APPLYING THRESHOLDS TO SUPPORT INVESTIGATIONS OF LOCAL POLLUTION IMPACT ON ACIDIFICATION IN THE SOUTHERN CALIFORNIA BIGHT





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OAH Expert Panel Recommended Use of Models to Investigate OAH Vulnerability and Impact of Local Pollution Sources





Goal of OAH Modeling Program

- Develop a model of the California Current System (CCS)
 - Validate with observational data
- Use the model to understand the relative contributions of:
 - -Natural climate variability
 - -Climate change
 - —Anthropogenic inputs
 - Assist in translating information to management decisions
 - Marine resource
 - Pollution management





California Has Significant "Local" Pollution Sources Along the Coast

POTW Outfalls contribute 75% of Annual TN

Export the Coast

Pathway	Annual TN Coastal Export (Gg yr-1)
POTW Outfall	82
River Export	39
Total	121



In SCB, anthropogenic inputs have doubled available N in the nearshore



Local CO₂ Domes from Our Urbanized Coast Can Outwell onto the Nearshore



Modeled CO2 in Los Angeles Region

Pollution Impact Assessment is An Opportunity to Apply Thresholds in Advance of OA Water Quality Objectives

- Biologically-relevant acidification thresholds are a key ingredient of this local pollution impact assessment, used to interpret model output
- We are working through "basic principles" of how to apply thresholds to model output
 - Devil is in the details (duration, extent, frequency)
 - We are working with scientists and engaging stakeholders to get consensus on approaches



Ocean Modeling System Basic Approach

- CCS-wide, at sufficient resolution to inform management at a local scale with nested grid
 - CCS scale = 4 km
 - Finer resolution nearshore: 1000 -300 m
- Three main model components
 - Atmospheric (Weather and Research Forecast Model; WRF)
 - Physical model (Regional Ocean Modeling System; ROMS)
 - Chemistry & Lower Ecosystem Model (Biogeochemical Elemental Cycling; BEC)
- Predicts mechanistic linkages of oceanic, atmospheric, and terrestrial forcing on OAH









Application of Thresholds to Model Output Requires Lots of Decisions

- Model contains huge amount of information
 - >35 state-variables and > 66 million grid cells per output (daily) for multiple years
 - And multiple time and space configurations

- What is considered a significant impact from local pollution sources?
 - What habitats and what focal taxa?
 - What threshold?
 - What spatial extent and duration of impact is biologically significant?

STATE VARIABLES

Ocean physics

Nutrients Nitrate, nitrite, ammonia phosphate silicate, Iron

> Plankton [2 phytoplankton groups an zooplankton biomass]

> > Organic matter

Oxygen

Carbonate system (pH, saturation state)

We are Working Through Some Basic Principles in First Local Pollution Impact Case Study: Southern California Bight

Bightwide, conduct a preliminary pollution impact assessment:

- Identify, <u>by subregion</u> along the SCB coast, where pollution impact > model uncertainty
- OAH thresholds specify spatial and temporal scales in which model needs to perform; focusing model validation at those scales

For each subregion, if pollution impact> uncertainty, then conduct a focused pollution impact assessment, at subregional scale:

- Source attribution (outfall-vs-river-vs-atmospheric, point sourcenonpoint source-natural)
- Pollution management and climate change scenario analyses



Basic Principles to Apply OA Thresholds to Model Output

#1 Apply thresholds to assess <u>compression</u> in benthic and pelagic habitats



Which Threshold?

#2 Apply "bookends" of risk to understand how choice in threshold affects magnitude of impact

Concentration Based Assessment

Pelagic Habitat: Pteropods

- Lethal $\Omega_{ar} = 0.95$, 14 day mean
- Sublethal Value $\Omega_{ar} = 1.5$, 28 day mean

Pelagic and Benthic: Echinoderms and Crabs

• Analyses pending



How to Apply OA Thresholds in a Multistressor Environment?

#3 Apply HSI model to provide a realistic estimate of potential habitat



Extent of Pollution = Impact

Habitat After Pollution Impact

Potential Available Habitat, Without Pollution

Actual available habitat is much less than if assessed with multiple stressors

So pollution impact could be greater if assessed with a more realistic estimate of habitat

HSI relates OA et al. stressors (e.g. temp.) to population measures (abundance) to estimate "realistic habitat"

Many Other Important Questions Still In Play

#4 Objective is to protect sustainability of populations, not every last individual

— What is the extent of habitat compression that represents a significant population level impact?

#5 Determine the critical period for biological impacts

- How can we apply the thresholds to assurance long term survival and reproduction of adults?
- How should we use thresholds to assure larval recruitment?

These "Basic Principles" Are Relevant to Other Threshold Applications

Need for Interplay between Threshold Development and Application



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