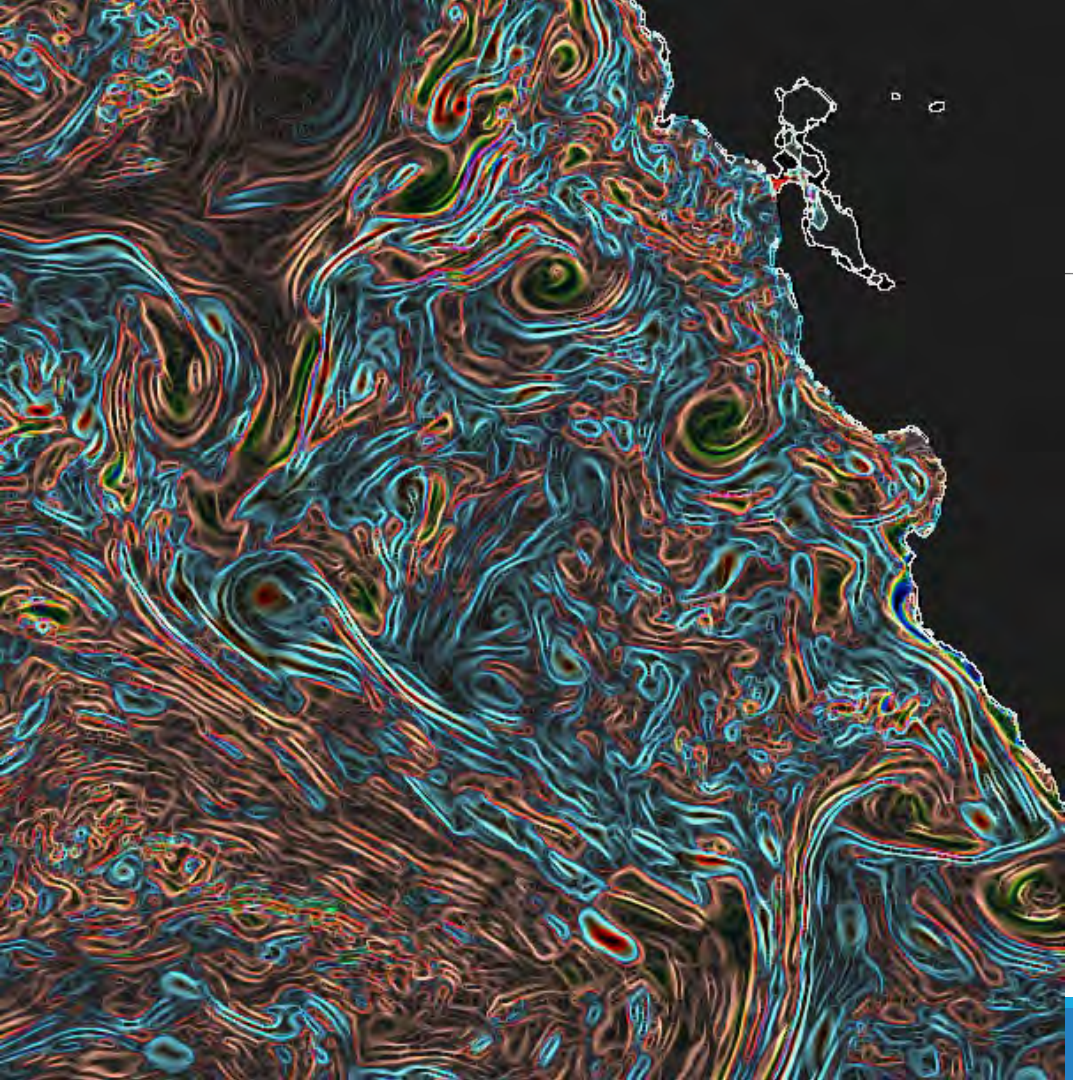


MODELING THE EFFECTS OF ANTHROPOGENIC INPUTS ON BIGHT BIOGEOCHEMISTRY

COMMISSION UPDATE

MARCH 5, 2021

WE ARE PIVOTING FROM MODEL DEVELOPMENT TO MODEL APPLICATION

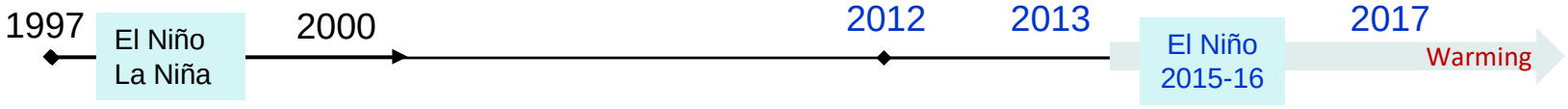
We developed a coupled physical and biogeochemical model

We worked with CTAG to validate the model to their specifications

