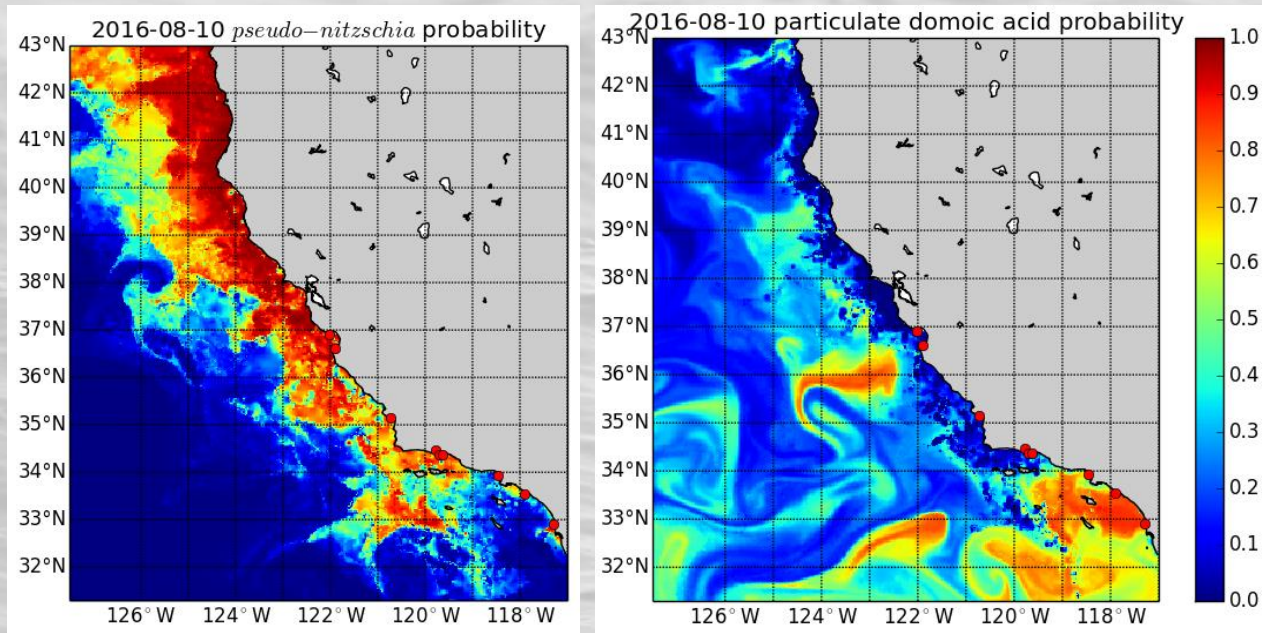
Monterey Bay Model vs. Mussels



Monterey and Santa Cruz diverge in 2016

SCW = 2 ppm
Monterey = 70 ppm

Current Status



August 10, 2016

LEFT: Probability of cells

RIGHT: Probability of toxin

Recent Data:

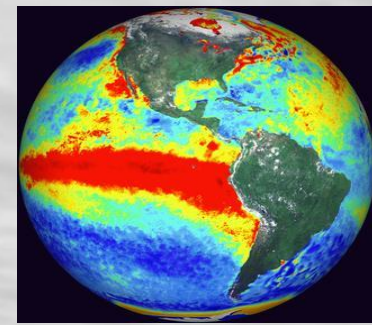
Trinidad, 0-800 $\mu\text{g/L}$

Santa Cruz, $\sim 5,000$ $\mu\text{g/L}$

Santa Barbara: 10-100 $\mu\text{g/L}$

- Conditions are similar, but cooler, to 2015—conducive to bloom events, but probably not a west-coast wide event
- Bloom/toxins started much later in the year, and have been slowly building
- Evidence for subsurface accumulation of toxin (Trinidad, Santa Barbara)
- **Observations and models suggest patchy, high-toxin regions that could accumulate (locally) in crabs and other organisms but not as widespread as 2015**

Living With a Warmer Ocean



- The 2015 “super bloom” was set up by unusually warm conditions and injection of nutrients from upwelling
- A warmer Eastern Pacific with localized upwelling would (statistically) increase the chance of more large-scale bloom events in the future
- 2016 is very warm and toxic, but more spatially variable—the late development of the bloom could result in trophic transfer to the benthic environment similar to 2015

Thank You

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