Wiring The Ocean to Understand Harmful Algal Blooms





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2011-2016: USGS Deployment of SPATT

Previous 1 Next





ALTY, Long-Residence



San Francisco Bay



Focusing on SF Bay, we know that several algal toxins are nearly ubiquitous in the Bay.

The Bay seems to act as a mixing bowl for both freshwater and marine toxins...



Those toxins accumulate in the food web





Domoic Acid (100% of mussels contaminated)

Microcystins (82% of mussels contaminated)

Paralytic Shellfish Toxins (25% of mussels contaminated)

Okadaic Acid, DTX-1, DTX-2 (100% of mussels contaminated)

Next-Generation Sensors



Wiring the Land-Sea Interface



San Lorenzo River, September 2015

Chlorophyll > 600 µg/L

218 ppb PSTs 146 ppb Nodularin



#	Affected Birds	Location, Year	HAB Species	
2250	Black Ducks, other	New Hampshire,	Gonyaulax	
	waterfowl	1972	tamarensis	
140	Brown Pelicans, Brandt's Cormorants	Santa Cruz, CA, 1991	Pseudonitzschia australis	
150	Brown Pelicans	Baja California, 1996	Pseudonitzschia spp.	
550	Northern Fulmars, Common Murres, large grebes	Monterey Bay, CA, 2007	Akashiwo sanguinea	
8000	Scoters, other divers	Washington State, 2009	Akashiwo sanguinea	
	-d	1		
September 2016				









HAB Toxin Detection on the 2nd Generation Environmental Sample Processor



~0.5 m

domoic acid

microcystins

PSTs



'pucks' hold filter media for sample collection & analysis

low toxin



membrane-based arrays used to conduct toxin cELISA; control & orientation features (green boxes) meter camera assay time ~1 hour



calibration curve provides quantitative estimate of toxin concentration

Credit: G. Doucette

Autonomous Water Sampling & Molecular Ecology

Wiring The Ocean: Are We There Yet?

Existing Shore Stations

Proposed Moorings

"Ecosystem Moorings" or persistently dwelling autonomous vehicles would improve HAB detection from ~20% to 70% for California

Frolov et al., Harmful Algae, 2013

4 0.0020 0.0050 0.0070 0.01 0.012 0.015 0.017 0.02 0.022 0.025 0.027 0.03 0.032 0.035 0.037 0.04 0.042 0.045 0.047 0.05

Interactive CeNCOOS Data Portal C-HARM Nowcasts and 3-day Forecasts http://www.cencoos.org/data/models/habs/

100, very high

Probability Maps

2015-01-01 pseudo-nitzschia probability

Particulate Domoic Acid Nowcast

432016-10-08 particulate domoic acid probability

432015-01-01 particulate domoic acid probability

1.0

Particulate Domoic Acid Forecast

Risk Maps

Geophysical Research Letters

RESEARCH LETTER

Midlatitude Marine Heatwaves:

10.1002/2016GL070023

Special Section:

Forrigg and Impay

An unprecedented coastwide toxic algal bloom linked to anomalous ocean conditions

Ryan M. McCabe¹, Barbara M. Hickey², Raphael M. Kudela³, Kathi A. Lefebvre⁴, Nicolaus G. Adams⁴, Brian D. Bill⁴, Frances M. D. Gulland⁵, Richard E. Thomson⁶, William P. Cochlan⁷, and Vera L. Trainer⁴

No...but we're headed in the right direction!

Wiring The Ocean

- The technology exists for sustained ocean observing of phytoplankton, HABs, and toxins
- No sensor is perfect—we need to combine traditional and "simple" technology with next-generation methods
- We are (slowly) moving towards supporting these efforts (transition from Research to Operations)
- We've come a long way!

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OCEAN PROTECTION

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