We assessed the effect of land-based nutrients on acidification and hypoxia (OAH)

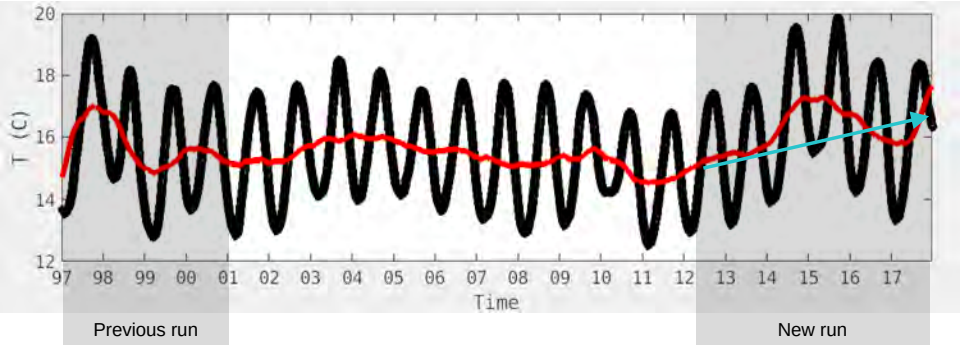
Those analyses showed nutrients have an important effect on OAH regimes in the SCB

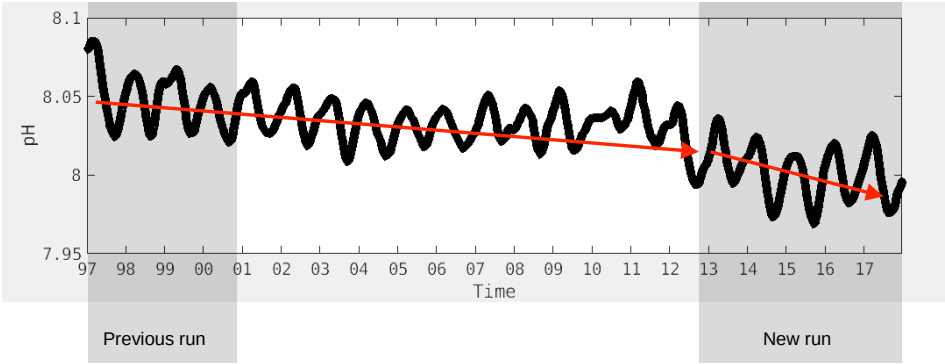
However, those simulations were of 1997 to 2000; we are updating runs of 2013 to 2017



