

## **Modeling in Support of Management of Coastal Hypoxia and Acidification in the California Current Ecosystem**

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### **OVERVIEW**

The US West Coast has experienced an increasing number of hypoxia/acidification events severe enough to affect coastal marine ecosystems. The primary drivers for this trend are processes that operate at a global scale, but there are several management actions that can be taken at the regional scale to either reduce the rate of hypoxia/acidification or lessen the effects of these events on the coastal marine ecosystem. Determining the likely effectiveness of regional management actions requires coupled biogeochemical and physical circulation models that presently don't exist for near coastal environments. Furthermore, it is not even clear whether the types of data necessary to calibrate and validate such models with adequate accuracy to support management action are available. Moreover, funding for model development is often siloed by topic (e.g., hypoxia, acidification, harmful algal blooms) or region, with a lack of interregional and interdisciplinary studies directed at linking management across the West Coast.

To stimulate development of models that address hypoxia/acidification management needs, a two-day workshop involving state and federal managers, industry representatives and leading academic researchers was held in Costa Mesa, California on December 10 - 11, 2013. The workshop featured two breakout sessions in which participants were tasked to identify the most significant impediments to developing models and to create a prioritized list of actions to overcome these impediments while focusing on two management questions:

1. What is the relative contribution of local anthropogenic nutrient inputs to coastal hypoxia and acidification?
2. What geographic locations are the most susceptible to hypoxia and acidification?

The participants reconvened in a general assembly at the conclusion of each of the breakout sessions to summarize discussions and form consensus regarding conclusions. The workshop ended with a plenary discussion to coalesce the workshop's primary findings and recommendations.

### **Significant Workshop Findings and Recommendations**

The workshop produced two major findings:

1. The participants concluded that there are no significant technical impediments to developing models that will answer both management questions. However, answering these questions will require investment of resources. Still, calibration data are available and preliminary modeling has been conducted for several coastal regions. These data

and modeling efforts can be used to provide preliminary information about the importance of local anthropogenic nutrient inputs to hypoxia/acidification managers and guide future expenditures of resources to address these questions in other regions.

2. The question of regional susceptibility to hypoxia/acidification events is more challenging and will require more investment to answer than the question about anthropogenic nutrient inputs. Workshop participants recommended focusing on the nutrient question, as the actions needed to address the question of the importance of local anthropogenic inputs will ultimately improve the modeling baseline needed to answer the susceptibility question.

Based on these conclusions, the workshop participants agreed there is a logical set of actions that should be conducted, the most prominent of which are:

- Build a community of modelers, observational researchers, and managers that:  
1) encourages dialog among sectors about model outputs necessary to address management endpoints and underlying policy decisions, 2) facilitates discussion about the level of model validation needed for making management decisions, and 3) serves as a vehicle for coordination of modeling products among different technical specialists. Participants noted a lack of clarity about the management decision endpoints that this interaction forum would help clarify as interim products were developed, and ensure cost-effective allocation of modeling and data collection activities.
- Use existing models to begin bounding the problem. This is best done through a model comparison. There are multiple approaches for addressing these questions and a comparison of outcomes from different approaches would provide multiple lines of evidence that constrain uncertainty in the answer. This model comparison should be conducted in a focused geographical region(s) and based on shared observational records and specific statistical measures that could be used to test various models. This comparison should be collaborative and ideally lead to integrated approaches.
- Collect observational data to support model refinement, including observations of oceanic state for model validation and short-duration, intensive monitoring to constrain key biogeochemical rate processes. This should go in tandem with a central repository for observational data and model output to provide open access and encourage research community participation.

Workshop participants also stressed the need for sustained research funding for basic science, including modeling, observational, and experimental studies to investigate the factors driving hypoxia/acidification events and their ecological effects.

**Full Text:**

[http://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/829\\_HypoxiaAcidification.pdf](http://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/829_HypoxiaAcidification.pdf)