OCEAN PHYSICS AND SOURCE WATERS ARE CHANGING

1997 El Niño La Niña — 2000 — 2012 — 2013 El Niño 2015-16 — 2017 Warming





Warming will affect physics/stability of water column: effect nutrient delivery to the surface

pH (and DO) of deep waters that are advected on the shelf are declining

Warming will affect solubility of oxygen

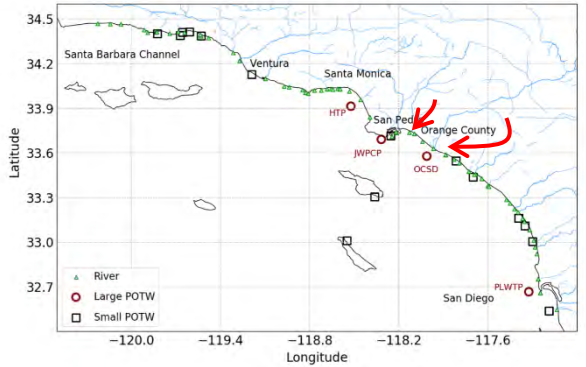
Habitat compression for fish and invertebrates

INORGANIC NITROGEN LOADING FROM OUTFALLS AND RIVERS HAVE DECLINED 12%

BUT THOSE CHANGES HAVE NOT BEEN EVENLY DISTRIBUTED ALONG THE SCB

Many POTWs have made upgrades
Largest declines along OC Coast due to nutrient management

Region	All Outfall DIN Loads (Metric Tons /day)			River DIN Loads (Metric Ton/day)		
	1997-2000	2013-17	% change	1997-2000	2013-17	% change
South San Diego	23	22	-4%	0.9	1.3	+42%
North San Diego	7	6	-7%	0.21	0.1	-37%
Orange County	33	19	-43%	0.9	0.6	-32%
San Pedro	39	42	+8%	11	1.8	-83%
Santa Monica Bay	37	38	+3%	0.15	0.13	-9%
Ventura	2	2	+28%	1.6	1.7	+8%
Santa Barbara	1	1	+5%	0.2	0.1	-44%
US SCB Total (inc. Islands)	143	132	-8%	15	5.9	-61%



LA River and San Gabriel River represent 73% of total riverine loads to the SCB.

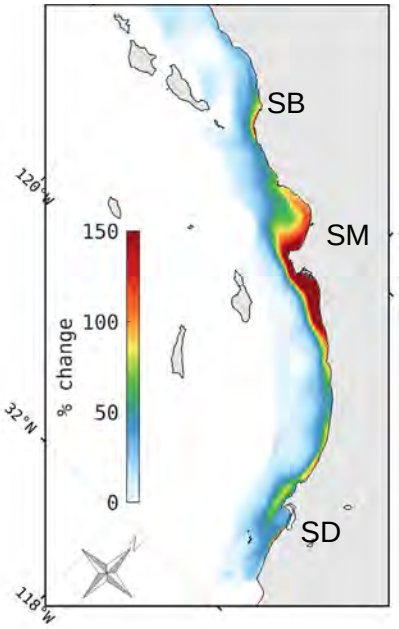
Reductions in those rivers from plant upgrades to advance nutrient management drove riverine trends for entire region.

COMPARISON OF MODEL SIMULATIONS FROM NOW VERSUS 20 YEARS AGO

SIMILAR PATTERNS, SUGGESTING NUTRIENTS ARE STILL HAVING AN EFFECT

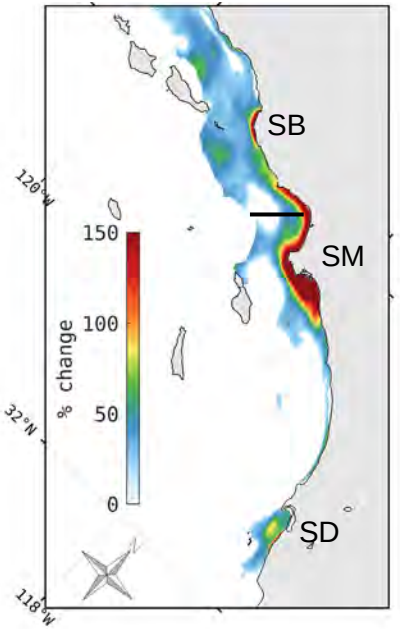
1997 — El Niño / La Niña — 2000 — 2012 — 2013 — El Niño 2015-16 — 2017 — Warming

Spring Summer 1997-2000

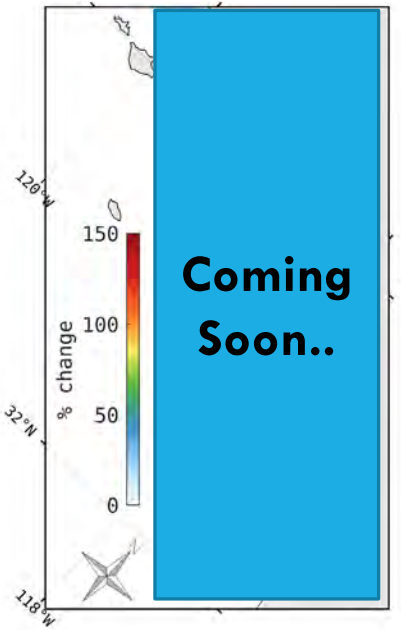


Like, the previous run, we see consistent phytoplankton biomass enhanced in the coastal band [0-20 km]

Spring Summer 2013-14



Spring Summer 2015-17



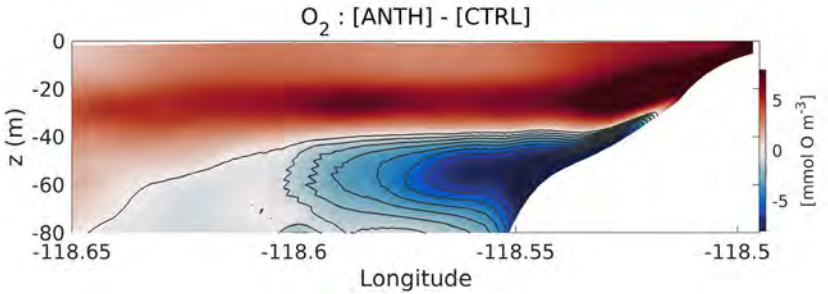
WE ARE NOW ANALYZING WHAT ARE NET EFFECTS ON O2 AND PH, *FROM PLUME TO SUBREGIONAL SCALES, AND ACROSS TIME*

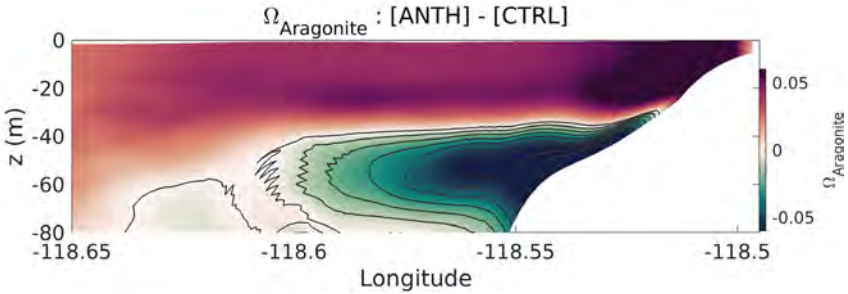
Santa Monica

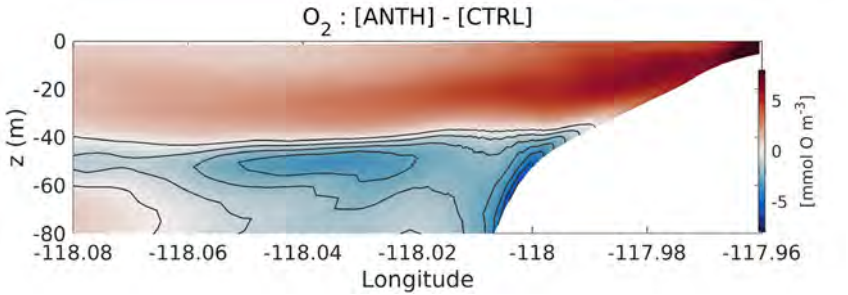
San Pedro - Orange C

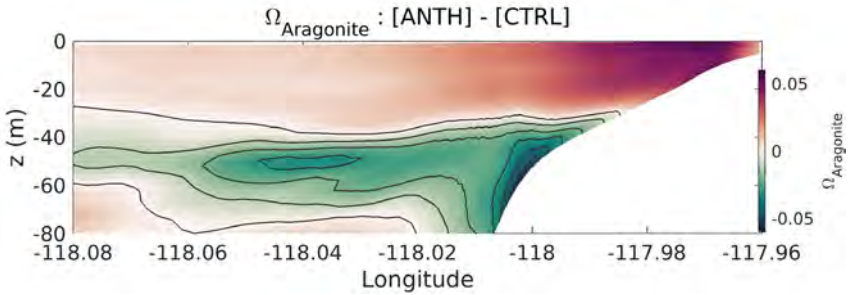
DO

Omega









THESE SIMULATIONS FORM THE BACKBONE OF OUR WORK OVER THE NEXT SEVERAL YEARS

Validation

- Run checks using recent data (e.g., time series, regional survey of aragonite saturation)

➢ Uncertainty workshop

Interpret biological effects of OAH in 1997-2000 & 2013-17 runs

- pH effects on marine calcifiers (Nina's talk will cover this)
- Oxygen effects on fish and invertebrates (will not touch on today)

➢Source attribution

➢Nutrient management and wastewater recycling scenario

THREE SOURCE ATTRIBUTION SCENARIOS TO EVALUATE CONTRIBUTIONS FROM POINT, NON-POINT SOURCE, AND NATURAL SOURCES

Updated model runs will form the foundation for new scenarios

Existing

Ocean	Large POTW outfalls	Small POTW outfalls	River POTW discharges	River Nonpoint source runoff	River natural sources	Atm. Deposition
Ocean	Large POTW outfalls	Small POTW outfalls	River POTW discharges	River Nonpoint source runoff		
Ocean	Large POTW outfalls	Small POTW outfalls	River POTW discharges			
Ocean	Large POTW outfalls	Small POTW outfalls				
Ocean	Large POTW outfalls					

All land-based anthropogenic

All point sources

All ocean outfalls

Contemplating adding, interested in your feedback

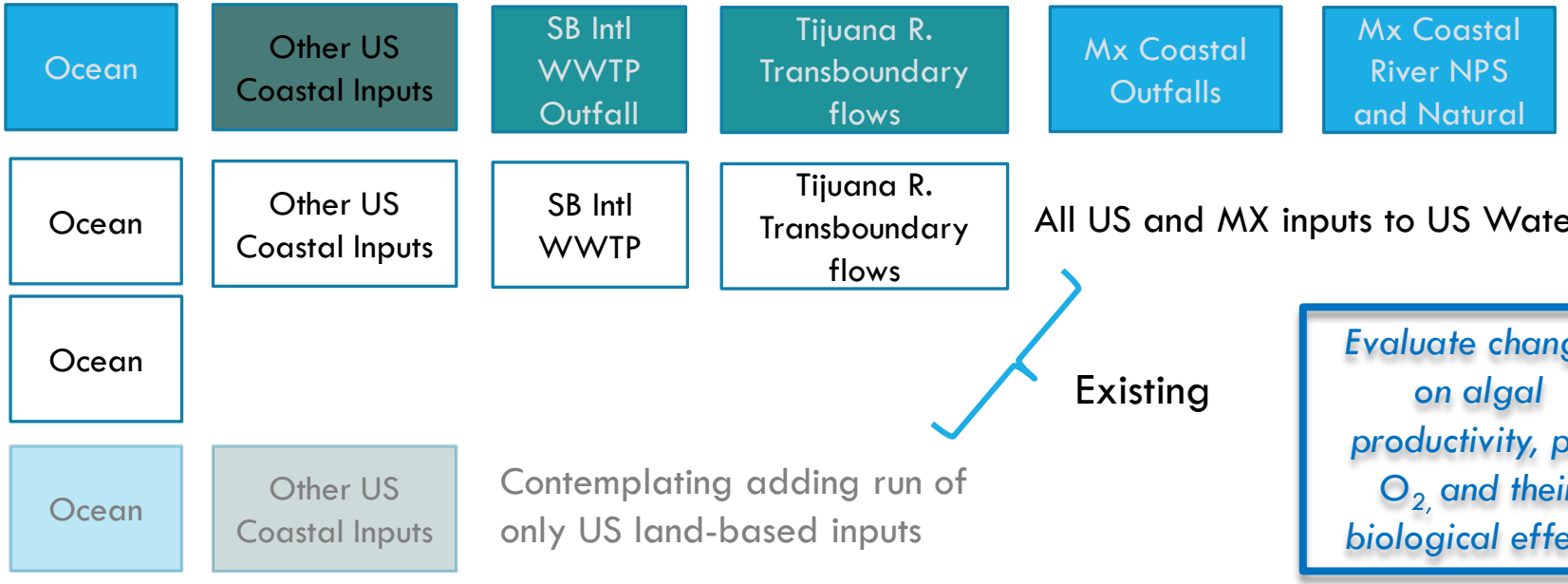
Evaluate changes on algal productivity, pH, O_2, and their biological effects

Ocean simulation = ocean + global CO2

Large POTW=≥ 50 mGD (~80% of total SCB inorganic nutrient loads)

4TH SOURCE ATTRIBUTION SCENARIO

Evaluate contributions of **Mexican** point (PS), non-point source (NPS) sources coming into Mexican and US Waters



NUTRIENT MANAGEMENT AND WATER RECYCLING SCENARIOS

Scenarios		Range of % effluent recycled for potable reuse		
		0%	50%	90%
Nutrient Management Options	Current loading (~35 mg/L mostly NH4)	X		
	Partial removal of inorganic nitrogen (~20 mg/L NH4+NO3)	X	X	X
	Full removal of inorganic nitrogen (~5 mg/L NH4+NO3)	X	X	X

Evaluate changes on algal productivity, pH, O_2 and biological effects

Other scenarios planned or under contemplation

Mechanisms:

- ✓ Freshwater inputs alone: what is the role of freshwater entrainment of deep water?
- Contribution of nitrate versus ammonia?

Alternative futures

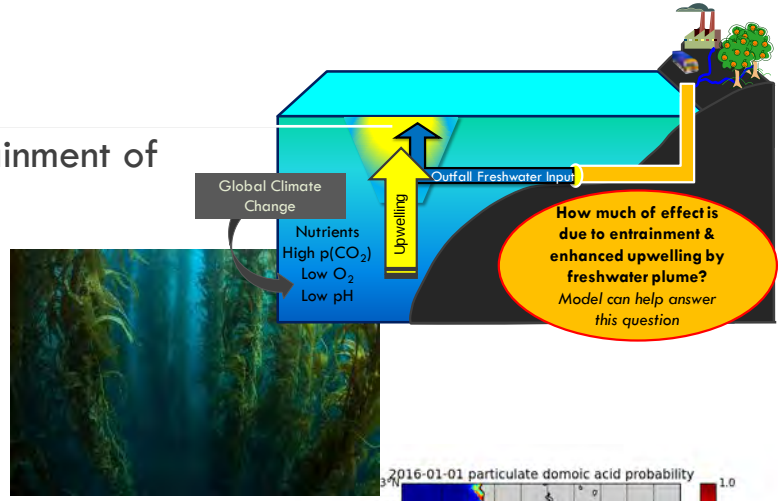
- Effect of climate change with & without CO2 reductions?

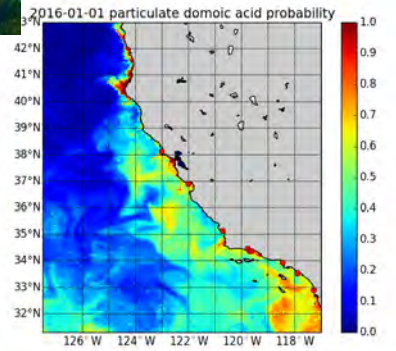
Alternative solutions

- What is the bioremediation potential of kelp farming?

Other management endpoints of concern: Harmful algal blooms (HABs)

- ✓ What is the performance of a predictive model of Pseudo-nitzschia HAB model, with and without the influence of anthropogenic nutrients?





We are Supporting CTAG to Investigate Uncertainty Approaches

Spring Webinar Series and Workshop

Expert Webinars #1-4 (90 min)

Open participation to public

- Educate on uncertainty approaches and inherent advantages and limitations, specific examples of how uncertainty been used to inform use of models guiding nutrient management
- Provide West Coast examples of how model uncertainty has influenced management acceptance of the model and ultimate actions taken

½ Day Roundtable discussion with Expert Panel

Invited participants; Open participation in listen only mode

- Discuss how these approaches are relevant for Southern California Bight, San Francisco Bay and Central Coast
- Expert panel summary talks and facilitated discussion among panel and invited participants (including CTAG members)

UNCERTAINTY WORKSHOP TIMELINE, PRODUCTS AND ANTICIPATED OUTCOME

Webinar Series: late March 2021 through late April 2021

Recorded webinars

Half Day virtual workshop: May 2021

Workshop Summary
Workshop recording

Outcome: Educated CTAG and SFB NMS that can actively contribute to discussions on next steps on quantifying uncertainty and what to do with it

UNCERTAINTY APPROACHES SHOULD CERTAINLY CONSIDER HOW PREDICTED SEAWATER CHEMISTRY IS INTERPRETED

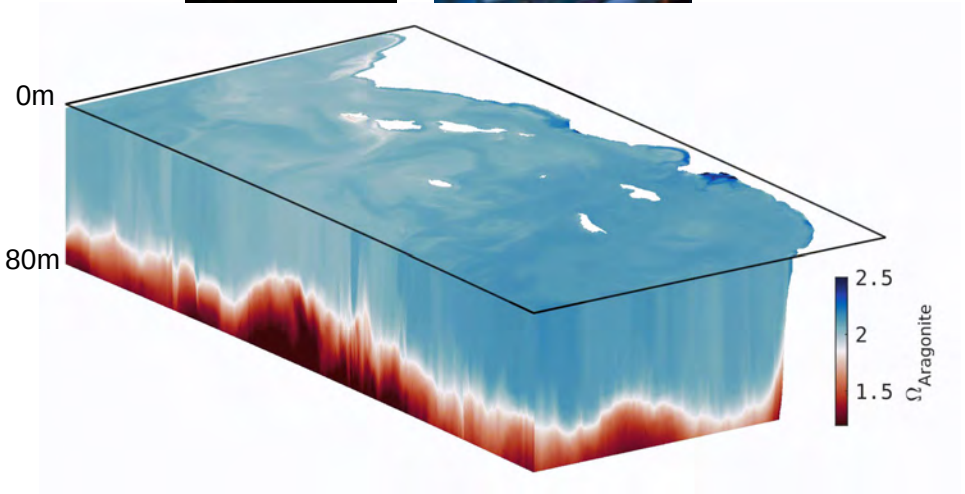
What approaches are being used to interpret biological effects?

Are we talking about a percent difference or an absolute threshold?

What are the relevant spatial scales?

- Plume?
- Subregional?
- Entire coast?

What are the relevant temporal scales?



Parting Thought: CTAG is Engaged

- Leadership on uncertainty workshop and continued conversation on validation
- Co-lead a Southern California Bight OAH Modeling workgroup
  - Similar composition of NOAA OAH Modeling SAG of last 6 years
- Drive discussions on additional scenarios

Questions ?

Concerns?

What Scenarios Are You Interested In?